INTRODUCTION
Clinical research information systems transform clinical care by employing computers to store extensive quantities of data, in turn eliminating various inconveniences related to paper documentation. These systems facilitate access to all patient information by authorized physicians, nurses, and researchers.

Clinical databases store comprehensive patient data in tables. It is typical for thousands of rows to describe just one individual. Although clinical research information systems return countless records across multiple patients with ease, seeking medical trends requires an additional resource: human cognition.

Computer processors and brains alike exhibit limitations. Computers cannot reliably detect clinically significant trends; human brains cannot retain tens of thousands of values for interpretation. Yet integration of computational and cognitive capabilities—data management and visual pattern recognition, respectively—with a data visualization intermediary enables longitudinal trend analysis in the medical research field.

OBJECTIVE
- To integrate human cognition and computers using software
- To facilitate trend analysis of four medical conditions
- To temporally report treatment and procedure outcomes
- To demonstrate to clinicians the utility of data visualization

MATERIALS
BTRIS Data Access
Raw data was gathered from Biomedical Translational Research Information System (BTRIS) Data Access, a repository of NIH clinical research data and medical subject data (1976-present). Some data included are: Demographics, Diagnosis & Procedure, Laboratory, Medication, Microbiology, Pathology, and Radiology.

EventFlow
EventFlow is a data visualization tool to aid temporal analysis of patterns among point-based events (e.g., surgery) and interval-based events (e.g., cycle of medication administration). Features include alignment, filters, grouping, and common sequence clustering.

Functionality. Once inputted, data can be aligned by an event to demonstrate temporal event patterns regardless of the actual date of admission. Data are filtered to analyze the frequency of event occurrences and/or sequences of events (e.g., show only patients who received dosage of Medication A then exhibited adverse Event B). Events can be easily omitted from view.

CASE STUDIES
Hypoparathyroidism
Hypoparathyroidism is an endocrine condition that occurs when the parathyroid glands produce insufficient levels of parathyroid hormone (PTH). Patients exhibit inadequate calcium absorption, thus low serum calcium, as well as elevated serum phosphorus. Calcium treatment may cause decreased renal function, indicated by low creatinine clearance and high serum creatinine. Elevated calcium excretion leads to nephrocalcinosis (kidney calcification).

Prostate Cancer
Severity is indicated by prostate-specific antigen (PSA) levels.

DISCUSSION
Longitudinal data analysis in standard table format—namely across multiple patients—proves to be a daunting task. For example, a hypoparathyroidism study followed 124 patients (each with four to five hundred data points) over 13 years. Fig. 3 displays trends for five patients in the adult cohort.

Data visualization facilitates medical research via computer data management and conversion into a cognitively-appealing visual format from which longitudinal trends become evident (otherwise could not be easily discerned from tabular data).

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