



Evolving Visual Analytics for Better Clinical Decisions

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Abstract

The exponential growth in digital data to support compound research, new drug development and clinical trials in advancing patient care provides distinct challenges to a clinical researcher. However, this also presents tremendous opportunities for new areas of exploration, cost savings and revenue growth to organizations that are willing to visualize their data in new ways.

Size and complexity of clinical data matters, and unfortunately today's visualization technology does not deliver the critical functionality for the researcher to quickly understand how data is connected and the dependencies between seemingly disparate data sets. Common dashboard visualizations do not provide the necessary context into how data is connected and what insights can be drawn based on these connections.

In order to meet the increasing board pressures to reduce cost and increase ROI, visual analytic tools must evolve to easily support all of the possible data available to researchers, including complex semi-structured, unstructured, and 3rd party data, and enable them to better understand which data is connected and how those data sets are related. This evolution provides the greatest opportunity for companies to use data in a more strategic way to improve value delivered to patients and shareholders.

In this session, we will introduce and provide a software demonstration to show:

- How very large, dense, complex data sets can be quickly and efficiently integrated into a visual analysis program
- A set of visualizations that explore the connections and dependencies across data sets
- A new method to visually analyze data, enabling a deeper, contextual exploration of data
- How customers adopting this new method are realizing tremendous cost savings and improving their competitive position

Keywords

Clinical research; Visual analytics; Unstructured data; Awareness; Pre-clinical analytics

Introduction

Our industry is now in the next evolutionary phase of how data can be used to improve how clinical research decisions are made. This is an evolution which moves past only using statistics, dashboards

and reports that describe data, to one which enables researchers and analysts to have a relationship-centric approach, which is an ability to understand the relationships and context within and across internal and external data sets. I believe this evolution has the potential to significantly impact how we conduct research and adaptively manage clinical data that can deliver improved patient care. However, to do so, we must be able to take advantage of what we currently cannot see.

Most common technology products used in pre-clinical research simply describe data, whether in statistical terms such as p-values or standard deviations, or graphically through bar charts and pie graphs. These tools describe what data is available so that analysts can decide what actions to take next against an endpoint analysis or a set of reporting requirements.

Unfortunately, the innovation behind these tools has primarily focused only on additional descriptive methods; simply continuing to describe the data through an updated set of charts or graphs, new statistical algorithms, or even new color schemas in current graphical solutions. At a recent clinical research conference, an MIT-trained data scientist presented on the next wave of visualization innovation in clinical data management was to incorporate brighter colors and bolder fonts in pie graphs to better highlight relevant data findings, as well as removing line patterns in bar charts so as to not distract the viewer's attention. Really? This is where "innovation" is going?

More substantive innovations enabling this evolutionary shift to a relationship centric analytic approach are being driven by the type of clinical and patient generated data that we now have access to today. However, this data requires more than only statistics or charts to unlock its value.

Most historic research data is two dimensional. It is quantitative, descriptive data that can be plotted on an axis or displayed in a graph in some way. In today's clinical world, there is value in data that comes not only from structured clinical systems, but also from the multitude of unstructured sources, both internal and external, that is available to the researcher. These data sources include patient generated health data such as medical devices and wearable's, but also from email, from social media, and from the internet. Most of this unstructured data cannot be statistically analysed, and requires a different type of multi-dimensional awareness in order to understand its value and use within the research process.

Multi-dimensional awareness is built on three key requirements. The first requirement is the ability to collect and leverage qualitative, observational data from any source into a research program. Studies have shown that this can add between 35% and 40% more data into a researcher program, giving the analyst significantly more data to use in their decision-making process.

The second requirement is the ability for agile, visual exploration of data. By visually exploring the relationships and patterns across full data sets and even individual data attributes, analysts can become aware of how a data set impacts and is related to another data set, strongly increasing the contextual understanding of their data which can directly improve decisions [1].

The final requirement is the ability to adaptively collect, use, monitor and share every data source, Scaled to the vast amounts

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of supporting data that are being created each day. This enables researchers to ensure they have access to and are using all of the most current qualitative data available, regardless of size or format, to support their analysis and research decisions.

Unfortunately, many companies continue to miss out on this new evolutionary phase. Our studies have shown that these companies share a set of challenges that prevent them from realizing the benefits of becoming more data aware. Initially, they lack integration across their multiple research and clinical development sites. Because of this, data is silo'd and sharing and collaboration becomes a very difficult, manual and time-consuming effort. Next, they have technical limits in integrating unstructured data into their research. They mostly lack tools that can build structure around the unstructured, to support the use of unstructured data, including email, graphics, imagery, and web data. Because of this, they lack the ability to analyze qualitative and observational data, which has been shown to tremendous value in everything from describing how patients feel, to who is talking about a particular compound and how that compound is being used in a clinical trial. And lastly, they experience poor data quality caused by manual efforts to integrate and normalize data. Missing out on this evolution can have very lasting impact to organizations. Many of these organizations in our research have had to make clinical research decisions with only 65% of the total data available to them, limiting the quality of many of these decisions. Additionally, the decision-making process can take up to 40% longer, which comes at an operational and financial cost.

What do we see as possible for those companies that are embracing this evolution? There are four primary capabilities that companies can realize throughout their data awareness journey that can dramatically improve how they make both research as well as clinical operations decisions, across a variety of use cases.

The first is the ability to integrate both internal and external data together in a common clinical data repository. Moving data out of functional and geographic silos into a unified database can streamline the data management process, enabling researchers to easily access and use the data necessary to support their decisions and monitor the impact. Second is the ability to support both structured and unstructured data. Structured data from clinical systems now represents a small percentage of available data to researchers and clinicians. Up to 80% of real-world patient data, both internal and external, is now unstructured and 60% of all clinical data contains valuable patient related information that is trapped in unstructured formats. Much of this patient information that researchers need for decision-making, and much of the data that could be used for trend analysis and research for the betterment of the public's health is difficult to get to, difficult to standardize, and difficult to share between disparate computer systems. Systems and solutions that automatically integrate multi-dimensional, unstructured data to allow for exploration and analysis can allow researchers to unlock the tremendous value in this data, and gain insights that statistics alone cannot provide to greatly improve how decisions are made.

Third is the ability to understand the context across all data sources. Most clinical reporting and dashboard systems are good at "describing" data. They allow the researcher to create multiple graphical, descriptive views of data, however they lack an ability to show the context of what the data means, how disparate data sets and data attributes are related, and even the degree of how one data set impacts another data set. Understanding the context across clinical data, not just the descriptive qualities, can give researchers previously

unachievable insights into their data that can validate or even invalidate hypotheses faster, or even highlight new opportunities or areas of research to explore.

Lastly is the ability to adaptively share all types of data throughout a clinical program. Data awareness is based on exploring relationships and patterns within data that can find new insights. The decisions that are made as these new insights are uncovered are enhanced by the ability to automatically extract the underlying data sets and share with peers and other analytic systems. This minimizes the time and resource investment in making decisions, and can save significant cost.

This next phase in the data awareness evolution is meant to augment, and not replace, current business intelligence and dashboard reporting systems. Companies adopting new systems and solutions that support a relationship-centric approach are implementing these upstream of their current statistical and dashboard reporting solutions, and are using these to more rapidly find, and then explore, the most relevant data sets that are then moved into current statistical and reporting tools. This approach is enabling these leading companies to move into, and through, their research decisions more efficiently, without changing their current infrastructure or process.

We have seen the value of this approach be applied in a growing variety of areas within clinical research, including new drug development, drug repurposing, precision medicine, Pharmacovigilance, patient recruitment, population health analytics, and clinical data management, and new use cases are being created every day by these leading organizations. They have found that better awareness of their data is driving better decisions, and this ability is driving significant benefit. This next phase of the data awareness evolution is providing unbiased insights across a significantly larger amount of valuable data that is enabling both bottom line cost savings and new top line research opportunities that can build greater competitive advantage [2].

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