

CPGmap: Visualization for Clinical practice guideline

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Abstract

Medical beneficences for Clinical practice guidelines are systematically developed to improve quality and to control costs by minimizing practice discrepancy, reducing errors, and promoting best practices. While guideline being performed, there are many barriers, including gaps and inconsistencies, inertia associated with traditional practice behavior and lack of incentives to change, etc.. In addition to these non-technical issues, accessible guideline content at the point care is critical; searching pages of text to locate a recommendation for a patient is very in-convenient and in-efficient. A way to ease the use of guidelines and display is to implement computerized and visualized guidelines. We present a method of computerizing and visualizing guideline. Our CPGmap is based on java combined with the techniques of hyperbolic tree and tree map.

Keywords : Clinical practice guidelines, Visualization, Hyperbolic tree, Tree map

1 Introduction

People believe that good medical qualities can provide an optimal patient care, reduce medical errors and improve patient safety by physicians' decision-making. To improve the quality of clinical decisions, traditionally, physicians have to find out solutions from textbooks, reviews, research articles, and experts [4, 6, 16]. Knowledge through organized medical textbooks offered to physicians is from a long time ago. Textbooks available to physicians in their workplace are often more than 10 years lagged behind and with limited chance encountering to their questions [14]. Former Dean of Harvard Medical School, Burwell [21] ever told his students, he said *My students are dismayed when I say to them "Half of what you are taught as medical students will in 10 years have been shown to be wrong. And the trouble is non of your teachers know which half."* Nowadays, good quality and rigorous appraisal of research literatures, such as case control studies, cohort studies, randomized clinical trials, systemic review, and meta-analysis are published and collected to assist making-decision in plenty of databases. Biomedical knowledge is vast, expanding, and scattered from theses literatures. Physicians immediately resolve problems of clinical patients by theses literatures. Unfortunately, they need more time and effort to review the medical literatures from libraries or web-base databases.

Given a rapid growth of medical information, technology,

and treatment methods, physicians must accumulate a large volume of new knowledge in a short time, which makes it difficult for a busy physician to keep up to date [18]. However, clinical decisions at the bedside must be making on a daily basis. Moreover, the healthcare systems face rising healthcare costs fueled by increasing demand for care, more expensive technologies, and an ageing population. Clinical practice guidelines (CPG) created for the purpose of enhancing the quality, appropriateness, and effectiveness of health care services. As defined by the Institute of Medicine (IOM) and the Agency for Health Care Policy and Research (AHCPR), practice guidelines are "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances." [10, 19] Over past three decades, the public or private healthcare systems in Europe, North America, Australia, New Zealand, and Africa have been heightening interest in clinical practice guidelines and developing continuously miscellaneous population-based, evidence-based, or research-based guidelines [18, 19]. Today, clinical practice guidelines are deemed the only one option for improving the quality of care [19].

Since developed countries are aware of the importance of medical service qualities, they tend to put into many efforts in developing evidence-based CPGs for various kinds of diseases. Numerous CPGs have been so fast produced and disseminated by a variety of government and professional organizations [15], such as the National Guidelines Clearinghouse (NGC), so far, have collected 1347 CPGs and related documents to provide physicians, nurses, and other health professionals, health care providers, health plans, integrated delivery systems, purchasers and others an accessible mechanism for obtaining objectives, detailed information on clinical practice guidelines (Clearinghouse, 1998-2004, <http://www.guideline.gov/>).

Because these guidelines exist largely in narrative, paper-based form or possess the thick-likeness of a book, even some CPGs are restored into electronic forms, such as .pdf-file or .word-file, they are sometimes ambiguous and generally lack the structure and internal consistency that would allow execution by computer. Physicians still spend more time to read CPGs, so that they can't immediately perform at just-in-time, point-of-care situation

Huth pointed out "Information is the central and indispensable tool of practice" [5]. Information needed

for clinical practice is not able to efficiently retrieve from bookshelves any more [17]. Physicians often take unexpected time and cost to deliver an optimal patient care by obtaining information when encountering a question that occurs in the context of patient care. Physicians facing different disease have to make an optimal decision for the care of individual patient in a timely basis. Therefore, for the physicians' long term education, information technologies are necessarily incorporated to access information and to support clinical decision-making. In this article we present a computer-interpretable, sharable, visual representation of clinical practice guideline, the aim is to assist physicians in easily obtaining, searching and performing CPGs.

2 Related Work

2.1 Traditional representation in CPG

In early period, with the development of pen and paper, these guidelines were also communicated and exchanged using text-based documentation methods. CPG usually has several versions as listed: Clinical Practice Guidelines, Quick Reference Guides for Clinicians, and Consumer Versions. Guideline implementation strategies that provide patient-specific advice automatically at the point-of-care are more likely to be effective than those in which guidelines are made available in nonpatient-care contexts, such as publication in monographs or journals [15]. Over past decade, a number of organizations and research groups are engaged in developing approaches to computer-encoded CPGs, an arduous task with much redundancy and overlap among the resulting products, but there is little standardization to facilitate sharing or to enable adaptation to local practice settings [15](<http://www.glif.org/>).

2.2 Information Visualization

A Chinese proverb says, "the five respects you have to do for pursue your studies: looking, listening, talking, writing, thinking". While there are many theories defining types of learning, they can generally be broken down into three varieties: visual, aural and kinesthetic. These types of learning aid people to memorize. For example, people prefer visual-input learn with charts, graphs, hierarchies, films and demonstrations, because they easily remember information they see. People prefer kinesthetic-input learn, they relate best to information with which they can interact through a hands-on approach, actively exploring.

The field of computer-based information visualization is about creating tools that exploit the human visual system to help people explore or explain data. Interacting with a carefully designed visual representation of data can help us form mental models that let us perform more effectively specific tasks, such as CPGs. Computer-based visualization lets humans wend their way through these mountains of data, making decisions based on understanding [12, 22] . One of the major venues in this field is the IEEE Symposium on Information Visualization, which started in 1995[22]. At a later date, visualizing information is emphasized even more important.

Information visualization applications rely on basic features that human perceptual system inherently

assimilates very quickly: color, size, shape, proximity, and motion. These features can be used by the designers of information systems to increase the data density of the information displayed. The familiar techniques of information visualization are multiple view, dividing window into different display parts, linking and focus& context and brushing (like Acrobat Reader), 2D (such as geographic information systems or 3D (like The Visible Human Project). Progressive approach is combined with multi-dimensional and dynamic techniques, for instance, the Dynamic HomeFinder application created by the University of Maryland's Human-Computer Interaction Laboratory provides a visualization of multi-dimensional housing data. Hierarchical data is data that has an inherent structure in which each item, or node, has a single parent node (except for the top-most or root node). Nodes can have sibling nodes (items that have the same parent node) and child nodes (items to which it is the parent node). Hierarchical structures are quite common [20]. The visual application of hierachical data display is cone tree, a three dimensional structure.

3 Materials

The book, Cervical Cancer Screening, Cervical Cancer, Endometrial Cancer and Uterine Cancer Clinical Practice Guideline, was edited by Gynecologic Oncology Disease Committee in Taiwan Cooperative Oncology Group (TCOG, established in 1989, is a multi-institutional cancer clinical trial organization) and published by National Health Research Institutes (NHRI). Gynecologic Oncology Disease Committee is composed of visiting staffs from major medical centers in Taiwan. This guideline have followed not only the evidence-based medicine(EBM) and experts' advices, but also Cervical Cancer, in National Comprehensive Cancer Network (NCCN) Practice Guidelines in Oncology, 2002 and 2003 version, FIGO Staging Classifications and Clinical Practice Guidelines in the Management of Gynecologic Cancer, Cervical Treatment, Health Professional Version published by National Cancer Institute (NCI) and Clinical Practice Guidelines for Cancer Care in the French National Federation of Cancer etc..

The format of this book describing with narrative and illustrating with flow diagrams (Figure 1), is stored with Portable Document Format.

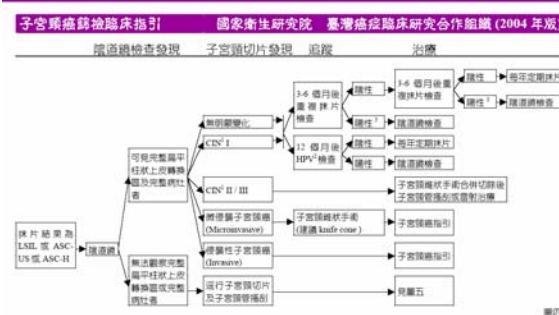


Figure 1: 17th page of Cervical Cancer Screening, Cervical Cancer, Endometrial Cancer and Uterine Cancer Clinical Practice Guideline

4 Method

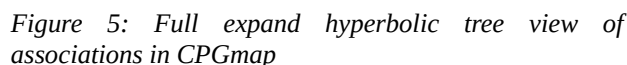
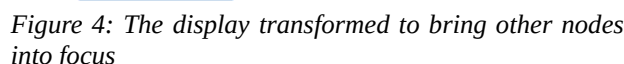
Before CPGmap, there are two pre-operation procedures. First, we need to transform the flow diagram of material

ST202	ST203	ST204	ST205	ST206	ST207	ST208	ST209	ST210	ST211	ST212	ST213	ST214	ST215	ST216	ST217	ST218	ST219	ST220	ST221	ST222	ST223	ST224	ST225	ST226	ST227	ST228	ST229	ST230	ST231	ST232	ST233	ST234	ST235	ST236	ST237	ST238	ST239	ST240	ST241	ST242	ST243	ST244	ST245	ST246	ST247	ST248	ST249	ST250	ST251	ST252	ST253	ST254	ST255	ST256	ST257	ST258	ST259	ST260	ST261	ST262	ST263	ST264	ST265	ST266	ST267	ST268	ST269	ST270	ST271	ST272	ST273	ST274	ST275	ST276	ST277	ST278	ST279	ST280	ST281	ST282	ST283	ST284	ST285	ST286	ST287	ST288	ST289	ST290	ST291	ST292	ST293	ST294	ST295	ST296	ST297	ST298	ST299	ST300	ST301	ST302	ST303	ST304	ST305	ST306	ST307	ST308	ST309	ST310	ST311	ST312	ST313	ST314	ST315	ST316	ST317	ST318	ST319	ST320	ST321	ST322	ST323	ST324	ST325	ST326	ST327	ST328	ST329	ST330	ST331	ST332	ST333	ST334	ST335	ST336	ST337	ST338	ST339	ST340	ST341	ST342	ST343	ST344	ST345	ST346	ST347	ST348	ST349	ST350	ST351	ST352	ST353	ST354	ST355	ST356	ST357	ST358	ST359	ST360	ST361	ST362	ST363	ST364	ST365	ST366	ST367	ST368	ST369	ST370	ST371	ST372	ST373	ST374	ST375	ST376	ST377	ST378	ST379	ST380	ST381	ST382	ST383	ST384	ST385	ST386	ST387	ST388	ST389	ST390	ST391	ST392	ST393	ST394	ST395	ST396	ST397	ST398	ST399	ST400	ST401	ST402	ST403	ST404	ST405	ST406	ST407	ST408	ST409	ST410	ST411	ST412	ST413	ST414	ST415	ST416	ST417	ST418	ST419	ST420	ST421	ST422	ST423	ST424	ST425	ST426	ST427	ST428	ST429	ST430	ST431	ST432	ST433	ST434	ST435	ST436	ST437	ST438	ST439	ST440	ST441	ST442	ST443	ST444	ST445	ST446	ST447	ST448	ST449	ST450	ST451	ST452	ST453	ST454	ST455	ST456	ST457	ST458	ST459	ST460	ST461	ST462	ST463	ST464	ST465	ST466	ST467	ST468	ST469	ST470	ST471	ST472	ST473	ST474	ST475	ST476	ST477	ST478	ST479	ST480	ST481	ST482	ST483	ST484	ST485	ST486	ST487	ST488	ST489	ST490	ST491	ST492	ST493	ST494	ST495	ST496	ST497	ST498	ST499	ST500	ST501	ST502	ST503	ST504	ST505	ST506	ST507	ST508	ST509	ST510	ST511	ST512	ST513	ST514	ST515	ST516	ST517	ST518	ST519	ST520	ST521	ST522	ST523	ST524	ST525	ST526	ST527	ST528	ST529	ST530	ST531	ST532	ST533	ST534	ST535	ST536	ST537	ST538	ST539	ST540	ST541	ST542	ST543	ST544	ST545	ST546	ST547	ST548	ST549	ST550	ST551	ST552	ST553	ST554	ST555	ST556	ST557	ST558	ST559	ST560	ST561	ST562	ST563	ST564	ST565	ST566	ST567	ST568	ST569	ST570	ST571	ST572	ST573	ST574	ST575	ST576	ST577	ST578	ST579	ST580	ST581	ST582	ST583	ST584	ST585	ST586	ST587	ST588	ST589	ST590	ST591	ST592	ST593	ST594	ST595	ST596	ST597	ST598	ST599	ST600	ST601	ST602	ST603	ST604	ST605	ST606	ST607	ST608	ST609	ST6
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Our CPGmap program is a Java-based application that can run on the platforms, such as Windows, Linux or SUN Unix. In the illustration of CPG, we propose the use of a hyperbolic tree view and a hierarchical list view to visualize the flow diagram of CPG. CPGmap supports several kinds of functions as listed multi-linguistics, drawing knowledge map and connected graph for custom-built interface.

5.1 Hyperbolic tree

The diagram is a hub-and-spoke model with a central yellow box labeled "Breast cancer CPG". Eight green lines radiate from this central box to eight surrounding red boxes, each containing a clinical trial identifier. The red boxes are arranged in a circle around the center. The identifiers are: "Clinical stage II T0N1M0, T1N1M0, T2N0M0, T2N1M0, T2N0M0", "Clinical stage T1N0M0", "Recurrence", "Ductal carcinoma in situ", "Clinical stage III T0N2M0, T1N2M0, T2N2M0, T3N1M0, T3N2M0, T4 any N1M0, Any T N0 M0", "Lobular carcinoma in situ", "Clinical stage IV any T any N M1", and "Clinical stage III T0N2M0, T1N2M0, T2N2M0, T3N1M0, T3N2M0, T4 any N1M0, Any T N0 M0".



Tree structured node-link diagrams, Tree-maps, was initiated by Prof. Shneiderman. This algorithm and the initial designs led to the first Technical Report in March 1991 which was published in the ACM Transactions on Graphics in January 1992 [1, 2]. Tree-maps are a representation designed for human visualization of complex traditional tree structures. Its' original motivation for this work was to gain a better representation of the utilization of storage space on a hard disk [1]. Nowadays, Tree structured node-link diagrams grow too large to be useful. It is exploited for business(Sales managers, see <http://www.hivegroup.com/>), photo image browser (PhotoMesa, see <http://www.cs.umd.edu/hcil/photomesa/>), file management(TreeReader), Newsgroups relationship in the Usenet (Netscan), Categorization Map(Cancer Spider),etc..

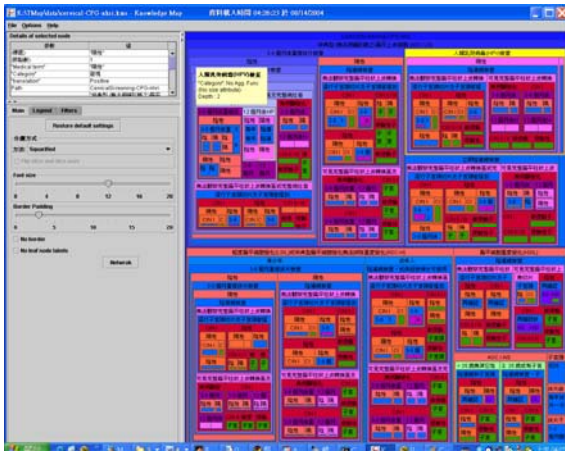


Figure 6: Cervical cancer screen clinical practice guideline display in CPGmap. Here we can see a flexible hierarchy and a interface combined with Chinese texts and translated English texts in the upper-left part of this figure



Figure 7: CPG is divided by slice

One approach is important that the category of procedure in CPG illustrates diverse color. That aid physicians fast to look, understand and learn step by step. For example, there are red-color icons represented as “DIAGNOSIS”, green-color icon represented as “TREATMENT” in Figure 8 and 9. If we are interested in other layer about thorough procedure, we just need double-click nest graph (Figure 10).

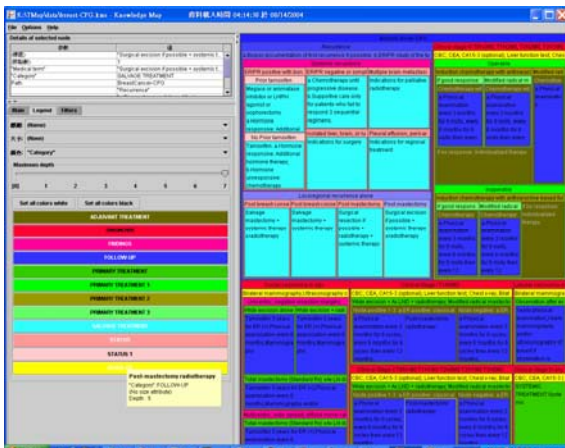


Figure 8: Color is represented as the category of procedure in clinical practice guideline

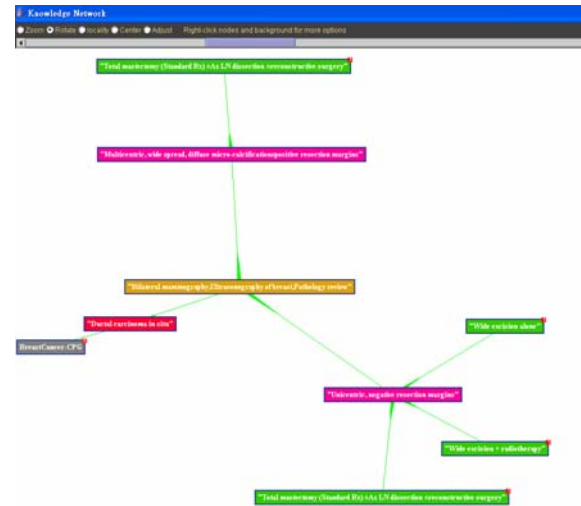


Figure 9: A display of hyperbolic tree, here color is represented as the category of procedure in clinical practice guideline

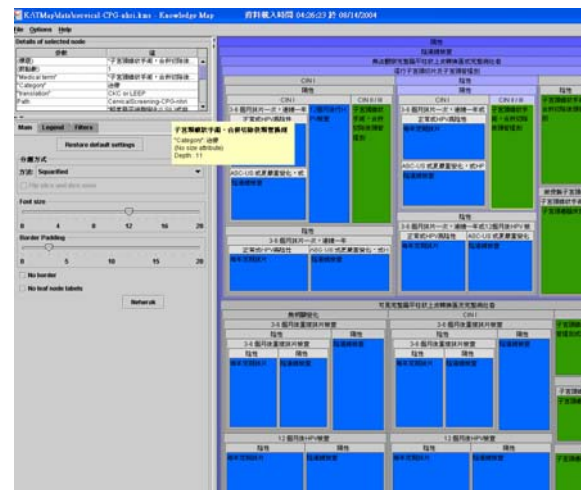


Figure 10: A display of deep layer

6 Discussion

How do we look after both sides of excellent quality of care and hospital-based self-management program? How do we perform the family physician network of NHI policy for the independent practitioners and clinic sector? The implementation of clinical practice guidelines are overwhelming tendency. In addition to non-technical issues, as physicians at the point of care may not accept CPG recommendations at face value, the rationale for each CPG should be clearly stated with supporting references [3]. Several approaches to support guideline-based care permit hypertext browsing of guidelines via the World Wide Web, listed as SIGN (<http://www.sign.ac.uk/guidelines/published/index.html>), NGC (http://www.guideline.gov/resources/guideline_index.aspx), NICE (<http://www.nice.org.uk/page.aspx?o=203195>), but approach, the above does not attempt to reduce the load on physicians by obviating the need for actually reading the guideline and customizing it to the patient's personal clinical history and current state[23]. Our CPGmap provides physicians a clear, tailor-made approach to browse the detail of interested CPG upon

evidence-based literatures.

Some computerizing methods in CPG are intended to standardize electronic guideline for exchange, such as GLIF. Another variety of methods to support the computerization of guidelines have been developed by the Health Informatics community. Those are based on guideline models which formalize clinical knowledge and can generate patient-specific recommendations for clinical decisions and actions, for instances rule-based Arden Syntax, logic-based *PROforma*, Network-based PRODIGY, Workflow GUIDE [13, 23]. CPGmap creates the flexible prototype of visual representation in CPGs. In the future, we wish that CPGmap combined with patient' electronic medical record, will offer physicians to make decision easily integrated with evidence-base and case-base at point of care.

7 Reference

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