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Disseminating Multimedia Protocols over Internet for Emergency and Catastrophe Management

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Abstract

Over the last years we have developed various computing methods to assist specialized personnel on various aspects of catastrophe and emergency management. New models can address tasks such as patient triage; stabilization, resource coordination and hospital alertness and techniques based on information technologies. In this paper we present various tools (written on Java and C++) that we created to store, represent, and disseminate practice guidelines and protocols over the World Wide Web. Guidelines and protocols are stored using a standard database program (e.g., ©Microsoft Access), and represented in a flowchart format linked to multimedia information such as text, pictures, sound, video or external sources of data. Using our JAVA tool, protocols can be disseminated over the Web and viewed with any browser with JAVA compliance. We have implemented 15 emergency protocols that we developed in collaboration with specialized military personnel from the Ministry of Defense, Spain. Users can access remotely those electronic protocols comparing their procedures and methods. Our goal is to enhance agreement and consensus among remote medical centers regarding emergency and catastrophe management, establishing discussions over the network. Our tools have also a potential for training medical and paramedical personnel for emergency situations.

Keywords

Catastrophes; Emergencies; Java; World Wide Web; Protocols; Multimedia.

Introduction

Clinical practice guidelines and protocols have been traditionally represented, stored, disseminated and used in paper format. Over the last years, different institutions have realized the advantages that computer implementations of protocols can give to professionals and users. A report of the Institute of Medicine addressed many of the methodological questions associated to protocols, recommending more research on applying information systems for their implementation [1].

Using computer representations, some of the common problems associated to protocols can be diminished. Those problems include: (1) checking consistencies; (2) dissemination; (3) updating to include new information; (4) local adaptation to different clinical settings; (5) evaluation of their impact in medical care; and (6) feedback to developers. Nevertheless, more extensive research and evaluations are being currently carried out to demonstrate those advantages. Institutions such as the Agency for Health Care Policy and Research are supporting related initiatives [1].

In this paper, we report a research project that we have carried out to implement protocols for disaster and emergency situations. Use of computers in catastrophe management has been proposed during the last two decades. For instance, computers can be considered for: (1) primary evaluation; (2) patient triage; (3) patient stabilization; (4) patient evacuation; (5) coordination of resources; (6) hospital awareness and preparation; (7) transmission of information among different levels of medical assistance; (8) remote access to expertise; and (9) retrospective analysis.

Different research groups and organizations have reported their results on global approaches to address the various aspects of disaster situations. Our group began to work on 1987 on such direction, designing a system called SIAC (Integrated System for Assistance in Catastrophes, in English), previously described [2,3].

DARPA has supported a macroproject called TCIMS (Trauma Care Information Management System), carried out by a consortium of partners from industry and universities, including companies such as Rockwell Corporation, AT&T, or Digital [4]. The Telematics Program of the European Commission has also funded various R&D projects with related goals.

Our current approach is an electronic implementation of emergency protocols used in disaster situations that can be disseminated over Internet. Our goal is to enhance coordination among different medical centers involved in emergency and catastrophe management.

Materials and Methods

We made different software programs to represent, store and disseminate clinical practice guidelines and protocols over Internet. Protocols are represented in a flowchart format, with

different kind of nodes linked to multimedia information such as text, pictures, video and sound.

Considering representation, we created several sections in the algorithm structure:

1. Title and General Information. This section describes the clinical problem addressed by the protocol. Additional information about goals, authors, organization, dates, and methodology used to elaborate the protocol is also included.
2. Glossary. This section includes a thesaurus of the terms considered in the document, bibliographic references, and also term definitions.
3. Flowchart. It shows the logical steps designed to manage each clinical situation. All nodes include information that will appear in the graphical representation and can be linked to related multimedia information and external sources of information. The description of dependencies among nodes determines the structure of the flowchart.

There are 3 kinds of nodes: Action, Clinical State, and Decision. Such model has been described in a proposal for clinical algorithm standards proposed by the Society for Medical Decision Making [5]. We have also considered and implemented different versions of our tools to accommodate our system to other specifications —e.g., some practice guidelines developed under the support of the Agency of Health Care Policy and Research, that include different steps labeled as "Council" nodes [6].

We have used an object oriented methodology in the design process, with two —C++ and Java— different language implementations. Protocols are stored in specific files and databases, and can be accessed, retrieved and viewed locally or remotely, over the World Wide Web.

We created a preliminary version of our system, where we used our own specification language to represent protocols and different edition and visualization tools. Our specification language for protocols is a data format to create ASCII text documents that represent clinical algorithms. We use tags to represent the different elements of each protocol, similarly as they are used in HTML (HyperText Markup Language). A description of this language was previously reported [7].

We believed that the system was simple to use and protocols could be easily implemented, but external opinions and users' evaluation made us change our approach. We realized that it would be more effective if we could follow a similar conceptual approach using widely used software programs.

Our current version includes a database format to store guidelines, facilitating acceptance from different users that can be reluctant to use our specification language. Developers can store protocols using any standard database program —e.g., Figure 1 shows below an example made using ©Microsoft Access—, filling the specific information of each section of the protocol.

The flowchart is created accessing a specific form, where users can label, number each node and fills its content. Multimedia information can be attached to each node.

Results

We have developed various protocols (15, at this moment) for medical assistance in catastrophes, in collaboration with specialists from the main Spanish medical military center, hospital Gomez-Ulla in Madrid. We created those protocols working with an expert' panel, using an informal consensus method.

Protocols were primarily drafted using text, tables and charts, in paper documents. They were later represented as flowcharts, showing the different steps of medical care. Such layout is par-

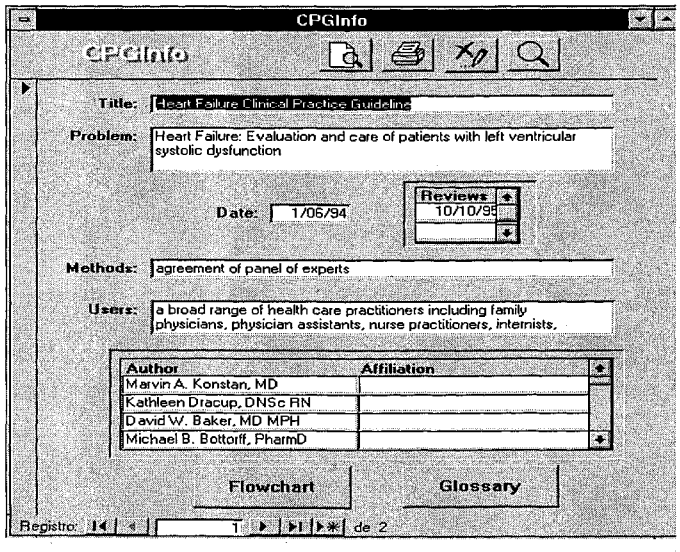

Figure 1 - An example made to create a multimedia version of AHCPR's Heart Failure practice guideline [6] using ©Microsoft Access.

ticularly indicated to allow a straightforward electronic implementation.

Once a protocol is stored in a database file, it can be visualized using different tools that we created. We used a Java tool to implement emergency protocols. Using this program, protocols can be visualized at remote sites over the WWW using any browser with Java compliance.

An extended description of the software tools has been reported elsewhere [8].

We show below an example of an emergency protocol, as it is visualized using our system.

Discussion

Computer implementations of protocols can increase their effectiveness in clinical practice. Our system has not been designed for patient consultation but as a tool designed to improve aspects of emergency and disaster management, coordination and staff training.

Using our tools, organizations can create computer servers to implement, store and disseminate protocols over the WWW in multimedia format, facilitating dissemination, local adaptation, updating, and evaluation.

Remote users can visualize algorithms graphically, accessing multimedia information related to each clinical problem. Since protocols can be viewed using any WWW browser with Java compliance, people can use the system with low training in computers. Technological transfer can be simple since users only need to click on the buttons or nodes that they want to expand or explore.

Our Java tools facilitate platform-independent access and display of multimedia information. Although they are more intuitive and easy to use than our C++ tools, the latter incorporate additional capabilities. With those C++ tools it is also possible to adapt protocols locally. An important reason for such question is variability in medical practice. For instance, other practitioners at different medical centers might not accept specific criteria. Users are able to modify nodes, arcs, contents, and multimedia links to ensure that protocols can be adapted to their specific clinical environments and circumstances.

An important question in emergency and disaster situations is patient triage. An injured person must be classified before a specific protocol can be used to stabilize his/her health condition and select the best evacuation choice. For such reason, we have also developed a triage method to classify patients following established procedures used on emergency management.

We created a decision tree based on methods such as Glasgow's coma score and Champion's methods, widely used on trauma care and emergency management. A specific Java program (see figure 3 below) prompts questions to users, who must click on the appropriate answer to each question. The program calculates the different scores and after the interaction with the user has been completed, it makes a decision calling a specific protocol for each patient and situation. Users will follow then recommendations (e.g., stabilization procedures) made by the protocol.

Conclusion

During catastrophes, the first sixty minutes after the disaster and emergency have been named as the "golden hour", that implies the time where more lives can be saved or lost. New emergency methods are needed to increase efficiency in those important moments

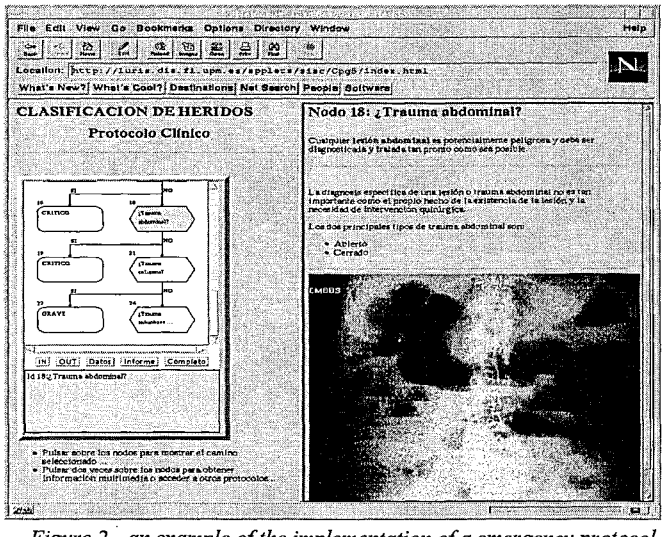

Figure 2 - an example of the implementation of a emergency protocol using our Java tool with Netscape Navigator (Note: the radiological image has been included to show the multimedia capabilities of the tool, and it is not part of the actual prototype).

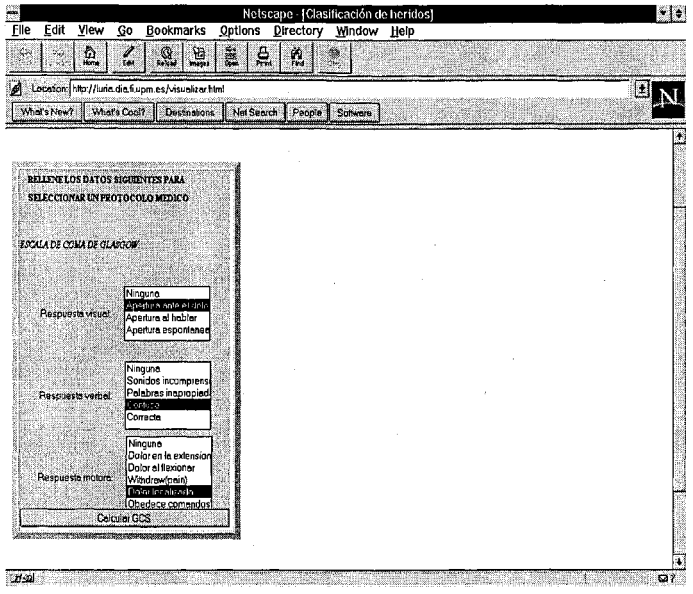

Figure 3 - A Java-based tool to prompt user values needed to calculate Glasgowís coma score.

In Spain, like in many other countries, teams of highly specialized professionals carry out medical assistance in emergencies and catastrophes. Those groups belong to various organizations, ranging from civil hospitals and organizations to military institutions. Whereas performance within each organization is commonly analyzed and enhanced, we need new methods to optimize coordination among emergency groups from different sites. Information technologies can provide professionals with advanced technologies for such purpose.

Our approach aims to provide developers and organizations with tools to create WWW servers where emergency and catastrophe protocols can be easily stored and accessed from remote sites.

Our hypothesis is that Internet can be used to enhance collaboration among institutions, and to increase consensus among practitioners adopting similar triage and stabilization protocols. These protocols can be proposed by some institution and agreement can be reached by getting feedback from remote colleagues.

Our system can also be employed as a teaching tool because it is quite simple to follow the logical steps involved in each specific situation. It is also easy to access related multimedia, to navigate the whole algorithm and to make use of additional capabilities of the system. Users can zoom the flowchart or create automatically a report showing the path and nodes that they have explored.

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