Implementing and Evaluating Visualizations of Complex Patient Data for Clinical Care

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Modern medical advances and information technology are allowing for the collection of unprecedented amounts of physiological and clinical data on both individual patients and aggregate populations. At the same time, however, is the parallel increase in the amount of information physicians and other caregivers must evaluate. Are there display formats which elicit more accurate and rapid assessments and diagnoses? In designing electronic medical record systems, how worthwhile is the extra effort, time, and cost in adding graphical or interactive features? What are the determinants of efficacy, usability, and user acceptance in such systems? And in general, how can the study of data and information visualization leverage caregivers' medical knowledge while addressing their cognitive limits as information processors, with the overall goal of improving medical care, outcomes, and the quality of life of their patients? Despite wide interest in visualization and user interfaces, relatively few evaluative studies exist in the medical domain comparing the impact of various display modalities on decision-making.

My doctoral research dealt with the intersection of medical decision-making and data visualization. Specifically, I investigated different means of displaying pulmonary and symptom information collected from patients in a lung transplant home monitoring program. I designed and conducted several experiments assessing decision accuracy and speed, as well as user preferences, across a number of different display formats, designed using current theories and "best practices" in visualization. Graphical, interactive display formats were found to be efficacious, rapid, and well-accepted means of displaying the relevant clinical information[1].

My postdoctoral work includes applying the visualization and evaluation techniques I developed to contribute to the disease management and information display research conducted at the Biomedical Informatics Research Center (BIRC). Specifically, I am evaluating and enhancing the visual displays of patient information developed there for diabetes management. Sophisticated, multivariable graphic displays of blood glucose levels and other clinical information have been developed, but have yet to be formally evaluated. My dissertation work involved the adaptation of several statistical and evaluative techniques never used before in data visualization and usability, including multiple-reader multiple-case ROC (Receiver Operating Characteristic) curve analysis and generalized linear mixed models. I expect to build on my dissertation work to further explore the practical and theoretical aspects of these evaluation methods, as applied to visualization and usability testing. As my research program expands, I also plan to address the influence of visual aesthetics on the perceived usability and user acceptance of data and information visualizations.

[1]Pieczkiewicz DS, Finkelstein SM, Hertz MI. "Design and evaluation of a web-based interactive visualization system for lung transplant home monitoring data." *Proceedings of the American Medical Informatics Association Fall Symposium* p. 598-602, 2007.