

Swimmer Plots in Clinical Programming Implementation and Visualization Using SAS and R

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ABSTRACT

Swimmer plots are commonly utilized in clinical trials to depict patient timelines, particularly in cancer studies. They provide valuable insights into treatment lengths, clinical responses, progression events, and instances of censoring. This poster illustrates how swimmer plots can be seamlessly incorporated into clinical programming processes using both SAS and R. This poster offers comparative analysis, demonstrating how each software approach addresses data preparation, visualization, and customization. Additionally, the workflow connects swimmer plots with summaries of treatment effects such as hazard ratios and emphasizing how individual patient visualizations enhance aggregated results. By analyzing code structures, visual outputs, and practical aspects, we seek to provide programmers with versatile solutions for creating submission-ready outputs in SAS and dynamic, interactive graphics in R. This leads to a cohesive and informative visual approach that ranges from individual patient timelines to overall treatment impacts, aiding in data assessment, communication with regulators, and clinical narratives.

INTRODUCTION

Visualization of subject-level treatment response is critical for understanding treatment effects in clinical trials, particularly in oncology. Swimmer plots provide an intuitive way to represent individual patient journeys over time, supporting programming review. This paper focuses on swimmer plot generation using SAS (PROC SGPLOT) and R (ggplot2), with emphasis on reproducibility, clarity, and regulatory usability.

WHY SWIMMER PLOTS?

- To Visualize individual subject treatment response over time.
- Commonly used in oncology trials to display subject-level treatment timelines.
- Shows whether, when, and for how long a subject responded to treatment.
- Simultaneously depicts treatment duration, response patterns, progression, and censoring.
- Reveals subject-level insights that are not evident from aggregate efficacy summaries.

END-TO-END WORKFLOW

The swimmer plot workflow follows a structured process:

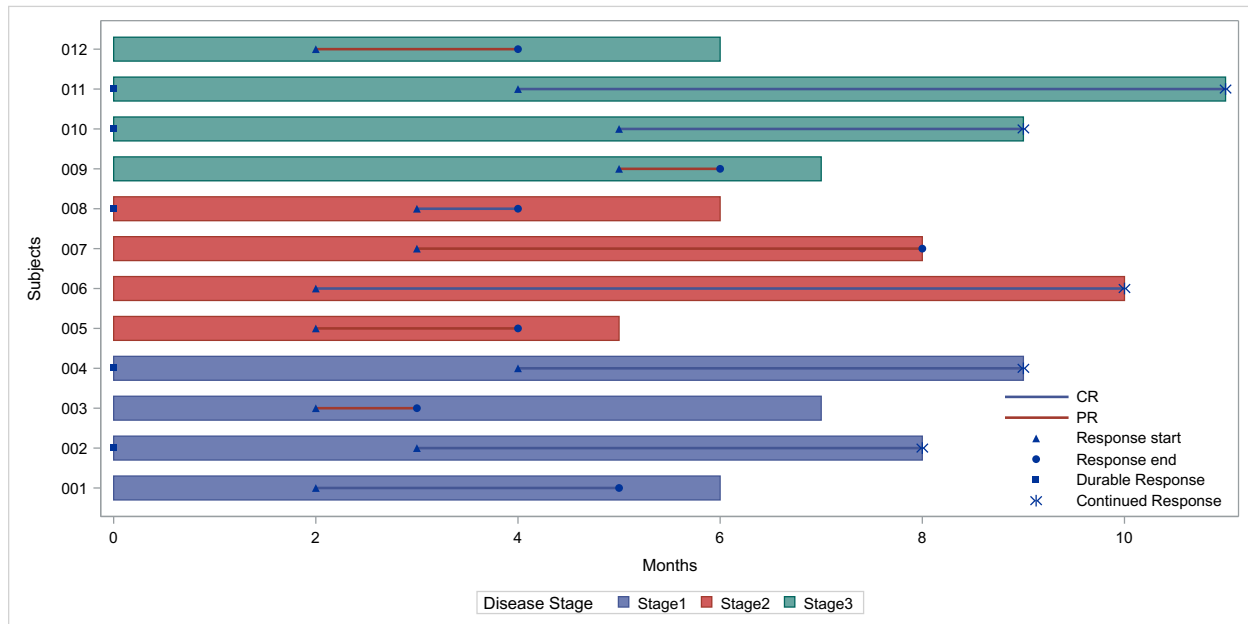
ADaM Data → Data Preparation → Swimmer Plot Generation (SAS / R) → Programming Review & Interpretation.

DATA DESIGN AND STRUCTURE

Swimmer plot construction relies on standardized, subject-level input data. One record per subject is typically used, with treatment start and end times defining the base timeline. Response start and response end variables capture response duration, while derived flags indicate durable and continued responses. Disease stage or treatment group is commonly represented as a categorical variable to support visual grouping.

SWIMMER PLOT COMPARISON

SAS IMPLEMENTATION (PROC SGPLOT)



```
proc sgplot data=swimmer;
/*-----
    Treatment duration (main swimmer bar)
    -----*/
highlow y=usubjid
    low=trt_start
    high=trt_end
    / name="stage" type=bar
    group=stage
    barwidth=0.6;
/*-----
    Response duration (overlay line)
    -----*/
highlow y=usubjid
    low=resp_start
    high=response_end_plot
    / name="response" type=line
    group=resp_type
    lineattrs=(thickness=2);
```

```

/*-----
    Response start marker
    -----*/
scatter y=usubjid x=resp_start
        / markerattrs=(symbol=trianglefilled
                        size=8)

        name="respstart"
        legendlabel="Response start";

/*-----
    Response end marker
    -----*/
scatter y=usubjid x=resp_end
        / markerattrs=(symbol=circlefilled
                        size=8)

        name="respond"
        legendlabel="Response end";

/*-----
    Durable responder marker
    -----*/
scatter y=usubjid x=durable_x
        / markerattrs=(symbol=squarefilled
                        size=8)

        name="durable"
        legendlabel="Durable Response";

/*-----
    Continued Response marker
    -----*/
scatter y=usubjid x=arrow_xend
        / markerattrs=(symbol=asterisk
                        size=10 )

        name="continued"
        legendlabel="Continued Response" ;

```

```

/*-----
  Axes
-----*/

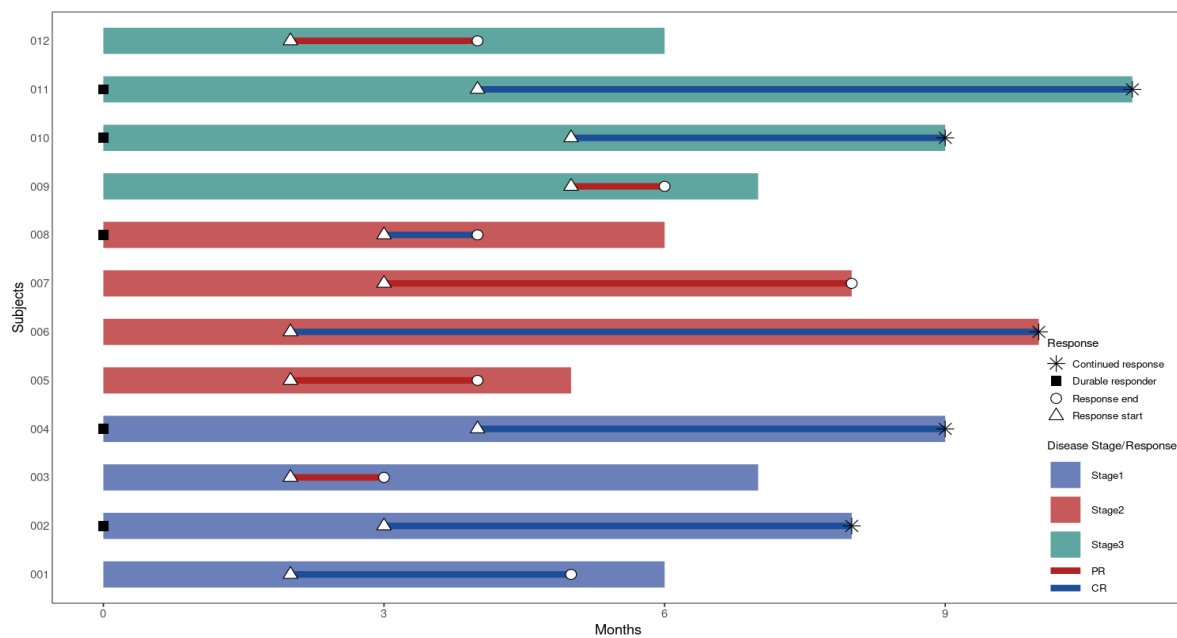
axis label="Months";
axis label="Subjects"
discreteorder=data;

keylegend "stage" / border
location=outside
position=bottom across=5
title="Disease Stage";
keylegend "response" "respstart"
  "respond" "durable" "continued"
  / noborder location=inside
  position=bottomright
  across=1;

run;

```

R IMPLEMENTATION (GGPLOT2)



```

# Treatment duration (main swimmer bar)
ggplot(df, aes(y = usubjid)) +
  geom_segment(
    aes(x = trt_start,
        xend = trt_end,
        yend = usubjid,
        color = stage),
    linewidth = 10,
    lineend = "butt"
  ) +

```

```

# Response duration
geom_segment(
  aes(x = resp_start,
      xend = response_end_plot,
      yend = usubjid,
      color = resp_type),
  linewidth = 2.5
) +
# Response start
geom_point(
  aes(x = resp_start,
      shape = "Response start"),
  size = 3.5, fill = "white"
) +
# Response end (ONLY if not continued)
geom_point(
  data = df[df$continued == 0, ],
  aes(x = resp_end, shape = "Response end"),
  size = 3.5, fill = "white"
) +
# Durable responder
geom_point(
  data = df[df$durable == 1, ],
  aes(x = trt_start,
      shape = "Durable responder"),
  size = 3.5, color = "black"
) +
# Continued response (asterisk)
geom_point(
  data = df[df$continued == 1, ],
  aes(x = trt_end, shape = "Continued response"),
  size = 4, color = "black"
) +
# Legend and Axes
scale_color_manual(
  values = c(stage_cols, resp_cols),
  breaks = c("Stage1", "Stage2", "Stage3",
             "PR", "CR"),
  name = "Disease Stage/Response"
) +
scale_shape_manual(
  values = c(
    "Continued response" = 8,
    "Durable responder"  = 15,
    "Response end"       = 21,
    "Response start"     = 24
  ),
  name = "Response"
) +
labs(
  x = "Months",
  y = "Subjects"
) +

theme(
  # Remove grids
  panel.grid.major = element_blank(),
  panel.grid.minor = element_blank(),

```

```

# White background
panel.background = element_rect(fill = "white", color = NA),
plot.background = element_rect(fill = "white", color = NA),

# Axes & border
axis.line.y = element_blank(),
axis.ticks.y = element_blank(),
panel.border = element_rect(color = "black", fill = NA),

# Legend position
legend.position = c(1, 0),
legend.justification = c(1, 0),
legend.background = element_blank(),
legend.key = element_blank(),
legend.title = element_text(size = 9),
legend.text = element_text(size = 8),
legend.key.size = unit(0.5, "cm"),
legend.spacing.x = unit(0.1, "cm"),
legend.spacing.y = unit(0.05, "cm")
)

```

SAS VS R: PROS AND CONS

SAS produces highly standardized, submission-ready swimmer plots using PROC SGPLOT, where treatment duration, response timing, durability, and continued response are derived in the dataset and directly mapped to plot statements. Attribute maps make it easy to maintain consistent color coding for disease stages across outputs, and legends are straightforward to control, which supports reproducibility and regulatory consistency. However, advanced visual customization—such as extending bars with arrows or complex annotations—often requires additional GTL templates and more coding effort. R generates the same swimmer plot using ggplot2 with a flexible, data-driven approach, allowing responses to be layered, filtered, and modified directly within the plotting step. The availability of multiple visualization packages and optional interactivity supports exploratory analysis and rapid iteration, but as plots become more complex, careful legend and layout management is required to maintain standardized outputs.

CONCLUSION

Both SAS and R generate equivalent subject-level swimmer plots when built on standardized input data. SAS is well suited for creating consistent, submission-ready visualizations with controlled formatting and validated outputs, while R offers greater flexibility for customization, rapid iteration, and exploratory visualization. Swimmer plots complement aggregate efficacy measures by visually linking individual treatment duration, response timing, durability, and ongoing benefit, helping translate overall treatment effects into clear subject-level insights.

CONTACT INFORMATION

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