Role of Visualization in Supporting Efficient Workflows across the Life Cycle of Drug Development

William Kuan
Industry Consultant, EMEA & APAC Health and Life Sciences Practice, SAS
Introduction

Visualization is not only for Descriptive Analytics

- What happened?
- Why did it happen?
- What will happen?
- How to make it happen?
- Prescriptive Analytics

Value

Descriptive Analytics

Diagnostic Analytics

Predictive Analytics

Difficulty
Introduction

Visualization is not only for Descriptive Analytics

Value

Descriptive Analytics

Why did it happen?

Diagnostic Analytics

What happened?

Predictive Analytics

What will happen?

Prescriptive Analytics

How to make it happen?
Visualization Across Life Cycle of Pharmaceutical Product

- **Strategy Development**
  - Improve speed in literature review

- **Preclinical R&D**
  - Save time in clinical trials

- **Clinical R&D**
  - Evaluate clinical outcome objectively via digital biomarker
  - Support efficient use and review of clinical data in SDTM

- **Regulatory Approval**
  - Better visibility of production processes to maintain quality

- **Manufacturing**
  - Support efficient use and review of clinical data in SDTM

- **Market Access and Commercial**
  - Improve efficiency in analyzing adverse events report

- **Post-marketing surveillance**
SAS Viya – The hero behinds the scenes

SAS Viya is one single platform for all your analytical needs, allowing seamless transition in your analytical lifecycle

- Faster at processing the same workload
- Agile and scalable
SAS 9 and SAS Viya

Main Differences

• **SAS Viya products are located centrally and accessed in one user interface (UI)** whereas SAS 9 has multiple UIs to access multiple products
• **SAS Viya is accessed securely through the web**, making it accessible on any device you are using
• The underlying architecture - analytics engine and microservices
SAS 9 and SAS Viya - User Interface (SAS 9)

SAS Display Manager

SAS Enterprise Guide

SAS Enterprise Miner, SAS Text Miner
SAS 9 and SAS Viya - User Interface (SAS Viya)

Application Menu

SAS Studio
SAS 9 and SAS Viya - User Interface (SAS Viya)

SAS Visual Analytics

SAS Visual Data Mining and Machine Learning

SAS Visual Text Analytics
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**Improve speed in literature review**
**Save time in clinical trials**
**Evaluate clinical outcome objectively via digital biomarker**
**Support efficient use and review of clinical data in SDTM**
**Better visibility of production processes to maintain quality**
**Improve efficiency in analyzing adverse events report**

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Improve the Speed in Literature Review

Use visual text analytics to mine COVID-19 research

• More than 50,000 full-text scientific research articles include studies on treatment effectiveness, vaccine development, mitigation efforts, genetic analysis, economic impact and more. It is impractical to analyze it all manually

• Effectively mining unstructured text from scientific literature can effectively categorize and determine relevancy of research findings

• Explore relevant research on coronavirus topics such as incubation period, genetic variations, risk assessment and more.

• Visualize extracted keywords and summarized quantitative data, quickly identify co-citations and the authority of papers using network analysis visualization, and search for key terms in free text

Powered by SAS Visual Text Analytics & SAS Visual Data Mining and Machine Learning in SAS® Viya
Visualize extracted keywords and summarized quantitative data
Explore relevant research on different topics
Identify co-citations and the authority of papers using network analysis visualization
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Save Time in Clinical Trials

Leverage Synthetic Control Arm

• In some circumstances, conducting traditional RCTs study design is unethical, impractical, or infeasible. (E.g., rare diseases)
• Provide researchers an interactive cohort building tool to identify external patient cohorts for comparison.
• Quickly identify appropriate synthetic control arms for the Tx arm in a single-arm trial.
• Reduce operation time or eliminate the need to enroll patients for control arms

Powered by SAS Health Cohort Builder & SAS Visual Analytics in SAS® Viya
Identify patient cohorts with easy drag-and-drop
Generate propensity score matched patient cohort with standardized analysis template

Table 1 Number of patients pre- and post-matching

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-matching</th>
<th>Post-matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment group</td>
<td>719</td>
<td>716</td>
</tr>
<tr>
<td>Control group</td>
<td>2383</td>
<td>716</td>
</tr>
</tbody>
</table>

Table 2 Standardized differences of baseline characteristics before and after propensity score matching

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Standardized Difference Pre-matching</th>
<th>Standardized Difference Post-matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAR_RISK_SCORE</td>
<td>0.18048</td>
<td>0.01224</td>
</tr>
<tr>
<td>GENDER_CD</td>
<td>-0.03298</td>
<td>0.03442</td>
</tr>
<tr>
<td>Logit Prop Score</td>
<td>0.18495</td>
<td>0.00138</td>
</tr>
<tr>
<td>Prop Score</td>
<td>0.18820</td>
<td>0.00156</td>
</tr>
<tr>
<td>age_at_index cd</td>
<td>0.00971</td>
<td>-0.04963</td>
</tr>
</tbody>
</table>

Summary of treatment and control groups matching information

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Metric</td>
<td>Propensity Score</td>
</tr>
</tbody>
</table>
Visualize demographics & clinical characteristics in patient cohorts
Support efficient use and review of clinical data in SDTM

Clinical Data Dynamic Report

• Clinical data reviewers work with programmers to produce reports for monitoring data quality issues, reviewing safety signal, and identifying trends. However, the back-and-forth communication is often a resources intensive process.

• Create an interactive, user-friendly dashboard for clinical data reviewing and monitoring task on an ongoing basis.

• Reduce operational costs and save patient lives in time.

Powered by SAS Visual Analytics in SAS® Viya
Visualize SDTM - Summary of Demographic Characteristics

- **Subjects in the study**: 254

- **Age**
  - Placebo: 75.2 years
  - Screen Failure: 75.1 years
  - Xanomeline High Dose: 74.4 years
  - Xanomeline Low Dose: 75.7 years

- **Gender Distribution**
  - Pbo: 86.28%
  - Scmfail: 96.31%
  - Xan_H: 62.35%
  - Xan_Lo: 62.35%

- **Race Distribution**

- **Ethnic Distribution**
Visualize SDTM - Adverse Events
Visualize SDTM - Adverse Events
Visualize SDTM – Concomitant Medication
Visualize SDTM – Concomitant Medication
Visualize SDTM – Lab Analysis
Visualize SDTM – Hy’s Law Analysis
Visualize SDTM – Patient Profile
Evaluate clinical outcome objectively via digital biomarker

Analyze Patient Motion with AI/Machine Learning

• Loss of balance can increase the risk of falling and impact the patient. Berg Balance Scale (BBS) is a paper-based clinical assessment tool to determine a patient’s ability to balance. However, it takes clinicians up to 20 minutes to complete the evaluation.

• Use cameras and sensors to capture movement data and build machine learning model to determine risk score for falling and assist early determination of progression of injury.

• Clinicians can analyze patients’ balance ability quickly, accurately and objectively.

Powered by SAS Visual Data Mining and Machine Learning & SAS Visual Analytics in SAS® Viya
Collect patient movement data
Determine risk scores in real-time
Build models to quantify variable importance related to risk scores
Visualize patient profiles by risk group
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Better visibility of production processes to maintain quality

Computer Vision on Product Quality

- Quality inspections are a key part of the manufacturing process. Some issues are still best identified via high-resolution images review by the human eye. This process is extremely time-consuming.
- Apply computer vision techniques to analyze product images to provide a ranking score for each product image. The product image that differs most from a gold standard image is identified (i.e., likely to be a defective product).
- The system can assess product images within seconds.
- Inspectors could prioritize batches for further manual review to save time.

Powered by SAS Visual Data Mining and Machine Learning in SAS® Viya

For more details: Computer Vision and Image Analytics

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Identify products with suspected defects

Suspected Defects

2

<table>
<thead>
<tr>
<th>Device ID</th>
<th>Part</th>
<th>Image Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>8915107</td>
<td>Spigot</td>
<td>March 18, 2019 08:27:57 AM</td>
</tr>
<tr>
<td>8915130</td>
<td>Spigot</td>
<td>March 18, 2019 08:40:21 AM</td>
</tr>
</tbody>
</table>

Mock image
Visualize the batch with suspected defects
Compare suspected product images with the gold standard.
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Improve efficiency in analyzing adverse events report

Use text analytics and visualization techniques

- Analyze unstructured data (i.e., symptom text) from vaccine adverse event reports
- An analytic platform that can generate Topics and Terms from text data automatically
- Provide researchers quick insights on serious adverse events from 500+ reports

Powered by SAS Visual Text Analytics & SAS Visual Data Mining and Machine Learning in SAS® Viya
Visualize the relationship between vaccine types and key topics
Visualize the relationship between vaccine types and key topics
Drill down to the individual text data

<table>
<thead>
<tr>
<th>Predicted Target</th>
<th>serious</th>
<th>age</th>
<th>days_till_event</th>
<th>category</th>
<th>Why Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>N</td>
<td>2.2</td>
<td>0</td>
<td>Febrile Seizure AB</td>
<td>The pt had a seizure several hours after the vaccination. The pt went to a hospital ER.</td>
</tr>
<tr>
<td>Y</td>
<td>N</td>
<td>1.3</td>
<td>0</td>
<td>Hospital Seizure</td>
<td>105 temp, seizure seen in ER, also diagnosed with stomach flu, 2 weeks later had pneumonia seizure with high fever, seen at hospital.</td>
</tr>
<tr>
<td>Y</td>
<td>N</td>
<td>0.2</td>
<td>1</td>
<td>Hospital Seizure</td>
<td>8 seizure like episodes which began 1 day following vaccinations and lasted 1 day, no episodes since (currently 3 days post last episode) sent to hospital and pt referred to neurology.</td>
</tr>
<tr>
<td>Y</td>
<td>N</td>
<td>0.4</td>
<td>1</td>
<td>Febrile Seizure AB</td>
<td>Felt warm per paramedics, ER at hospital. Seizure Activity 11/25/04 6:00am 52 at home.</td>
</tr>
</tbody>
</table>
Visualize the key topics and terms from text data
Visualize the relationship between seriousness and key topics.
Takeaway Messages

• In addition to having all the powerful analytical techniques SAS is known for in SAS 9, **SAS Viya** also contains the latest machine learning, deep learning and visualization capabilities with friendly user interface.

• SAS 9 and **SAS Viya** are integrated so you can still use what you’ve built. SAS code and SAS 9 is here to stay, as part of the **SAS Viya** environment.

• Visualization helps people interact, understand and even analyze the data, especially for users with different level of analytical skills.

• Visualization can support efficient workflows and data-driven decision across the life cycle of drug development.

• Modernize the analytics platform can help organizations stay competitive in the market.
Thank you!

Any Question?

William.Kuan@sas.com

Confident decisions at every moment.