PharmaSUG 2015 - Paper AD13-SAS

Patient Profiles and SAS Visual Analytics

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ABSTRACT

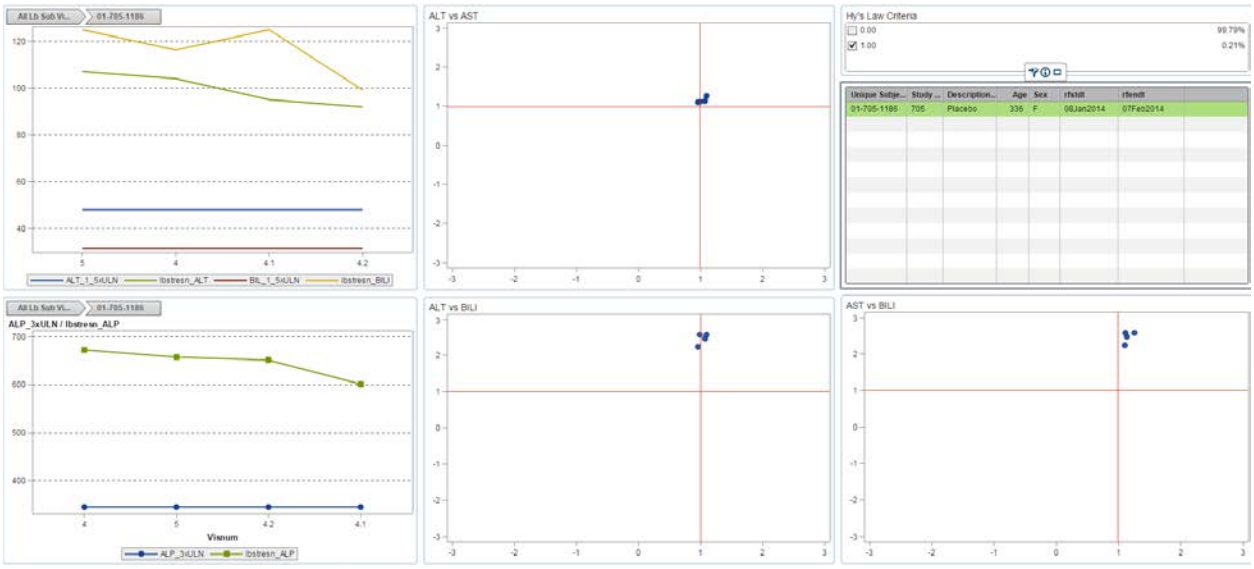
Clinical trials data are collected from many different sources. Once the trial begins, all of the data needs to be cleaned, explored and reviewed before they are processed. Patient profiles are used for many phases of the process. These profiles can take many forms depending upon the reviewer and the purpose. An ideal patient profile would contain all current data for each subject thereby empowering reviewers to rapidly assess the patient's status while still allowing access to any level of detail desired. This paper will explain how end users of various technical skill levels can use SAS Visual Analytics (VA) to achieve this, as well as other productivity improvements throughout the clinical trial process

CLINICAL OPERATION INNOVATION

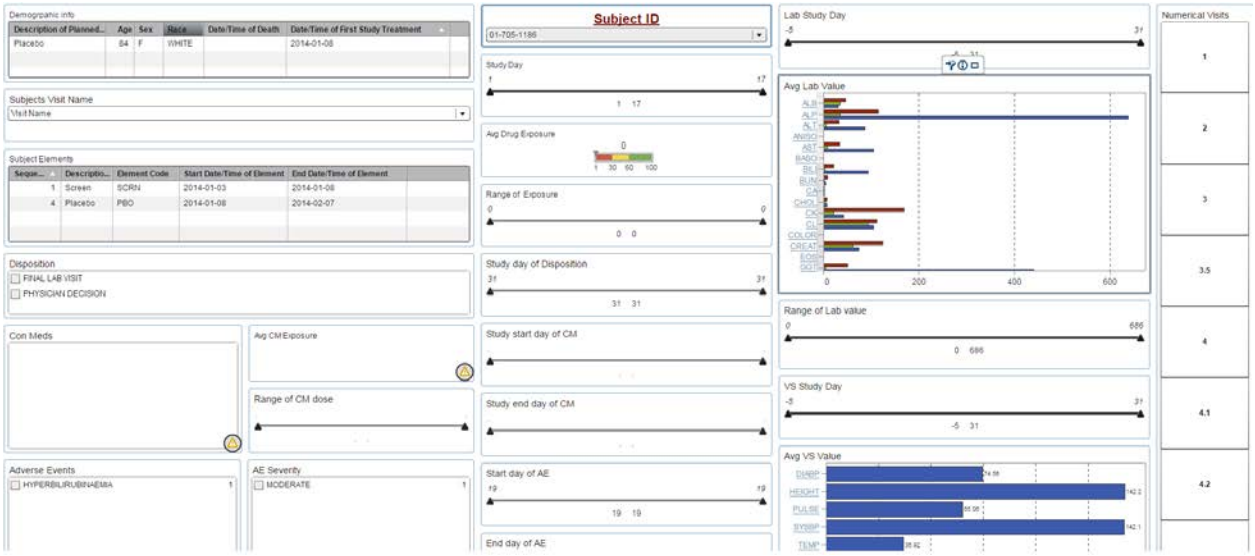
Innovations from SAS are changing the way technical and non-technical users create and consume analytics. These innovations include advancements in data management, business intelligence and visualization, as well as high performance analytics. Using SAS, analytics can be performed on a PC, on a server, on grid, in database or in memory. This can be accomplished by writing code or by using a point-and-click interface. So, what happens when a traditional clinical SAS programmer experiences the latest SAS technology and capabilities? Innovation in Clinical Operation.

SAS Visual Analytics can help users create visually appealing clinical reports and patient profiles across all data domains, without writing a single line of code. Visuals are highly interactive in nature and direct links can be provided from a particular domain analysis directly to another. In this way, a user can better understand a cluster of patients in a particular domain of interest and then explore patient-level details.

Display 1.1 shows all subjects' clinical data related to Hy's Law is in VA. In Display 1.2, VA provides the link to that particular Patient's profile



Display 1.1 Subjects with potential liver issues indicated by a Hy's law plot

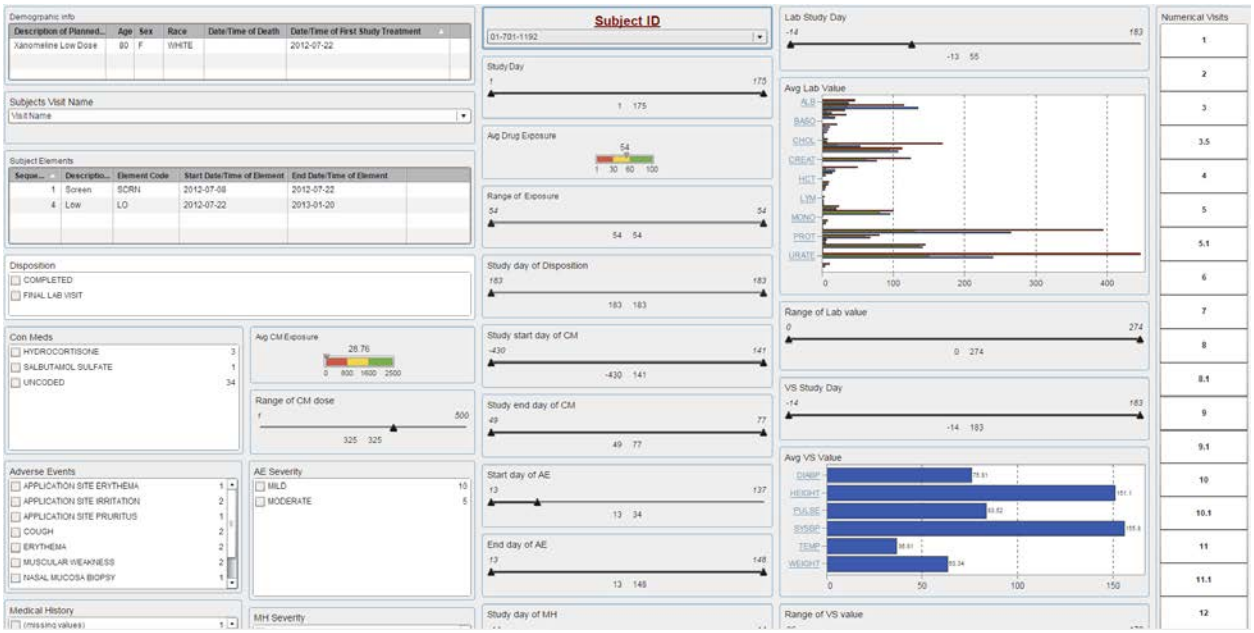


Display 1.2 Patient profile of subject with liver injury suspected from Hy's law plot

If you are running a central monitoring or risk-based monitoring initiative where certain risk indicators indicate study, site, and eventually a subject at risk, we can create a link path using SAS Visual Analytics which will allow us to see the patient profile of that subject at risk. The same patient profile can be used by a monitoring team, the clinical data review team, or the clinical trial development team -- even if the data are sourced from EDC or data formats such as SDTM and ADAM. SAS Visual Analytics' capability to map any kind of data structure instead of creating separate datasets provides immense flexibility to the end user.

Display 2.1 shows a subject's risk level based on Transcelerate position paper: Risk-based monitoring methodology. In Display 2.2, VA provides the link to the particular patient's profile which is highlighted in Display 2.1.

Display 2.1 Subject with high AE count compared to average AE count across all sites



Display 2.2 Patient profile of a subject with high risk

PATIENT PROFILE: PAST AND PRESENT

Past: J. J. Hantsch and Janet Stuelpner, based on Pharmasug Paper 211-2012, have explained how Patient profiles were created (SAS code, EG and JMP/Clinical) as well as the user audience (CRAs, medical writers and physicians). A typical approach has been to use Base SAS code to generate each patient's profile as separate PDF files which are then delivered to the medical writers. Andrea Ritter, PharmaSUG paper –TT03 has explained this process in her paper, as well.

Present: Creating patient profile has not meaningfully changed even though technology has advanced. The FDA and EMA are asking sponsors to be more vigilant about the quality of patient data and patient safety. The ability to quickly in corporate all clinical data and enable report users to easily drill down to an individual patient profile level will be critical. More users and stake holders will be asking for patient level information. An additional aspect is how quickly this information can be available. Technology from SAS now allows end users not only to create a custom patient profile, but also enables to create a more self-service view for exploring, consuming, and sharing the report: as a static PDF or printout; or interactively on Apple or Android mobile devices or using Microsoft Office tools (Excel, PowerPoint, Word, Outlook) and SharePoint -- all from one saved report.

SAS VISUAL ANALYTICS-INTRODUCTION

SAS Visual Analytics is a web-based platform for interactively visualizing data. The distributed, in-memory architecture allows users to graph, filter, summarize and analyze very large volumes of data without coding or waiting.

The key components of SAS VA include Reporting (including viewing and authoring), Exploration, Analytics and Data Builder. In addition, there are capabilities for administration, user and resource management and other tools.

Reporting allows an author to define a report using various graphical and tabular displays, expose filters to the users, define drillable hierarchies and create interactions between visualizations – all without writing any code. Data sources used by a report can be updated or changed, allowing reuse of the report across time or similar data structures. Once a report is created and saved, users with the appropriate permissions may access it to view and interact with the current data.

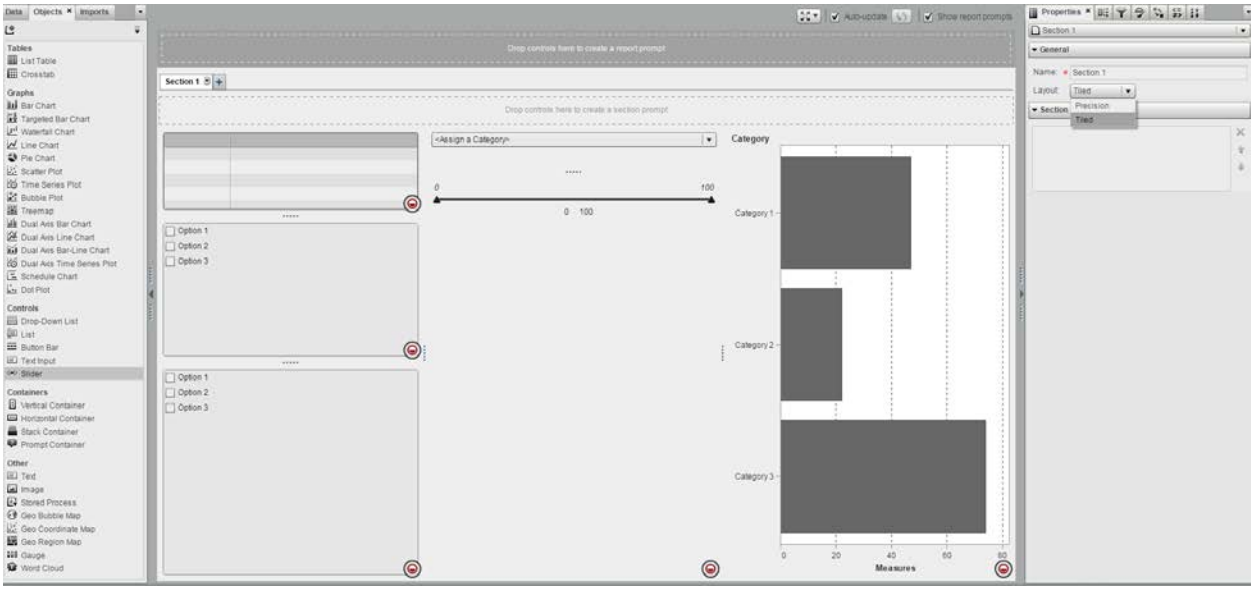
Although an Exploration may be saved with visualizations and other controls already created, this aspect of the platform allows users to interact with the data without the predefined constraints of a report – one may change variables used in plots, create new visualizations, create new variables, etc. In addition, Exploration provides additional analytics capabilities beyond those exposed in Reporting, including interactive forecasting tools, correlations, decision trees and text sentiment analysis.

The distributed, in-memory architecture of the platform provides a number of advantages. As a distributed application, the hardware environment can be scaled to any size data and is fault tolerant. VA's "LASR engine" manages, persists and shares the data in memory where all of the analytics are also performed. By holding the data in memory at the lowest level of granularity, the need to execute queries, predefine cubes or wait for data to load is eliminated.

CREATING PATIENT PROFILE USING SAS VISUAL ANALYTICS

To start with, have a layout in mind for the report design. Datasets, raw or CDISC-based, should be already loaded in LASR. SAS Visual Analytics' flexible Report Designer supports precision or tiled report layouts. The examples in this paper use a "tiling" method where VA helps guide the layout. VA offers many graph, chart and control types. The report designer creates a report by dragging objects from the tabs on the left onto the canvas in the center. Good choices for patient profile reports include list tables and bar charts with drop down lists, and sliders as control items. Using the right panel, the user can control the properties of each individual graph. For a bar graph, for instance, a user can select a horizontal or vertical layout. In addition to a rich set of graph types, a custom graph template allows the user to combine the design of multiple graphs or graph types into a single visualization. For instance, a butterfly plot template can be created by combining to bar charts with a shared vertical axis. For initial versions of your patient profile report, the best approach is to keep your audience in mind and keep it simple.

In Display 3.1, the List Table, Drop-Down List and Bar Chart were added first. Then, two additional List Controls were added below the List Table and a Slider was added below the Drop-Down list to provide additional user control.

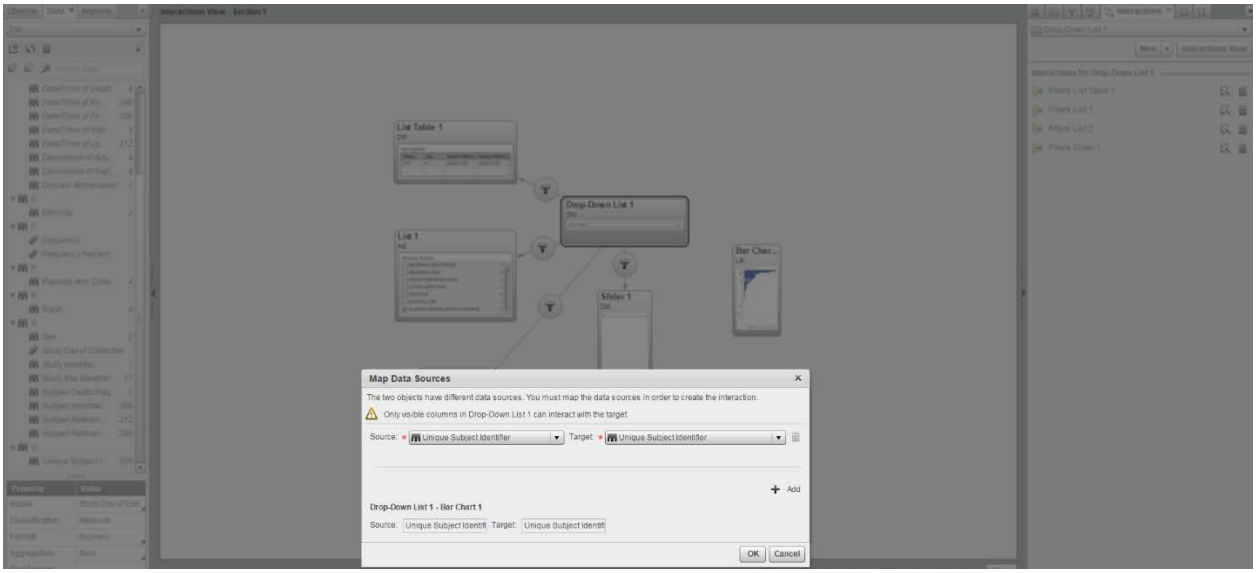


Display 3.1 Starting with layout and template

In the next step, the data elements are added to the object placeholders. Since patient profiles display the information for a single subject, one good starting point is to populate the drop-down control with the patient identifier variable from the demographics data. This will allow us to control the data displayed in each of the visualizations we add to the report. Building a report as complex as a patient profile will be an iterative process, so be patient and orderly. One recommendation is to start with the safety data and then add additional sources such as adverse events and labs to define how interactions should work. VA even supports interaction between different reports using different

datasets.VA will also try to help by automatically offering to map variables with the same name such as patient or site identifiers.

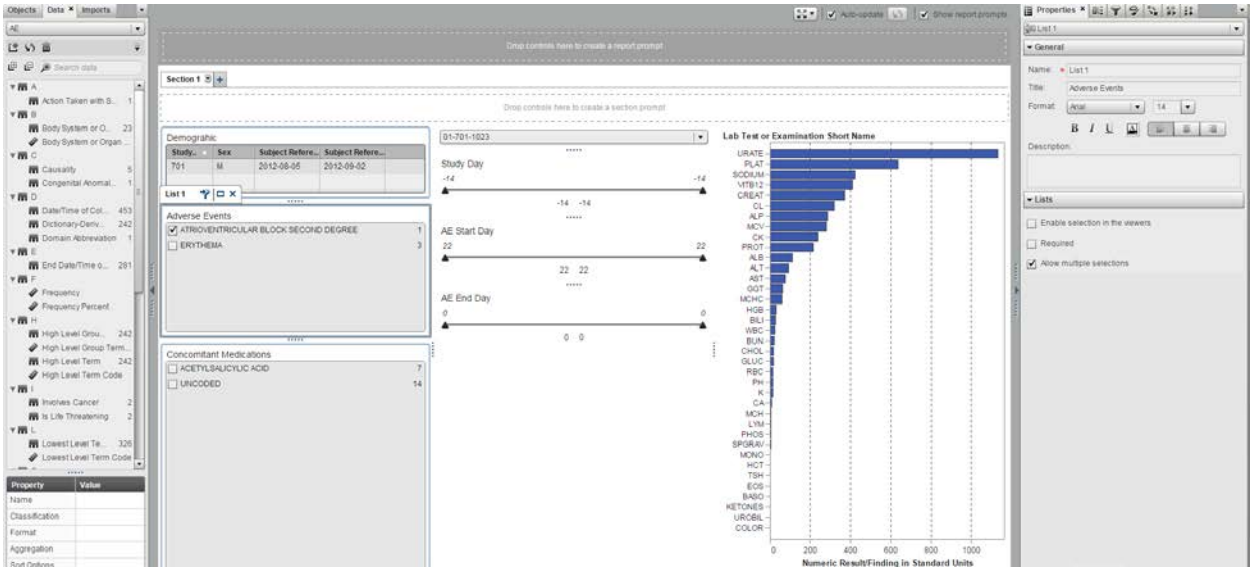
In Display 3.2, from the menu, choose “View, Show Interactions.” The user can drag between two charts or controls to create an interaction.



Display 3.2 Assigning data to objects and mapping different data sources

As explained above, add objects and data that are vital to the study design and start exploring your data. It is quite interactive and interesting to create a click path or a link to a section, report or a stored process that gives you further insight about a subject via a pop-up.

Display 3.3 shows a partial view of a Patient profile in edit mode. The left panel show the Data, Objects and imports tab loaded with an adverse event dataset. The central panel shows the dashboard content and the right panel shows the Properties, Roles, Filters, Styles, Interactions, Display Rules, Ranks tab.



Display 3.3 Partial patient profile in report designing mode

THOUGHTS AND BEST PRACTICES

LAYOUT

A patient profile is a detailed visualization showing patient row level data. SAS VA allows us to put many charts and graphics in visuals. Based on our experience, listings and cross tabs with display rules look neat and clean. Decision will also have to be made on how these visuals are going to be consumed. Patient profiles look much better when viewed using a browser. If report access using Apple iPads is important, the report designer may need to rearrange the report layout to reduce the amount of information on each page due to the limits of the display size.

DATA

A patient profile can be built by either bringing multiple domains into SAS VA or bringing one single dataset having all the domains. Each method has advantages and disadvantages. If using multiple data sources, relationship between multiple domains will be defined within VA. Care needs to be taken when reusing the same patient profile for different studies. SAS VA can retain all its metadata information but the designer needs to be vigilant and test thoroughly to ensure the report is giving the desired results. The advantage of this approach is a completely point and click experience for the end user. When using the method single dataset, light programming is needed to set up the patient profile data. All the charts will easily be connected using SAS VA interaction. Use filters to narrow down on one particular domain. Tests have shown it is easy to transfer patient profiles from one study to another. Administrators will also have an easy task to maintain the profiles since they will be only looking at one dataset

MIGRATION AND BACK-UP

SAS Management Console (SMC) will provide the migration from one version of SAS VA to another using a simple point-and-click wizard to import and export your SAS VA content which will be in the form of a SAS package file with a .spk extension. It zips all the metadata information of folder, files, reports, data which you can then use either as a back-up or to import and export from one version to another. Based on the considerations discussed above in 'Data' section, if you are creating patient profiles using multiple domains, care must be taken while importing this metadata information as SMC will ask the user to fill in all the details regarding all the domains available in the LASR server for the patient profile to work instantly. It is easier if there is one dataset, one patient profile to import and export by your SAS Admin.

AUDITING

Starting with SAS VA Version 7.1, a VA report showing which users are accessing each report, when the report was accessed, what dataset was used (even the columns in the dataset that were used) are available for an administrator. This is especially useful for the administrator to monitor patient profile reports, patient profile datasets, server load, size of the biggest dataset and more. The in-memory data size could vary considerably when moving from study to study, depending on the number of datasets per domain being used. Patient profile reports don't take much space in the VA environment but dataset(s) lifted into the LASR server can impact system performance. If studies are closed and that patient profile is not needed, those dataset(s) could be removed easily and brought back again within minutes upon request in SAS VA LASR server.

CONCLUSION

This paper is focused on innovation around clinical operations and patient profile reporting. FDA and EMA requests sponsors to be more vigilant regarding patient safety and quality of data. This will usher in a new era where patient profiles are of vital importance both to stake holders and regulatory bodies. By quickly building and deploying a graphical patient profiles with SAS VA, various departments in clinical operations can enable rapid decision making. Let the conventional way of building a patient profile take its course during the end of trials, but start looking at the data early on using patient profiles with SAS Visual Analytics.

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- http://www.cdisc.org/sdtm. Study Data Tabulation Model (SDTM)

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I would like to thank my managers Mike Henderson and Kathy Schaan. Mike for reviewing this paper and providing HY's law algorithm. Kathy for reviewing this paper. Robert Collins for reviewing and sharing this paper with me for introducing SAS Visual Analytics section. My wife Chakshu Desai (MD) to help me understand how they write patient narrative, mini narrative and clinical data review using patient profile.

RECOMMENDED READING

- SAS Visual Analytics 7.1: User's Guide

CONTACT INFORMATION

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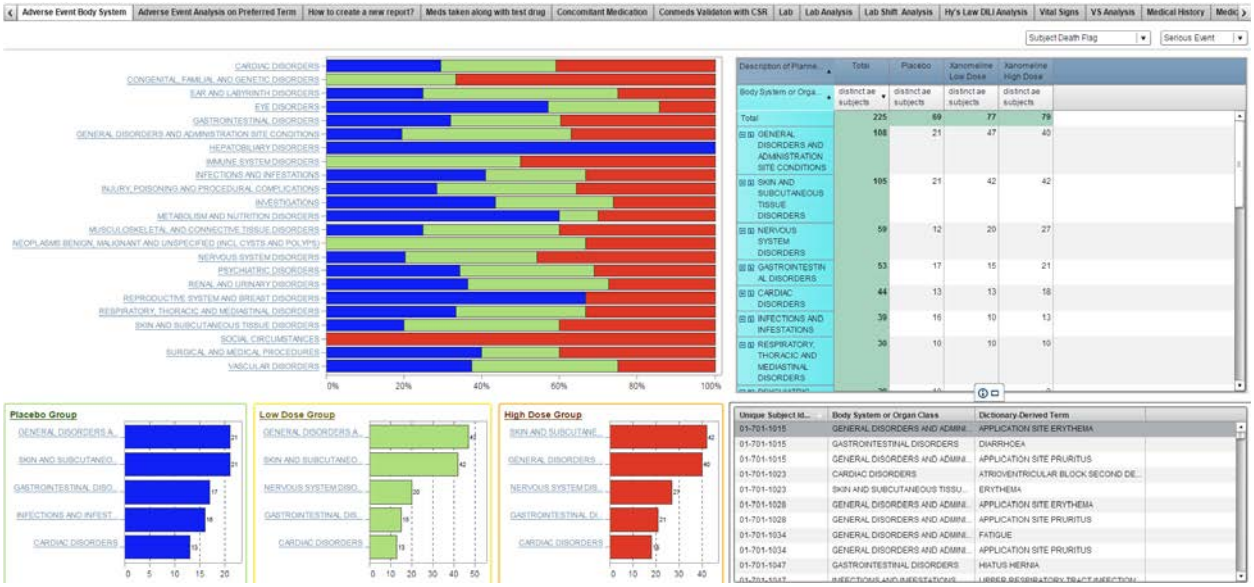
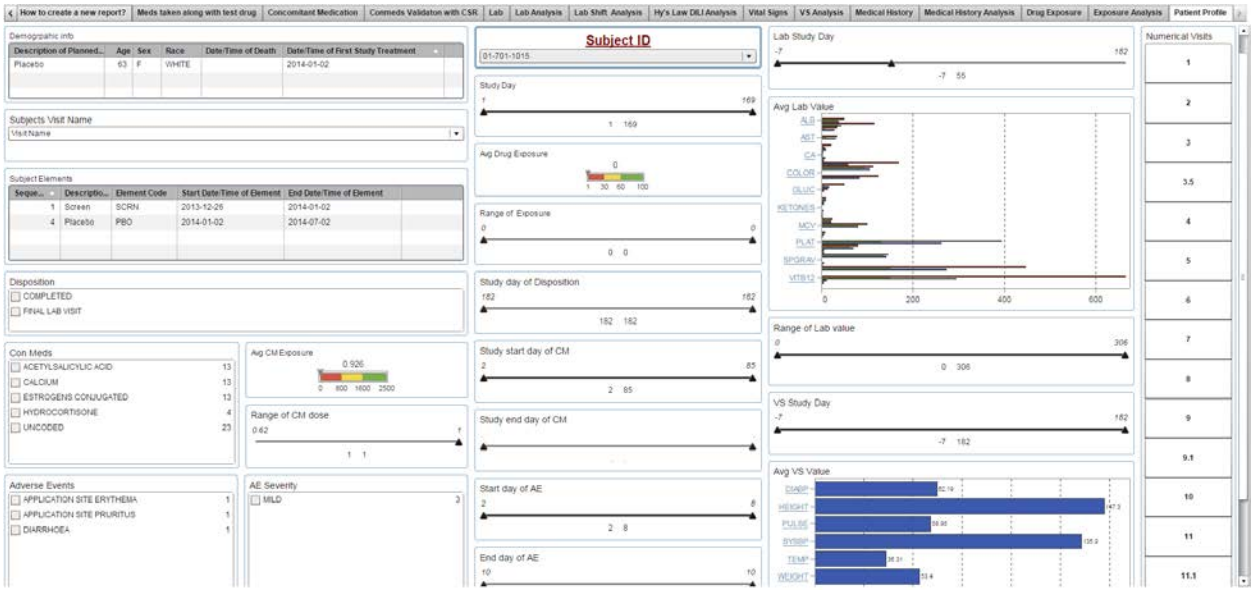
Sample Reports

Display 4.1 Shows AE body system and preferred term count and listing. User can drill in body system to look at its preferred term. Display 4.2 shows the corresponding patient profile of the subject highlighted in gray in display 4.1

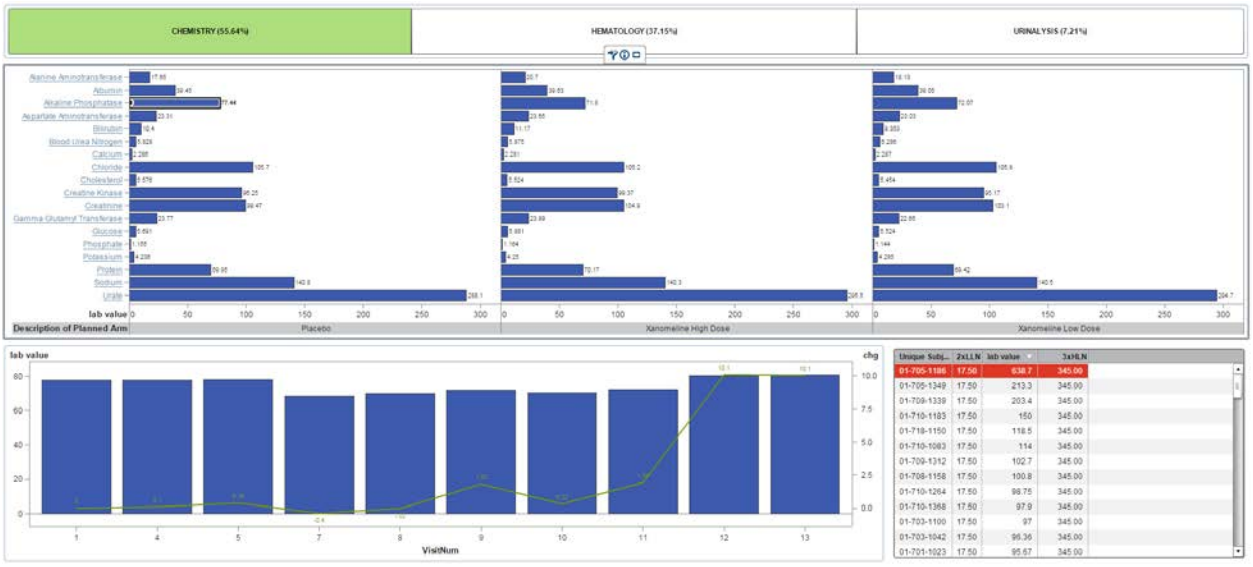


Display 4.1 VA report showing adverse event body system and drill path to preferred term

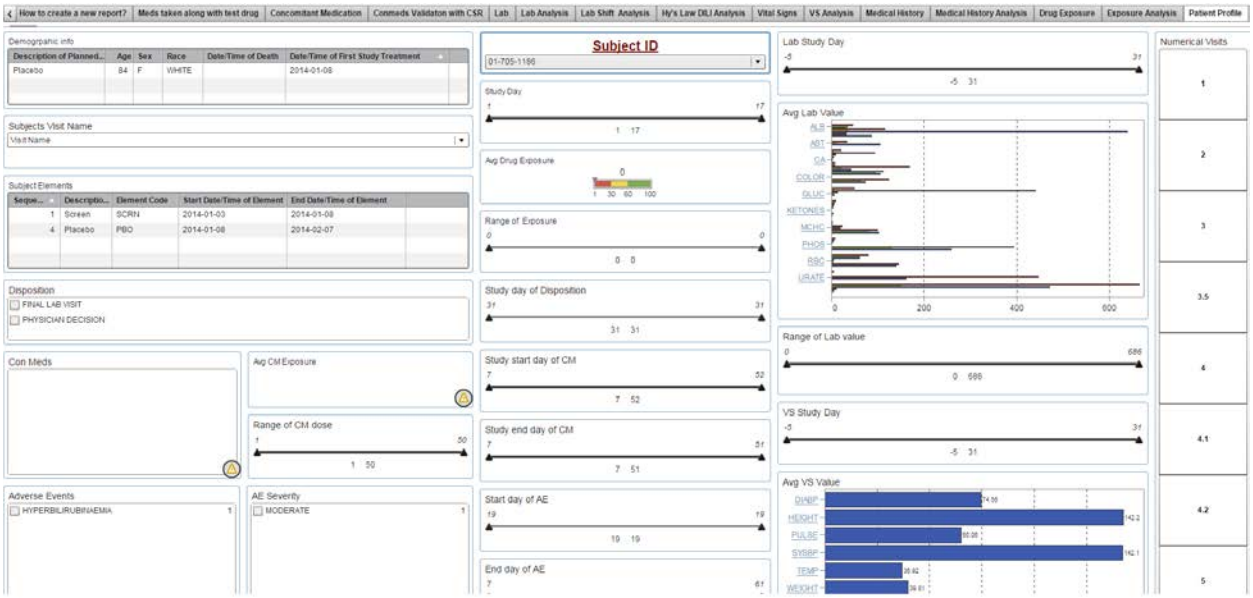


Display 4.2 VA Patient profile report of the subject highlighted above in report 4.1

Display 5.1 Shows lab analysis and change across visit. Listing shows the lab value which is either 2 times lower the lower limit and three times higher than upper lab limit. Display 5.2 shows the patient profile of the subject highlighted in red in display 5.1



Display 5.1 VA report showing lab analysis



Display 5.2 VA patient profile report of subject highlighted above in 5.1