

Visualization of Oncology Data from Interactive Dashboards

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ABSTRACT

In clinical trials, the data are represented and analyzed in the form of statistical tables, listings and figures (TLF) which are typically generated using SAS statistical procedures. It relies on statistical programmers to generate the TLF or patient profiles for data review or medical monitoring. Until most recently, the static outputs are time-consuming to generate and not to be the interactive visualization to help the end-users to drill down to explore signal or timely make the decision for the ongoing clinical trial. With the rapidly increasing availability of data visualization and analytic tool, TIBCO Spotfire software essentially shows its advantage of interactive visualization and its smart, secure, flexible features. In this paper, we present the TIBCO Spotfire application to generate the patient profiles in dynamic dashboards and static outputs for exploring, data review and monitoring needs in ongoing oncology trials (e.g. swimmer, waterfall, spider, line graphs). We not only provide the results at a high level but also drill down to a subject level via DXP file or web link helping end-users to effectively review and make decisions on one complete big page.

INTRODUCTION

Visualizing the data is a crucial part in oncology trials, helping the reviewers understand difficult concepts more easily. It is beneficial for the visualization to be interactive. So, in this paper, we use SAS statistical procedures along with data visualization tools such as TIBCO Spotfire software to create interactive clinical trial graphs that are widely used in oncology trials.

Spotfire is an analytics platform where data can be explored inter-actively. Numerous in-built visualizations can be selected. The Spotfire can provide the deep-dive, real-time analytics on live streaming data [1]. Meanwhile, it can provide the web-access to share and download the patient profile for end users to review more interactively and directly. Statistical programmers and reviewers get further information to build-up a good relationship for further collaboration as shown in Figure 1.

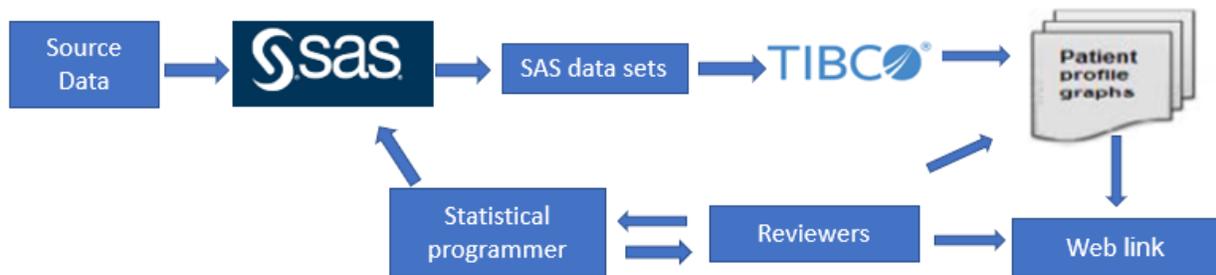


Figure 1: Data Visualization Solution from Source Data via SAS and Spotfire

SWIMMER PLOT

Swimmer plot is a graphical tool used to display individual subject over time. A swimmer plot can tell a full story using horizontal bars to represent each subject's tumor response (e.g. RECIST measurements), lines, points, and arrows are utilized to display additional information including tumor type, cohort level and treatment discontinuation reason. One traditional way of generating swimmer plot is by using SAS graphics procedures. However, the output generated by SAS software is static and not suitable for reviewers to explore and drill-down further. Also, modifying and customizing these kinds of outputs is still a complicated process [2]. To avoid these limitations, the Spotfire software can be used to generate the swimmer plot. The convenient accessibility of the software helps the end user with their interactive data review and data exploration.

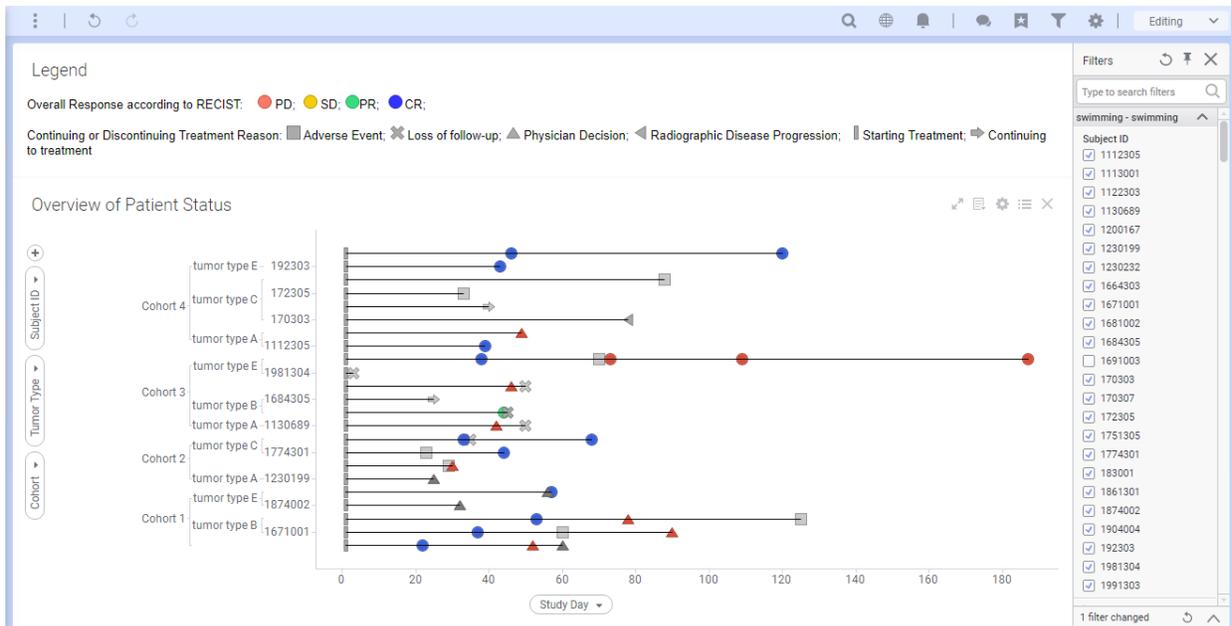


Figure 2: Swimmer Plot

Figure 2 shows the swimmer plot generated by the Spotfire. The above plot in Spotfire is created by plotting unique subject identifier against study day of the subject differentiated by response. The subject's response to the study drug is differentiated by different color and shape. The plot in the above example, shows us different bits of information such as the duration of the response, type of response and start and end days of response, treatment discontinuation reason was to the study drug etc. As mentioned earlier, Spotfire allows the user to apply filters on the visualization as shown in Figure 2, in which study day, cohort stage, tumor type, subject unique ID filters have been added on right of filter area. The user can modify any number of filters that are needed for the analysis.

WATERFALL PLOT

In oncology trial, when a subject is enrolled for treatment, the diameter of target lesion is measured on different visits. Overall drug response is usually analyzed using Response Evaluation Criteria in Solid Tumors (RECIST) criteria. Waterfall plot can present the maximum change in the diameter of target lesion for each subject. When the patient population in a particular trial is large, waterfall plot is the unambiguous presentation to give a good idea about drug activity. The x-axis in the waterfall plot may represent the unique subjects participated in the trial and the y-axis may represent the percentage change (growth or reduction) in the tumor diameter [2].



Figure 3: Waterfall Plot

Figure 3 displays the waterfall plot generated by Spotfire. The above waterfall plot gives us a whole picture about the performance of the study drug by showing the best percentage change of the tumor diameter in target lesion from baseline for each subject and differentiating the bars by color based on the subject's cohort level information. In the figure above, the reviewer may modify the filters at the right or zoom sliders, making the result interpretation easier. Apart from 0, reference lines are also drawn at 20 and -30.

SPIDER PLOT

The spider plot is another way of presenting the change from baseline for tumors for each subject in a study by different tumor assessments.

In spider plot, every subject is represented as a line that starts from the same point. The lines then are plotted based on increase or decrease in tumor size. This way the % change from baseline for each subject is plotted across the entire study duration. Spider plots are easier to interpret for small number of subjects. If the number of subjects is large, the plot may be more cluttered and harder to read [3].

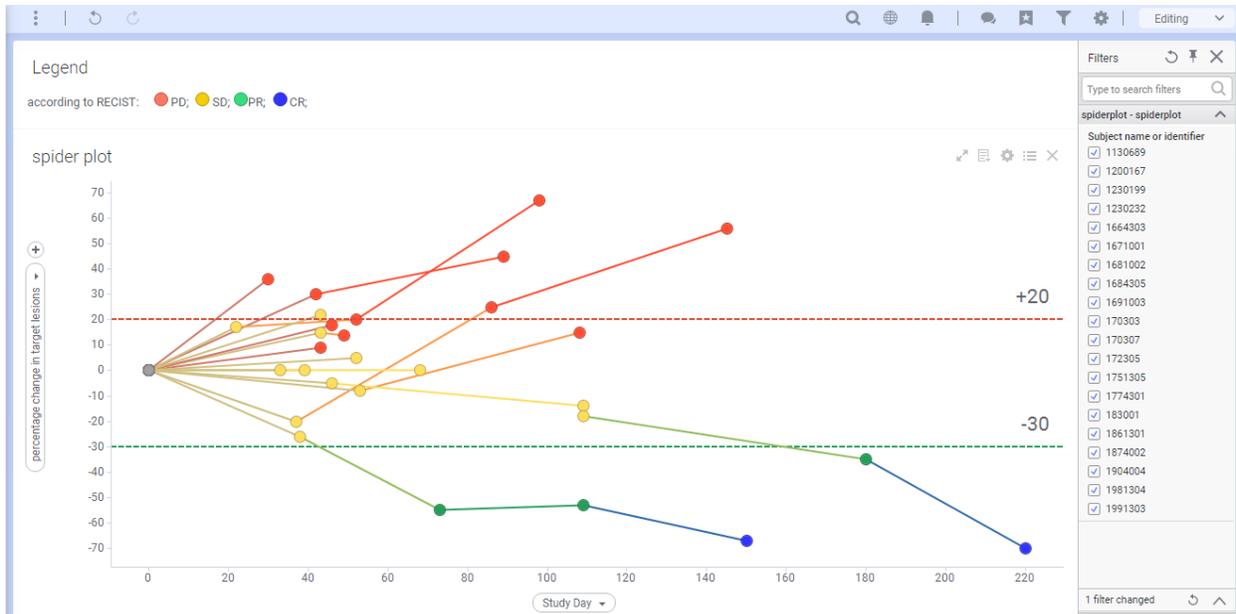


Figure 4: Spider Plot

Figure 4 displays the spider plot generated by Spotfire. The above spider plot gives us a whole picture about the performance of the study drug by showing the percentage change of the tumor diameter in target lesion from baseline for each subject at every tumor assessment. Percentage change from baseline of the tumor to each visit is calculated using SAS procedures. End users can apply the filters function to drill-down to get a complete picture easier. Apart from 0, reference lines are also drawn at 20 and -30 by different colors.

LAB ANALYSIS VISUALIZATION

Line plot is a graphical tool used to display the result of individual parameter over time. One traditional way of generating line plot is by using SAS procedures for every parameter. However, the output generated by SAS procedures is static and can't be modified. Figure 5 displays the line plot generated by Spotfire. All laboratory parameters results can be reviewed one page including additional information (e.g. baseline and normal range). In details, the reviewers can just modify the filters and zoom sliders in dynamic dashboards and drill-down to exploration, data review and monitoring. This dashboard enables reviewers to drill-down to get a complete picture of 'data of interest' by using marking and filtering functionality. Compared with static outputs, the lab analysis visualization by Spotfire is more friendly and effective for exploration and decision making.

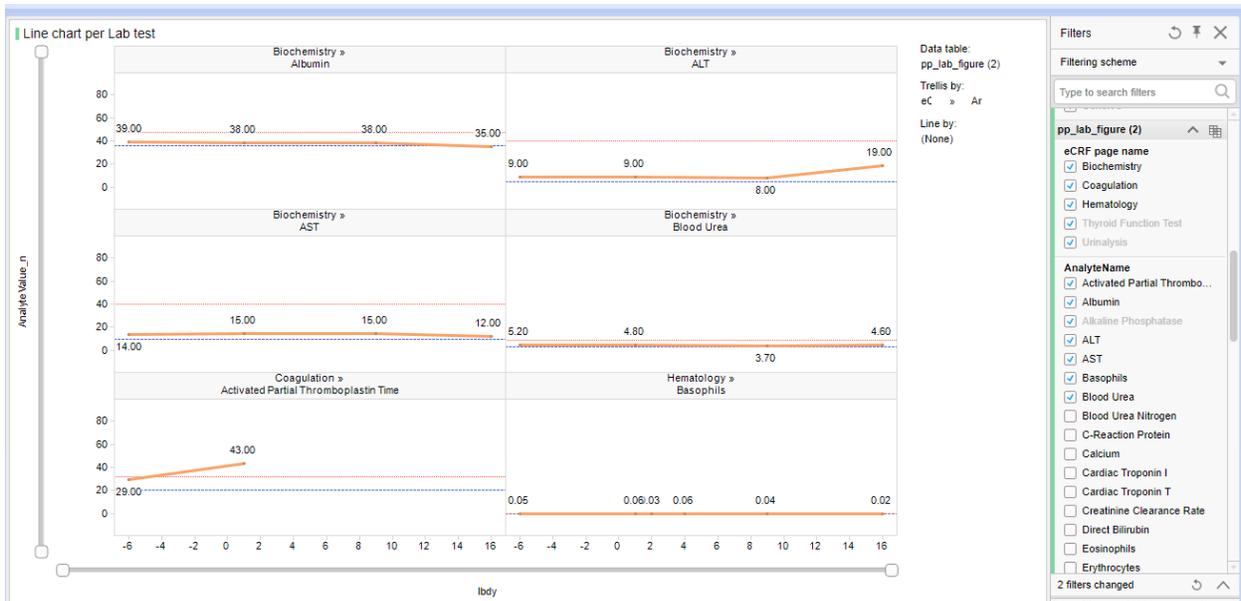


Figure 5: The lab by-patient and parameter plot shows line plots of the actual values per study day for the selected patient and parameters.

EXPORT IN SPOTFIRE

The Spotfire has displayed the interactive and flexible features. Besides, it enables users to export visuals/datasets effortlessly in form of CSV, PDF, or Microsoft PowerPoint [4]. The PDF page can be modified and customized in Figure 6 including headers, footers, borders, background, etc. In addition, users can effectively export PDF document using button control in Figure 7. Moreover, Spotfire supports publishing of visualization on the web for end users to access via Spotfire Consumer license to dig deeper into their data of interest.

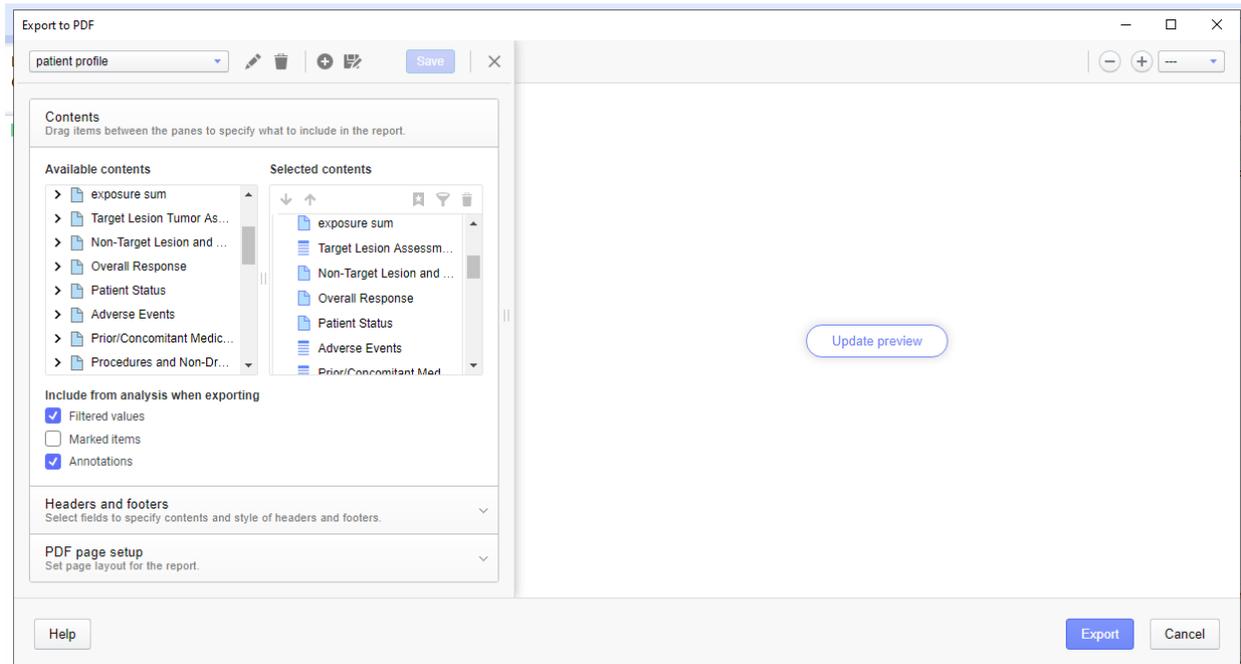


Figure 6: PDF export set-up

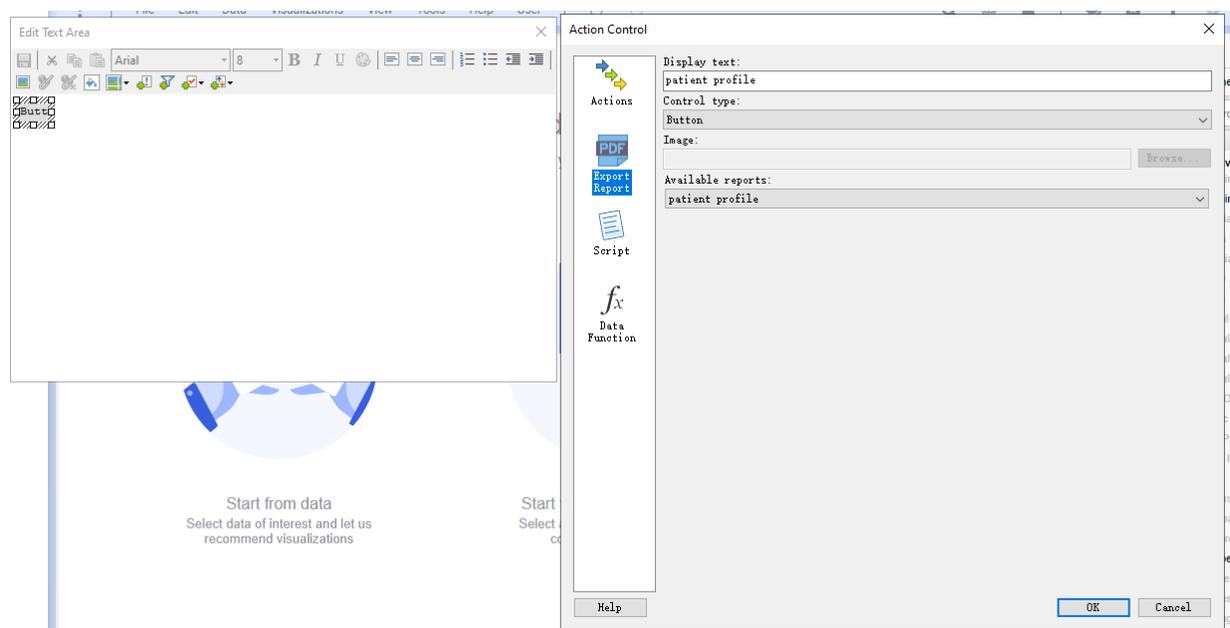


Figure 7: Button control of PDF export

CONCLUSION

This paper represented the interactive visualizations via Spotfire software for reviewers to ‘see’ clinical data more interactively: identifying trends; visualizing the patient profiles; and reviewing results at a high-level while still being able to drill-down to get a complete picture. It makes the data review process faster and more effective. With the power of SAS and Spotfire, we were able to build a multiple dashboard where user is able to seamlessly navigate between summary level and subject level details by reviewing the built-in patient profile pages, both graphical and in listing format. In addition, statistical programmers and reviewers get further information to build-up a good relationship for further collaboration.

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ACKNOWLEDGMENTS

I would like to thank all reviewers for their great support and review of this paper.

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