Toward Automated Visual Management and Presentation of Content Recommendations for Patient Note Generation

Lauren G. Wilcox   **Steven K. Feiner**

Department of Computer Science
Columbia University, New York, NY 10027
{wilcox, feiner}@cs.columbia.edu

INTRODUCTION

A patient note is a clinical document, written by a physician, describing a patient under his or her care. Various kinds of notes document the patient's status over time, and comprise the official medical record for legal and billing purposes. Composing these notes encompasses several disparate, but interdependent subtasks. Physicians gather and review previous and current patient data, such as lab results, physical exams, medications, and hospital events, to determine patient progress; select and input relevant information for the current note; and form appropriate assessments and plans for each patient. Currently, most of these subtasks are not supported by domain-informed assistance. While sophisticated systems exist for retrieving and visualizing clinical patient data (e.g., [1, 3, 5, 7, 9]), support for inserting this data into a patient note is limited, less flexible, and more complicated to use than editing notes manually in a generic word processing application. In practice, physicians often edit each current note by hand—manually searching through previous notes and copying and modifying material written for previous notes—a time-consuming and error-prone process.

We are working with physicians in the New York Presbyterian Hospital (NYPH) Cardiothoracic Intensive Care Unit (CTICU) to design a user interface for patient note creation. We are developing new presentation techniques through which appropriate content can be recommended, and new interaction techniques for effectively browsing, selecting, and inserting these recommendations directly into the notes, as they are edited.

RELATED WORK

Our work builds on previous and current work in context-sensitive information recommendation systems and recommendation systems for the medical domain [6, 10, 11]. Typically, these recommendation systems analyze user input in response to an initiation cue (e.g., upon typing or on pressing a "Search" button) and run system-specific algorithms for formulating queries, retrieving results from data sources, and ranking information suggestions. The recommendation system then presents its suggestions to the user and allows interactions with the recommended content items to assist in text entry completion [4] or to allow the user to navigate to recommended information [8]. For textual recommendations, a scrollable list of links or an interactive in-place drop-down menu might be presented.

Recently developed visual analytics systems for recommending graphical information (e.g., sets of data points in the context of a larger trend) make use of visualization templates in the recommendation view [2]. These systems focus on automated presentation of the retrieved content based on explicit user actions. Depending on the features of the data retrieved, as well as the current context of the user task, the content presentation may take different forms or views in order to be most comprehensible. However, little work has been done to support patient note authoring tasks through the use of automated presentation of recommended content.

RESEARCH

Our system design uses both implicit and explicit user actions to initiate recommendation requests. It then automatically generates and presents context- and task-specific content recommendations according to features of the content data retrieved, as well as the note and task context. Physicians can interact with recommended content, using textual menus and temporal visualizations, to directly insert recommended content items into the patient note.

We are building on a content recommendation engine [6] that detects information needs, formulates queries, processes results retrieved from the online patient record, past notes, and data tables, and extracts information from the retrieved content. We are adding a *visual management component* for managing recommendation presentations and a *user interaction manager* for note and content recommendation interactions. We are also designing the following components with physicians in the NYPH CTICU to extend the content recommendation engine:

Medical note template. This manages recommendation cues and system initiative and augments the existing input template of the recommendation engine.

Visual recommendation templates. These determine how to present retrieved recommended content (e.g., as a phrase or a chart).

Interaction techniques. These allow the physician to select and group individual recommended content elements and directly insert these into the note, in context.

REFERENCES

[1] ECLIPSYS http://www.eclipsys.com/

[2] Gotz, D., Wen, Z., Lu, J., Kissa, P. and Zhou, M. "Harvest: Visual Analytics for the Masses", *Submission to IEEE Symp. on Information Visualization,* 2008.

[3] Gresh, D., Rabenhorst, D., Shabo, A., and Slavin, S. "PRIMA: A Case Study of Using Information Visualization Techniques for Patient Record Analysis", *Proc. IEEE Visualization,* 509–512, 2002.

[4] Hermens, L. and Schlimmer, J. "A Machine-Learning Apprentice for the Completion of Repetitive Forms", *Proc Ninth IEEE Conf. on Artificial Intelligence for Applications*, 28–33, 1994.

[5] Hripcsak, G., Cimino, J., and Sengupta, S. "WebCIS: Large Scale Deployment of a Web-based Clinical Information System", *Proc Amer. Med. Informatics Assoc. (AMIA) Symp.,* 804–808, 1999.

[6] Kandogan, E., Lu, J., and Zhou, M. "Intelligent Content Assistance", *U.S. Patent Application*, filed October 2007.

[7] Plaisant, C., Mushlin, R., Snyder, A., Li, J., Heller, D., and Shneiderman, B. "LifeLines: Using Visualization to Enhance Navigation and Analysis of Patient Records" *Proc AMIA Annual Fall Symp.*, 76–80, 1998.

[8] Rhodes, B. and Starner, T. Remembrance Agent: A Continuously Running Information Retrieval System, *Proc First Int. Conf. on The Practical Applic. of Intell. Agents and Multiagent Tech.,* 487-495, 1996.

[9] Shahar, Y. and Cheng, C. "Knowledge-Based Visualization and Navigation of Temporal Data" *Proc. AMIA Ann. Fall Symp.* 155–159, 1998.

[10] Spenceley, S. and Warren J. "The Intelligent Interface for On-Line Electronic Medical Records Using Temporal Data Mining" *Proc Hawaii Int. Conf. on System Sciences*, v. 5, 266–274, 1998.

[11] Wen, Z., Zhou, M., and Aggarwal, V. "Context-Aware Adaptive Information Retrieval for Investigative Tasks", *Proc 12th Int. Conf. on Intelligent User Interfaces,* 122–131, 2007.