

PROC SGPLOTによるSwimmer Plot – 見やすさを求めて –

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Drawing the Useful and Clear Swimmer Plot Using PROC SGPLOT

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要旨:

本発表では、PROC SGPLOTのannotationを利用した、従来よりも明瞭なswimmer plot作成のSASプログラムを紹介する。

キーワード:

Swimmer Plot, SGPLOT, annotation, Immuno-Oncology Therapy

What is Swimmer Plot ?

Time to Response



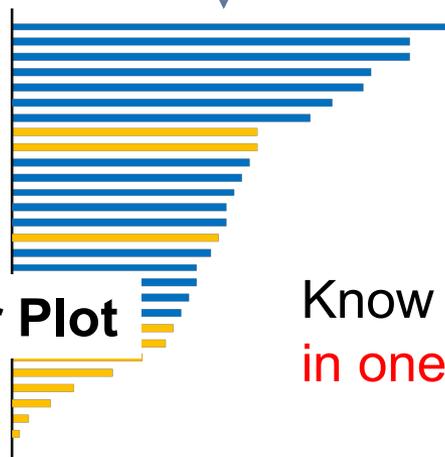
RECIST



Other Information
(e.g. Treatment Group)



Swimmer Plot



Know a subject's response "story"
in one glance

Immuno-Oncology and Swimmer Plot

Late and long-term effects emerge in immuno-oncology therapy in comparison to traditional chemotherapy. (like right figure)

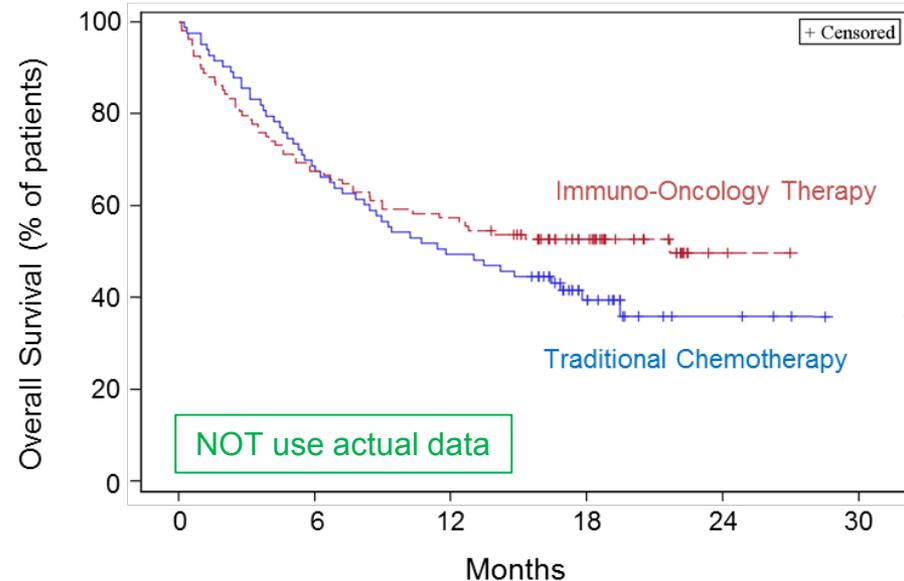


Understanding whether a subject continues the treatment is significant.



Swimmer plots previously reported do **NOT include “treatment ongoing” information** or **NOT so beautiful** even if it is included.

We try to create the ideal plot!



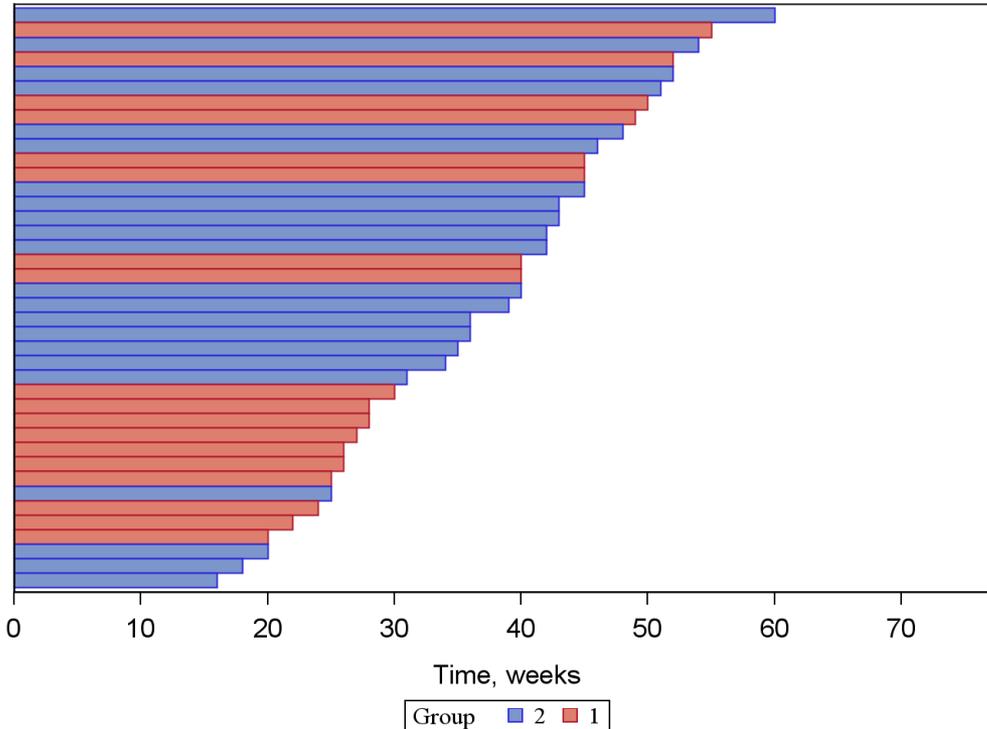
Input Data for Swimmer Plot

USUBJID	GROUP	STARTLINE	ENDLINE	ENDLINE01	ENDLINE02	CR	PR	PD	SD	LASTDOSE	ONGOING
DRUG A-001	1	0	40	40	.	23.1	.	30.2	30	38	.
DRUG A-002	2	0	35	.	35	.	25	.	.	18	.
DRUG A-003	1	0	20	20	.	.	16	.	.	.	20
DRUG A-004	1	0	22	22	.	.	15	.	.	.	22
DRUG A-005	1	0	24	24	.	15.2	.	.	.	20	.

USUBJID	Unique Subject Identifier
GROUP	Treatment Group
STARTLINE	Start time
ENDLINE	End of treatment time for subject
ENDLINE01	End of treatment time for DRUG A High Dose
ENDLINE02	End of treatment time for DRUG A Low Dose
CR	Start time of complete response as best response
PR	Start time of partial response as best response
PD	Start time of progressive disease as best response
SD	Start time of sable disease
LASTDOSE	Last time of Drug A dose
ONGOING	Time of Treatment ongoing



Completely Basic Swimmer Plot



Requirements

- ◆ Treatment ongoing status
- ◆ Group legend with text format
- ◆ RECIST category
- ◆ Last drug dose timing
- ◆ Change colors freely
- ◆ Change symbols freely

Clinicians need beautiful plots!!

```
proc sgplot data = SWIMMER_PLOT;  
  hbar Y_ORDER/group = group response = ENDLINE barwidth = 1 transparency = 0 dataskin = none ;  
  yaxis type = discrete discreteorder = data display = ( nolabel noticks novalues ) ;  
  xaxis type = linear label = "Time, weeks" values = ( 0 to 70 by 10 ) ;  
run ;
```



Plots Customization with Annotations in SGPLOT Procedure

By annotation ...

- Use various symbols
- Use various line patterns
- Adjust colors
- Add texts
- Add images

etc.

Example: annotation data set

FUNCTION	DRAWSPACE	_TYPE	X1	Y1	WIDTH	TEXTCOL
TEXT	WALLPERCENT	SYMBOL	60	40	100	GRAY
TEXT	WALLPERCENT	SYMBOL	60	35	100	GREEN

Example: SG annotation functions

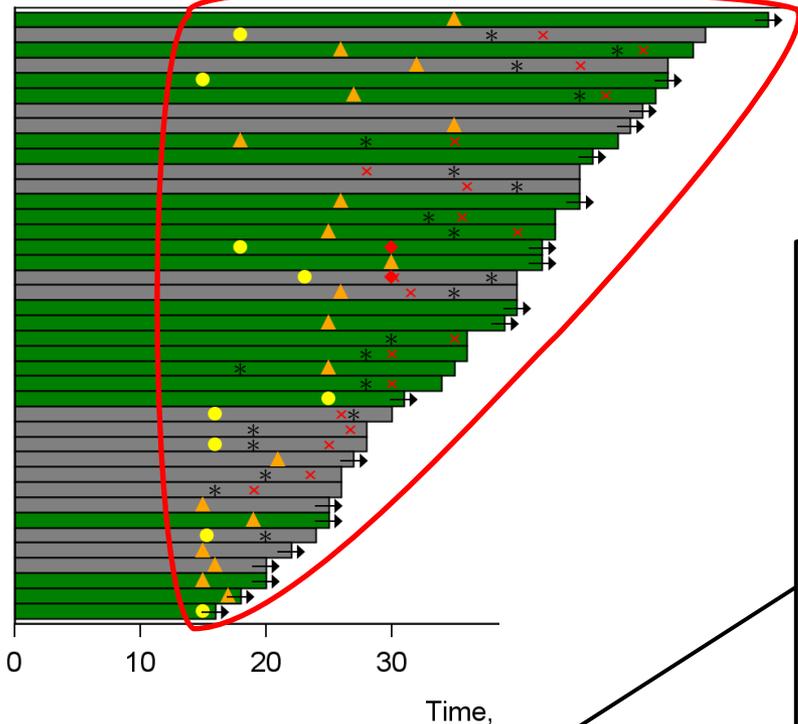
Text	Draw a text on the graph
Textcont	Continue a text string from the text function
Image	Draw an image on the graph
Line	Draw a line on the graph
Arrow	Draw a line with an arrowhead on the graph
Polygon	Draw a polygon on the graph
Polyline	Draw a polyline on the graph
Polycont	Continue a polygon/polyline from the polygon/polyline function

```
proc sgplot data = input_data sganno = anno ;
```

```
⋮
```

```
run ;
```

Annotation Data for Data Symbols



Draw data symbols by annotation data
 Example: Annotation Data Set (SGANNO_SYMBOLS)

FUNCTION	DRAWSPACE	_TYPE	_NO	X1	YC1	WIDTH	ANCHOR	JUSTIFY	TEXTFONT	LABEL	TEXTCOLOR	TEXTSIZE	Y1
TEXT	DATAVALUE	SYMBOL	3	25.0	0000000034	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.
TEXT	DATAVALUE	SYMBOL	3	31.0	0000000038	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.
TEXT	DATAVALUE	SYMBOL	3	45.0	0000000027	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.
TEXT	DATAVALUE	SYMBOL	3	52.0	0000000037	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.
TEXT	DATAVALUE	SYMBOL	3	46.0	0000000023	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.
TEXT	DATAVALUE	SYMBOL	3	40.0	0000000021	100	CENTER	CENTER	Arial/unicode	*(unicode 25CFx)	YELLOW	8	.

TEXT	DATAVALUE	SYMBOL	4	16.0	0000000011	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	23.1	0000000007	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	15.0	0000000033	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	18.0	0000000026	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	16.0	0000000009	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	25.0	0000000038	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	4	18.0	0000000001	100	CENTER	CENTER	Arial/unicode	*(unicode 25B2x)	ORANGE	8	.
TEXT	DATAVALUE	SYMBOL	5	50.0	0000000030	100	CENTER	CENTER	Arial/unicode	*(unicode 25C6x)	RED	8	.
TEXT	DATAVALUE	SYMBOL	5	30.2	0000000007	100	CENTER	CENTER	Arial/unicode	*(unicode 25C6x)	RED	8	.
TEXT	DATAVALUE	SYMBOL	5	23.5	0000000013	100	CENTER	CENTER	Arial/unicode	*(unicode 25C6x)	RED	8	.

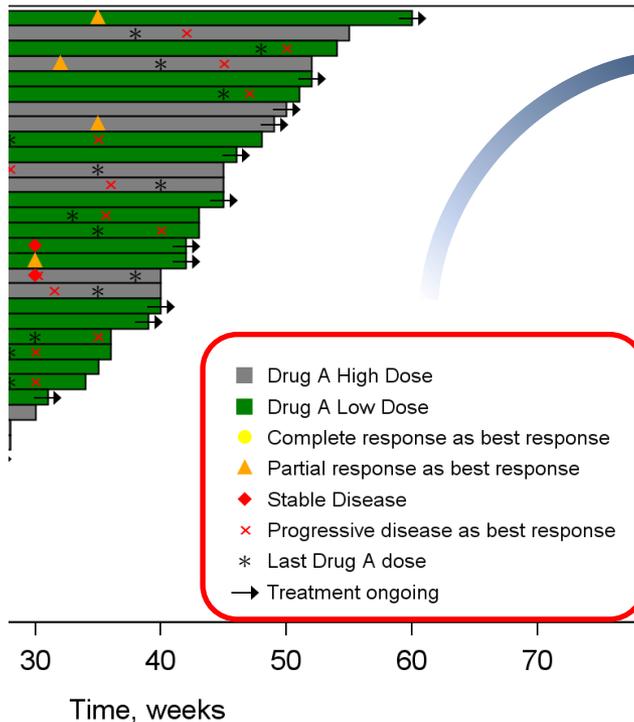
TEXT	DATAVALUE	SYMBOL	6	25.0	0000000004	100	CENTER	CENTER	Arial/unicode	*(unicode 0007x)	RED	10	.
TEXT	DATAVALUE	SYMBOL	6	26.0	0000000027	100	CENTER	CENTER	Arial/unicode	*(unicode 0007x)	RED	10	.
TEXT	DATAVALUE	SYMBOL	7	30.0	0000000026	100	CENTER	CENTER	Arial/unicode	*(unicode FF0Ax)	BLACK	8	.
TEXT	DATAVALUE	SYMBOL	7	30.0	0000000007	100	CENTER	CENTER	Arial/unicode	*(unicode FF0Ax)	BLACK	8	.
TEXT	DATAVALUE	SYMBOL	8	26.0	0000000013	100	CENTER	CENTER	Arial/unicode	*(unicode 279Dx)	BLACK	15	.
TEXT	DATAVALUE	SYMBOL	8	2.0	0000000005	100	CENTER	CENTER	Arial/unicode	*(unicode 279Dx)	BLACK	15	.

Define symbols including ...

- ✓ Treatment ongoing status 
- ✓ RECIST category    
- ✓ Last drug dose timing 

✓ Freely change symbols and colors

Annotation Data for Legend



Draw legend symbols and texts by annotation data
Example: Annotation Data Set (SGANNO_LEGEND)

FUNCTION	DRAWSPACE	_TYPE	_NO	X1	YC1	WIDTH	ANCHOR	JUSTIFY	TEXTFONT	LABEL	TEXTCOLOR	TEXTSIZE	Y1
TEXT	WALLPERCENT	SYMBOL	1	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '25A0'x]	GRAY	10	40
TEXT	WALLPERCENT	SYMBOL	2	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '25A0'x]	GREEN	10	35
TEXT	WALLPERCENT	SYMBOL	3	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '25CF'x]	YELLOW	8	30
TEXT	WALLPERCENT	SYMBOL	4	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '25B2'x]	ORANGE	8	25
TEXT	WALLPERCENT	SYMBOL	5	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '25C6'x]	RED	8	20
TEXT	WALLPERCENT	SYMBOL	6	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '00D7'x]	RED	10	15
TEXT	WALLPERCENT	SYMBOL	7	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode 'FF0A'x]	BLACK	8	10
TEXT	WALLPERCENT	SYMBOL	8	60.0		100	CENTER	CENTER	Arial/unicode	^[unicode '279D'x]	BLACK	15	5
TEXT	WALLPERCENT	LEGEND	1	62.0		100	LEFT	LEFT	Arial	Drug A High Dose	BLACK	9	40
TEXT	WALLPERCENT	LEGEND	2	62.0		100	LEFT	LEFT	Arial	Drug A Low Dose	BLACK	9	35
TEXT	WALLPERCENT	LEGEND	3	62.0		100	LEFT	LEFT	Arial	Complete response as best response	BLACK	9	30
TEXT	WALLPERCENT	LEGEND	4	62.0		100	LEFT	LEFT	Arial	Partial response as best response	BLACK	9	25
TEXT	WALLPERCENT	LEGEND	5	62.0		100	LEFT	LEFT	Arial	Stable Disease	BLACK	9	20
TEXT	WALLPERCENT	LEGEND	6	62.0		100	LEFT	LEFT	Arial	Progressive disease as best response	BLACK	9	15
TEXT	WALLPERCENT	LEGEND	7	62.0		100	LEFT	LEFT	Arial	Last Drug A dose	BLACK	9	10
TEXT	WALLPERCENT	LEGEND	8	62.0		100	LEFT	LEFT	Arial	Treatment ongoing	BLACK	9	5

✓ Freely describe a legend

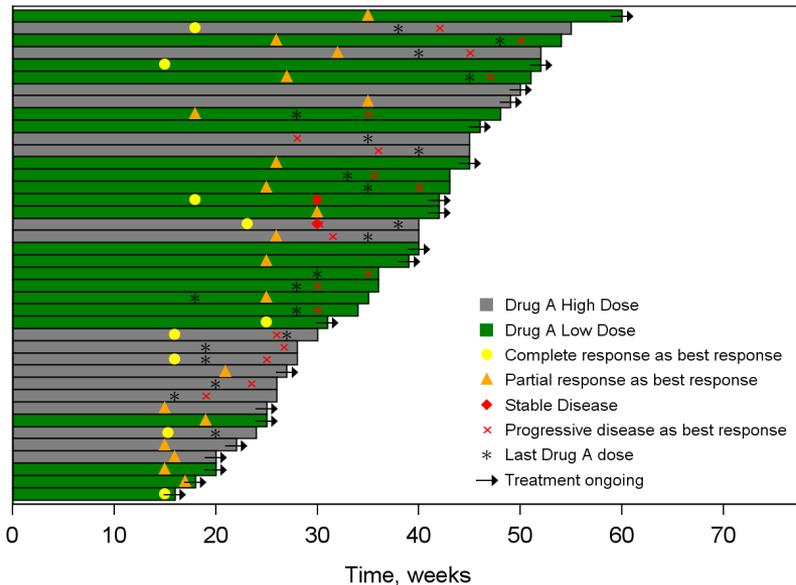
Create annotation data set

```
data SGANNO ;
  set SGANNO_SYMBOL
      SGANNO_LEGEND ;
run ;
```

Set sganno option to SGANNO data set

```
proc sgplot
  data = SWIMMER_PLOT sganno = SGANNO ;
  :
run ;
```

Customized Swimmer Plot with Annotation Data



```
proc sgplot data = SWIMMER_PLOT sganno = SGANNO
noautolegend ;
  hbar Y_ORDER /
    response = ENDLINE01
    barwidth = 1 fillattrs = ( color = gray )
    transparency = 0 dataskin = none ;
  hbar Y_ORDER /
    response = ENDLINE02
    barwidth = 1 fillattrs = ( color = green )
    transparency = 0 dataskin = none ;
yaxis
  type = discrete discreteorder = data
  display = ( nolabel noticks novalues )
  offsetmin = 0.02 offsetmax = 0.02 ;
xaxis
  type = linear label = "Time, weeks"
  labelattrs = (family = "Arial" size = 12)
  values = ( 0 to 70 by 10 )
  valueattrs = ( family = "Arial" size = 12 )
  offsetmin = 0 offsetmax = 0.1 ;
run ;
```

Complete all requirements!!



Brief Instruction for Swimmer Plot Program (Word File)

Brief explanation on the program developed for Swimmer Plot

- **Program Name:**

SwimmerPlotUnicodeSymbol.sas

- **Description**

The program makes swimmer plot with arrow for treatment ongoing mainly for oncology Phase 1 and Phase 2 studies as shown below. SGPLOT from SAS.9.3 is used to create the swimmer plot.

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- **General design**

In order to make the graph looks better, annotation dataset is created for symbols and legend. The annotation data set of SGANNO is consisted from two parts: one is for symbols and the other is for legend. Based on the sample size, some modification is needed on the contents of the data set, which is easily done. Based on the data set, the following two parts in the program need to be modified:

- "TEXTSIZE", "X1" and "Y1" in annotation data set are needed to be adjusted to make the size of symbols and location of legend suitable in the whole figure.
- In the proc sgplot, the values for xaxis are also needed to be adjusted based on the concrete data.



Conclusion and Issue



Conclusion

- We created a clear swimmer plot including necessary information, especially “treatment ongoing” status.

Issue

<Targets of this swimmer plot program>

- 40 - 50 subjects in oncology clinical trials
- Phase 1 or Phase 2 trials



When there are a very large number of subjects, such as global studies with several arms, it's difficult to show all subjects in one plot.



References

- Dan Heath “Now You Can Annotate Your Statistical Graphics Procedure Graphs” *SAS Global Forum 2011*, Paper 277-2011 (2011)
- Stacey D. Phillips “Swimmer Plot: Tell a Graphical Story of Your Time to Response Data Using PROC SGPLOT” *PharmaSUG 2014*, Paper DG07 (2014)
- Nora H. Ruel, Paul H. Frankel “Graphical Results in Clinical Oncology Studies” *SAS Global Forum 2016*, Paper 7520-2016 (2016)