

PP04: Behind the Scenes: from Data to Customized Swimmer Plots Using SAS® Graph Template Language (GTL)



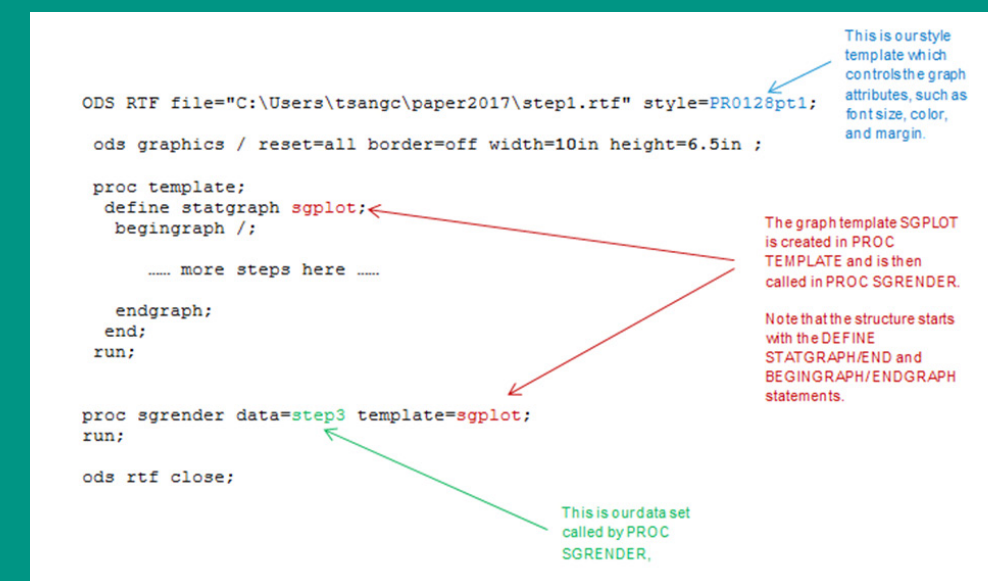
Introduction

What is a Swimmer Plot?

- A useful and compelling visual tool to assess treatment efficacy for individual subjects in oncology clinical trials
- Efficacy endpoints: Response Evaluation Criteria in Solid Tumors (RECIST), percent change from baseline in target lesions for measurable disease
- Other valuable information for individual subjects: treatment doses, duration of treatment, primary tumor type, and ongoing treatment status

SAS GTL

- In SAS Graph Template Language (GTL), SGRENDER and TEMPLATE procedures used for customization
- PROC TEMPLATE to create a graph template
- Data structure and variables created and called by PROC SGRENDER
- Style template used for defining graph attributes in ODS RTF



Step 1:

Create horizontal bars for treatment duration by dose group and primary tumor type for individual subjects

Step 2:

Annotate tumor response over time, treatment status, and the percent change at maximum reduction from baseline in target lesions

Step 3:

Annotate dose group values and label on the Y-axis

Development : Creating a Swimmer Plot in 3 steps

Step 1

- Create horizontal bars for treatment duration by dose group and primary tumor type for individual subjects
- A blank line added between each dose group for better visualization
- PROC TEMPLATE: VECTORPLOT and DISCRETELEGEND statements

Snapshot of the data: An additional record is added between each dose group. A new record identifier variable (ID) is added based on the sorting order. The ID variable is used for the Y-axis display.

ID	USUBJID	TRT01P	TRT01PN	PRITRTYP	TRTDURW	SCSTAT	AVALC	ADW	OVLRLRESP	ID
1	001	5.0	7	R	10	54%	12	PD		1
2	002	5.0	7	R	10	54%	12	PD		2
3	004	5.0	7	S	10	97%	12	SD		3
4	004	5.0	7	S	10	97%	22	SD		3
5	006	5.0	7	S	10	29%	12	SD		4
6	006	5.0	7	S	10	29%	16	SD		4
7	007	5.0	7	S	10	54%	11	SD		5
8	400	5.0	7	S	7	50%	9	PD		6
9	405	5.0	7	B	4	70%	-			7
10	008	5.0	7	B	4	56%	-			8
11	-	-	-	-	-	-	-	-	-	9
12	004	1.0	6	R	16	52%	11	PD		10
13	004	1.0	6	R	16	52%	16	PD		10
14	410	1.0	6	S	13	74%	12	PD		11
15	401	1.0	6	S	10	68%	11	PD		12

Variables:

USUBJID - unique subject identification number

TRT01P - planned treatment in text

TRT01PN - planned treatment in numeric

PRITRTYP - primary tumor type

TRTDURW - treatment duration in week

SCSTAT - treatment status with values of blank or "ONGOING"

AVALC - percent change at maximum reduction from baseline in target lesion

ADW - tumor response assessment time from date of first dose in weeks over time

OVLRLRESP - overall tumor response assessment using RECIST over time

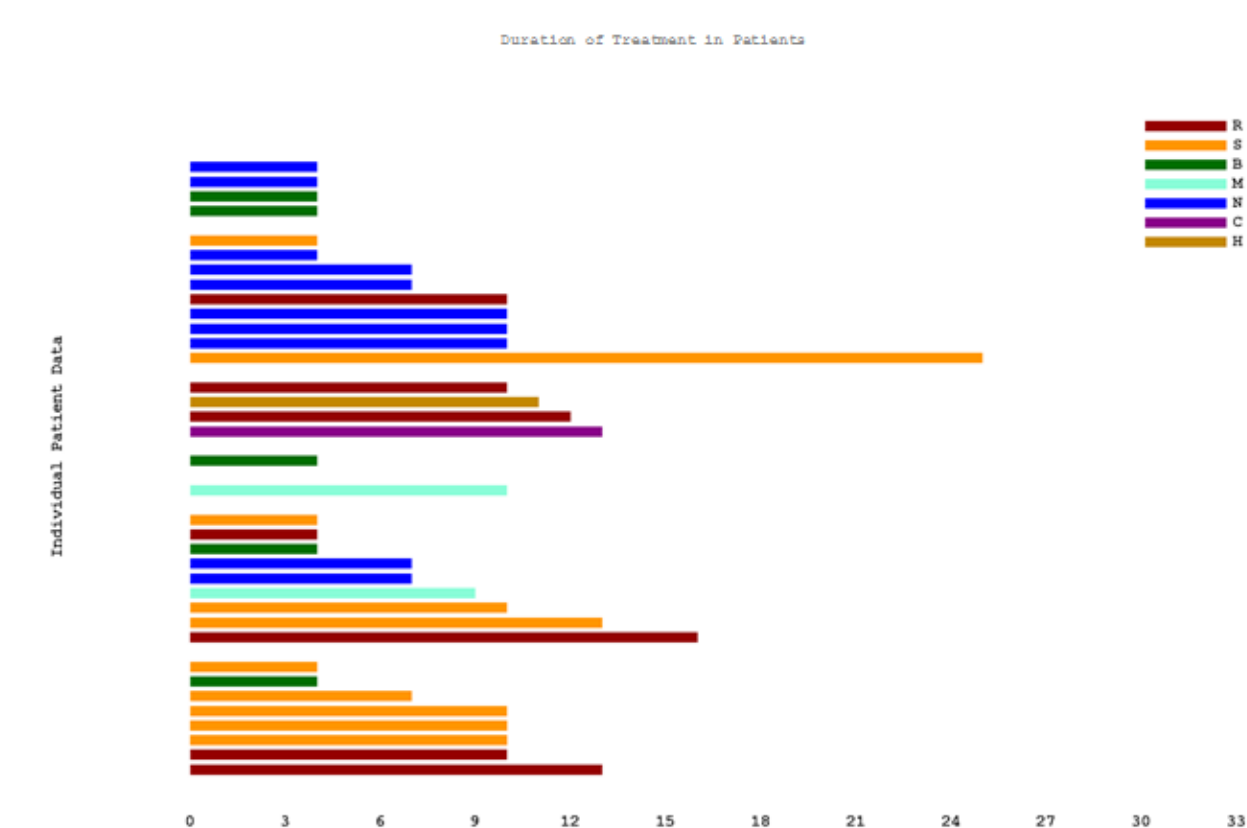
PROC TEMPLATE code:

Horizontal Bars:
VectorPlot X=trtdurw Y=id XOrigin=0 YOrigin=id/
group=prtrttyp Lineattrs=(Pattern=1 Thickness=7px)

ARROWHEADS=FALSE NAME="type";

Legend:

DiscreteLegend "type" / Location=inside
across=1 autoAlign=(topright) Title=" " Border=false
valueattrs=(SIZE=8pt);



Step 2

- Annotate tumor response over time, treatment status, and the percent change at maximum reduction from baseline in target lesions
- PROC TEMPLATE : SCATTERPLOT and DISCRETELEGEND statements

Snapshot of the data with additional derived variables:

ID	USUBJID	TRT01P	TRT01PN	PRITRTYP	TRTDURW	SCSTAT	AVALC	ADW	OVLRLRESP	X1	XE	SD	PD	MAXX	MAXX + 1
1	001	5.0	7	R	10	54%	12	PD		12	13	12	PD	12	13
2	002	5.0	7	R	10	54%	12	PD		12	13	12	PD	12	13
3	004	5.0	7	S	10	97%	12	SD		12	13	12	SD	12	13
4	004	5.0	7	S	10	97%	22	SD		12	13	12	SD	12	13
5	006	5.0	7	S	10	29%	12	SD		12	13	12	SD	12	13
6	006	5.0	7	S	10	29%	16	SD		12	13	12	SD	12	13
7	007	5.0	7	S	10	54%	11	SD		12	13	12	SD	12	13
8	400	5.0	7	S	7	50%	9	PD		12	13	12	PD	12	13
9	405	5.0	7	B	4	70%	-			12	13	12		12	13
10	008	5.0	7	B	4	56%	-			12	13	12		12	13
11	-	-	-	-	-	-	-	-	-	12	13	12	-	12	13
12	004	1.0	6	R	16	52%	11	PD		12	13	12	PD	12	13
13	004	1.0	6	R	16	52%	16	PD		12	13	12	PD	12	13
14	410	1.0	6	S	13	74%	12	PD		12	13	12	PD	12	13
15	401	1.0	6	S	10	68%	11	PD		12	13	12	PD	12	13

Variables:

PD - lesion assessment in week for PD (ADW when OVLRLRESP =PD)

SD - lesion assessment in week for SD (ADW when OVLRLRESP =SD)

MAXX - used for deriving X1 and XE

X1 - annotation for percent change at maximum reduction from baseline (AVALC), derived as MAXX + 0.4 when AVALC is populated

XE - annotation for treatment status (SCSTAT), derived as MAXX + 1 when SCSTAT value is "ONGOING"

Step 2 (continued)

PROC TEMPLATE dynamic programming code to annotate tumor response data with missing values (only PD and SD are available in data):

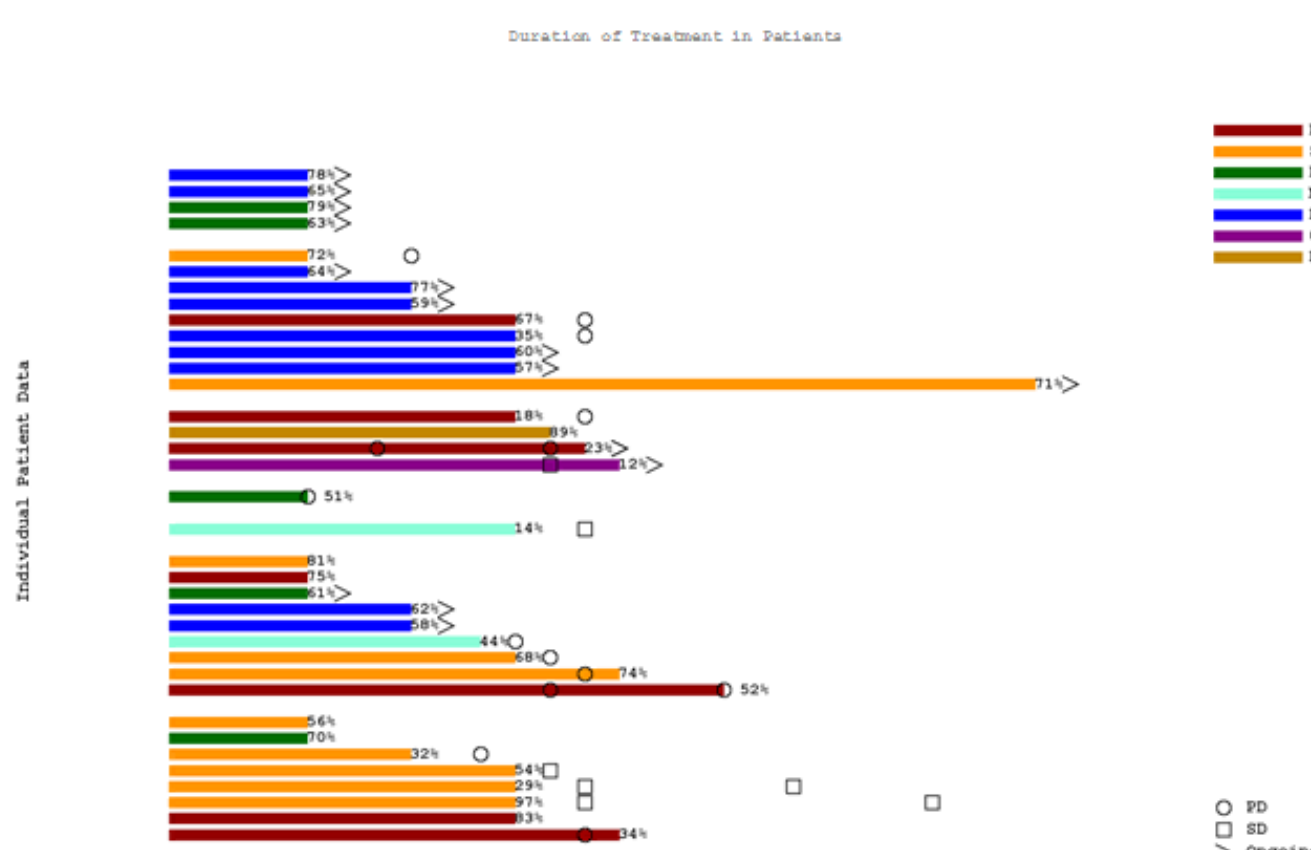
```
%do %while (%scan(&resp,&r) ne );
  %if %scan(&resp,&r)=CR %then %do;
    ScatterPlot X=cr Y=id/Markerattrs
    =(color=black Symbol=diamond Size=9px)
    LegendLabel="CR" NAME="cr";
  %end;
  %if %scan(&resp,&r)=PR %then %do;
    ScatterPlot X=pr Y=id /Markerattrs
    =(color=black Symbol=triangle
    Size=9px) LegendLabel="PR" NAME="pr";
  %end;
```

```
%if %scan(&resp,&r)=SD %then %do;
  ScatterPlot X=sd Y=id /Markerattrs
  =(color=black Symbol=square Size=9px)
  LegendLabel="SD" NAME="sd";
%end;
%if %scan(&resp,&r)=PD %then %do;
  ScatterPlot X=pd Y=id /Markerattrs
  =(color=black Symbol=circle Size=9px)
  LegendLabel="PD" NAME="pd";
%end;
%let r=%eval(&r+1);
%end;
%let r=1;
```

PROC TEMPLATE dynamic programming code to assign legend for response data with missing value:

```
DiscreteLegend
%do %while (%scan(&resp,&r) ne );
  %if %scan(&resp,&r)=CR %then %do;
    "cr"
  %end;
  %if %scan(&resp,&r)=PR %then %do;
    "pr"
  %end;
  %if %scan(&resp,&r)=SD %then %do;
    "sd"
  %end;
```

```
%if %scan(&resp,&r)=PD %then %do;
  "pd"
%end;
%let r=%eval(&r+1);
%end;
/ Location=inside across=1 autoAlign =(bottomright)
Title=" " Border=false valueattrs=(SIZE=8pt);
```



Step 3

- Annotate dose group values and label on the Y-axis
- PROC TEMPLATE : SCATTERPLOT and VECTORPLOT statements

Snapshot of the data with additional derived variables:

ID	USUBJID	TRT01P	TRT01PN	PRITRTYP	TRTDURW	SCSTAT	AVALC	ADW	OVLRLRESP	X1	XE	SD	PD	MAXX	MAXX + 1	YLS1	YLE1	Y1
1	001	5.0	7	R	10	54%	12	PD		12	13	12	PD	12	13	0.005	0.01	0.005
2	002	5.0	7	R	10	54%	12	PD		12	13	12	PD	12	13	0.005	0.01	0.005
3	004	5.0	7	S	10	97%	12	SD		12	13	12	SD	12	13	0.005	0.01	0.005
4	004	5.0	7	S	10	97%	22	SD		12	13	12	SD	12	13	0.005	0.01	0.005
5	006	5.0	7	S	10	29%	12	SD		12	13	12	SD	12	13	0.005	0.01	0.005
6	006	5.0	7	S	10	29%	16	SD		12	13	12	SD	12	13	0.005	0.01	0.005
7	007	5.0	7	S	10	54%	11	SD		12	13	12	SD	12	13	0.005	0.01	0.005
8	400	5.0	7	S	7	50%	9	PD		12	13	12	PD	12	13	0.005	0.01	0.005
9	405	5.0	7	B	4	70%	-			12	13	12		12	13	0.005	0.01	0.005
10	008	5.0	7	B	4	56%	-			12	13	12		12	13	0.005	0.01	0.005
11	-	-	-	-	-	-	-	-	-	12	13	12	-	12	13	0.005	0.01	0.005
12	004	1.0	6	R	16	52%	11	PD		12	13	12	PD	12	13	0.005	0.01	0.005
13	004	1.0	6	R	16	52%	16	PD		12	13	12	PD	12	13	0.005	0.01	0.005
14	410	1.0	6	S	13	74%	12	PD		12	13	12	PD	12	13	0.005	0.01	0.005
15	401	1.0	6	S	10	68%	11	PD		12	13	12	PD	12	13	0.005	0.01	0.005

Variables for annotating the dose group label and values:

TRT2 – "Dosage (mg/kg)"

XPT – X value for the annotation

Variables for drawing a vertical line for each dose group:

_YLS1 – minimum Y value for TRT01PN=1

_YLE1 – maximum Y value for TRT01PN=1

_Y1 – mid-point of the Y value range for TRT01PN=1

Step 3 (continued)

Annotation of top label, Dosage (mg/kg):

ScatterPlot X=xpt Y=id/MarkerCharacter=trt2
MARKERCHARACTERATTRS
= (family='Courier New' size=8pt weight=bold);

Annotation of dose value (e.g. 0.005) at mid-point:

ScatterPlot X=xpt Y=_y1/MarkerCharacter=trt01p
MARKERCHARACTERATTRS = (family='Courier New'
size=8pt weight=bold);

Variables for drawing a short horizontal line at the midpoint (_Y1) of each dose group:

_XLS – maximum X value

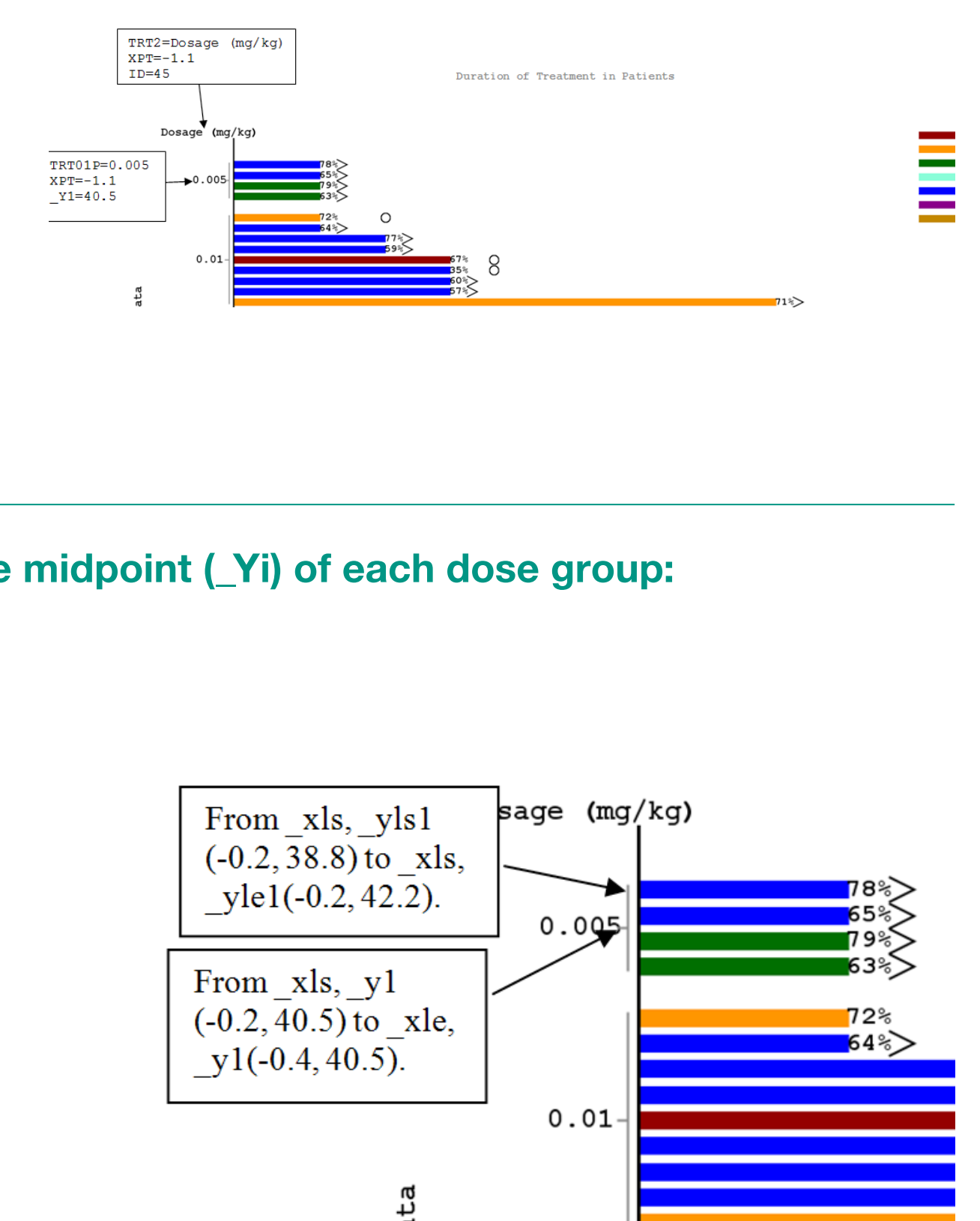
_XLE – minimum X value

Vertical grey line next to the dose value:

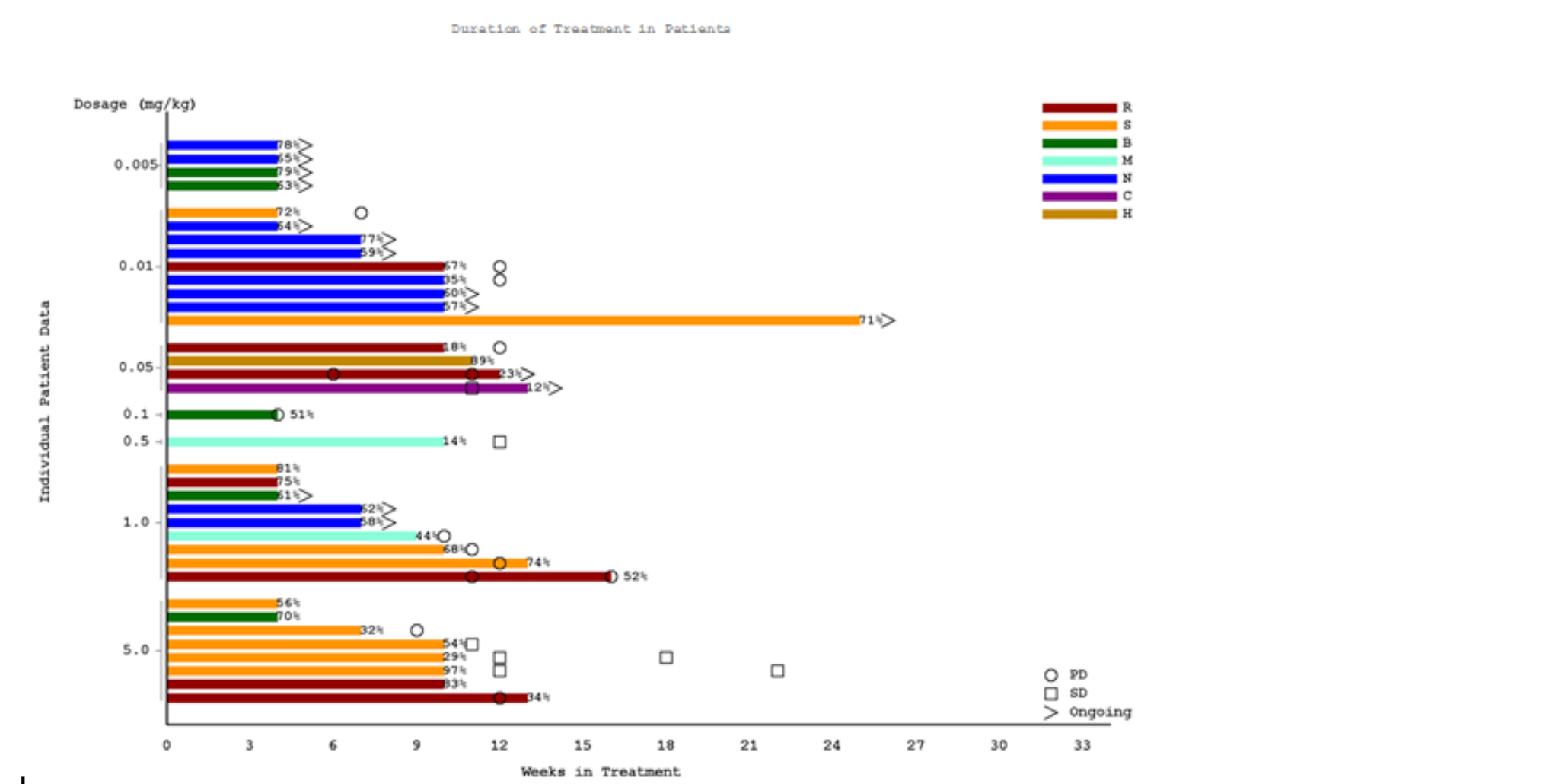
VectorPlot X=_xls Y=_yle1 XOrigin=_xls YOrigin=_yls1
/ Lineattrs=(Color=grey Pattern=1 Thickness=1px)
Arrowheads=false;

Short horizontal grey line next to the dose value:

VectorPlot X=_xle Y=_y1 XOrigin=_xls YOrigin=_y1
/ Lineattrs=(Color=grey Pattern=1 Thickness=1px)
Arrowheads=false;



Final



Conclusion

- A well-prepared data set is an important first step to create a customized swimmer plot using PROC TEMPLATE and PROC SGRENDER.
- SAS GTL is a versatile tool for generating any professional graphic

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