Researchers Using Visual Analytics to Improve Care Quality

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By Teeradache Viangteeravat, PhD, and Naga Satya V. Rao Nagisetty, MS

Editor's note: This article is an excerpt from a manuscript published in the Winter 2014 issue of AHIMA's quarterly scholarly research journal, Perspectives in Health Information Management, "Giving Raw Data a Chance to Talk: A Demonstration of Exploratory Visual Analytics with a Pediatric Research Database Using Microsoft Live Labs Pivot to Promote Cohort Discovery, Research, and Quality Assessment."

Using visual analytical techniques will create a solid foundation for clinical research studies, facilitate the ability to link clinical diagnosis data to treatment outcomes, and help to support clinical decisions, health information management (HIM) researchers believe. The use of visual analytics also has the potential to improve the quality of healthcare delivered, in part through its ability to offer Big Data-like analysis for healthcare providers. Visual analytics result when a user asks a question via an interactive visual interface, a data query is performed, and the resulting data are transformed into a visual presentation.

The Role of Visual Analytics in Clinical Research

Visual analytics takes advantage of humans' ability to optically process large amounts of information at once, allowing them to apply analytical reasoning and assess, plan, and make decisions. The study of the visual and analytical platform PRD Pivot database, as observed by the authors of this article, demonstrated the first stage of validating the rich content within the recorded data that are extracted from electronic health records (EHRs).

Given the recent advancements in Web service technologies, a basic component to be considered when developing distributed image portals for viewing massive image collections is the ability to efficiently interact with and effectively search large amounts of data to answer multidimensional analytical queries, along with the ability to augment the data with pertinent experiential knowledge.

The authors demonstrated the addition of a visual analytics layer PRD Pivot to their clinical research database using Microsoft Live Labs Pivot technology, a free tool that offers a novel way to examine and arrange huge amounts of clinical data online. This added layer enables data visualization and the ability to drill down—moving from summary to detailed data—by filtering and sorting information in electronic databases, leading to the discovery of patterns and relationships that would otherwise not be apparent.

The Metadata Process

The data sources used include files marked for inclusion in the Pediatric Health Information System that are extracted from EHRs. The Pediatric Health Information System is an administrative database containing hospital data from 43 leading North American children's hospitals. The authors built the database to accommodate the data fields from the "clinician" and "physician" files that would be the most useful to clinicians conducting research. The database uses all patient refined diagnosis related groups (APR-DRGs), which are normed on a pediatric patient population.

The data are aggregated and cleaned before a customized extract-transform-load (ETL) process is executed to place data into the PRD Pivot. The ETL process restructures the de-identified data into the format required by PRD Pivot. The PRD Pivot programmer examines all quality assurance, usability, and feasibility needs in a highly secured staging environment before pushing the database forward to a production environment. The production database will be able to be queried through a Web-based interface with appropriate controlled access and login authentication.

Research Project Results Show Potential

The authors summarized the patient characteristic classifications, such as gender, race, ethnicity, and patient type, for the data retrieved using the PRD Pivot search. Among all patient admission types, 71.4 percent (2,453 admissions) were emergency room, 15.1 percent (518 admissions) were inpatient, 13.5 percent (463 admissions) were observation, and 0.1 percent (2 admissions) were ambulatory surgery. For single patients, tracked by patient ID, the authors calculated the time interval between the last discharge date and the next admission date using the "Patient Type" status (0 = inpatient, 1 = emergency room, 2 = ambulatory surgery, 3 = observation) for specific readmission types like inpatient to inpatient or inpatient to emergency room.

The authors note that the results presented in this article should not be taken as an accurate representation of their patient data because the results do not include all the data records. These results are meant to demonstrate the potential of the PRD Pivot database and the feasibility of a full-scale data exploration tool using visual analytics like Pivot. Visual analytics—which again is when a user asks a question via an interactive visual interface, a data query is performed, and the resulting data are transformed into a visual presentation—takes the process of data analysis many steps further from conventional visualizations, in which data are transformed into a presentation by focusing on what a researcher wants to know rather than merely on what data are available.

Development of a clinical research database that can handle a massive amount of information in one centralized database, or data warehouse, was challenging. Although such a database is not a new concept, making it intuitive for physicians and researchers to use and extracting meaningful information with a powerful informatics tool is a rewarding task. Researchers believe that using visual analytical techniques will improve clinical research and diagnosis accuracy, and help support other clinical decisions.

From the usability side, visual analytics allow users to directly interact with the underlying data to gain insights, draw conclusions, and ultimately make better decisions. This study of the PRD Pivot database demonstrated the first stage of validating the rich content within the recorded data that are extracted from EHRs.

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Teeradache Viangteeravat (tviangte@uthsc.edu) is the technical director, biomedical informatics core at the Children's Foundation Research Institute and an assistant professor of biomedical informatics, department of pediatrics at the University of Tennessee Health Science Center, based in Memphis, TN. Naga Satya V. Rao Nagisetty (nnagiset@uthsc.edu) is a bioinformatics research specialist at the Children's Foundation Research Institute, Le Bonheur Children's Hospital, based in Memphis, TN.

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