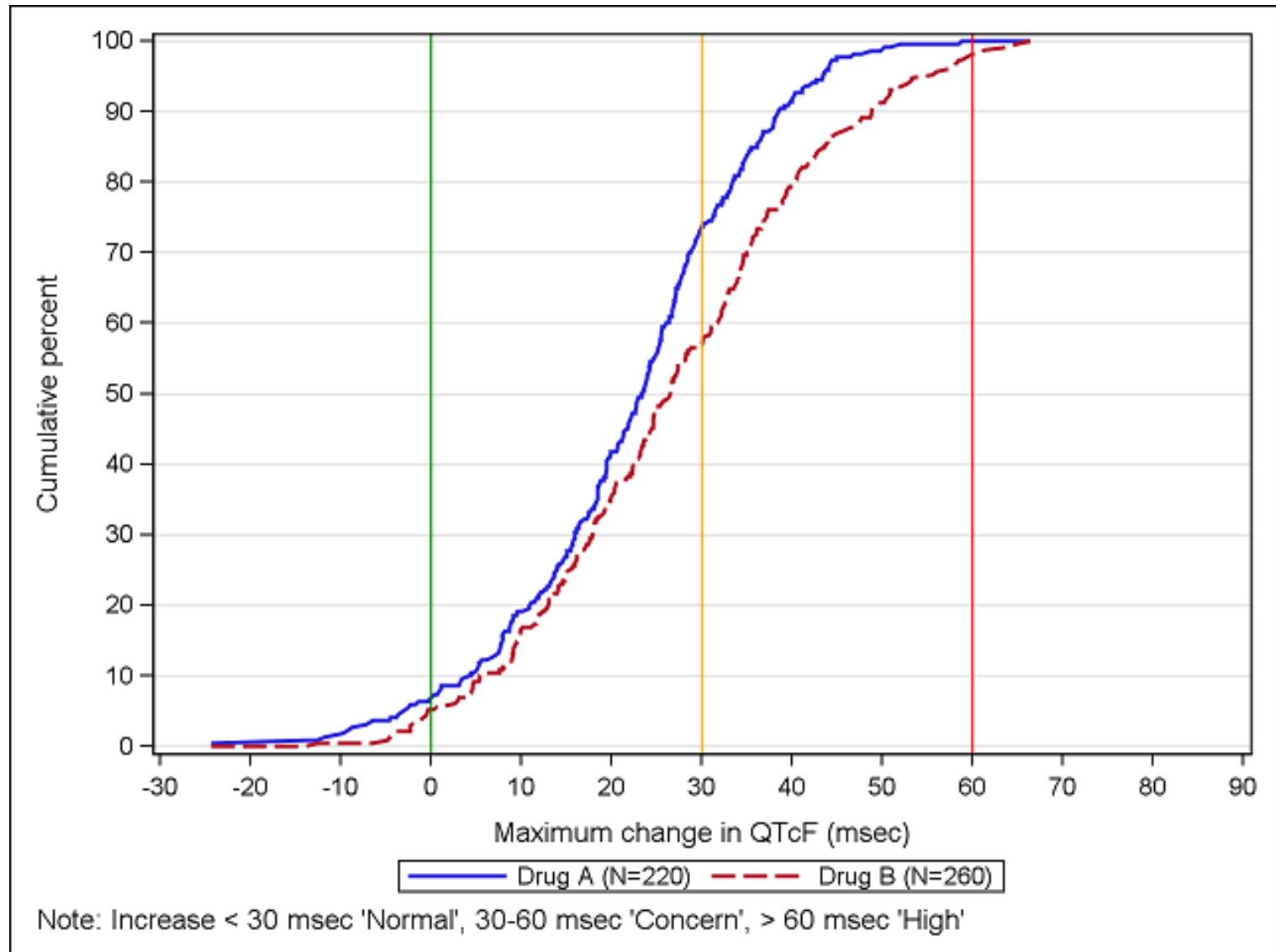


Data Visualisation Using SAS – Beyond Just Summary Tables

Dhaval Mehta

TCS

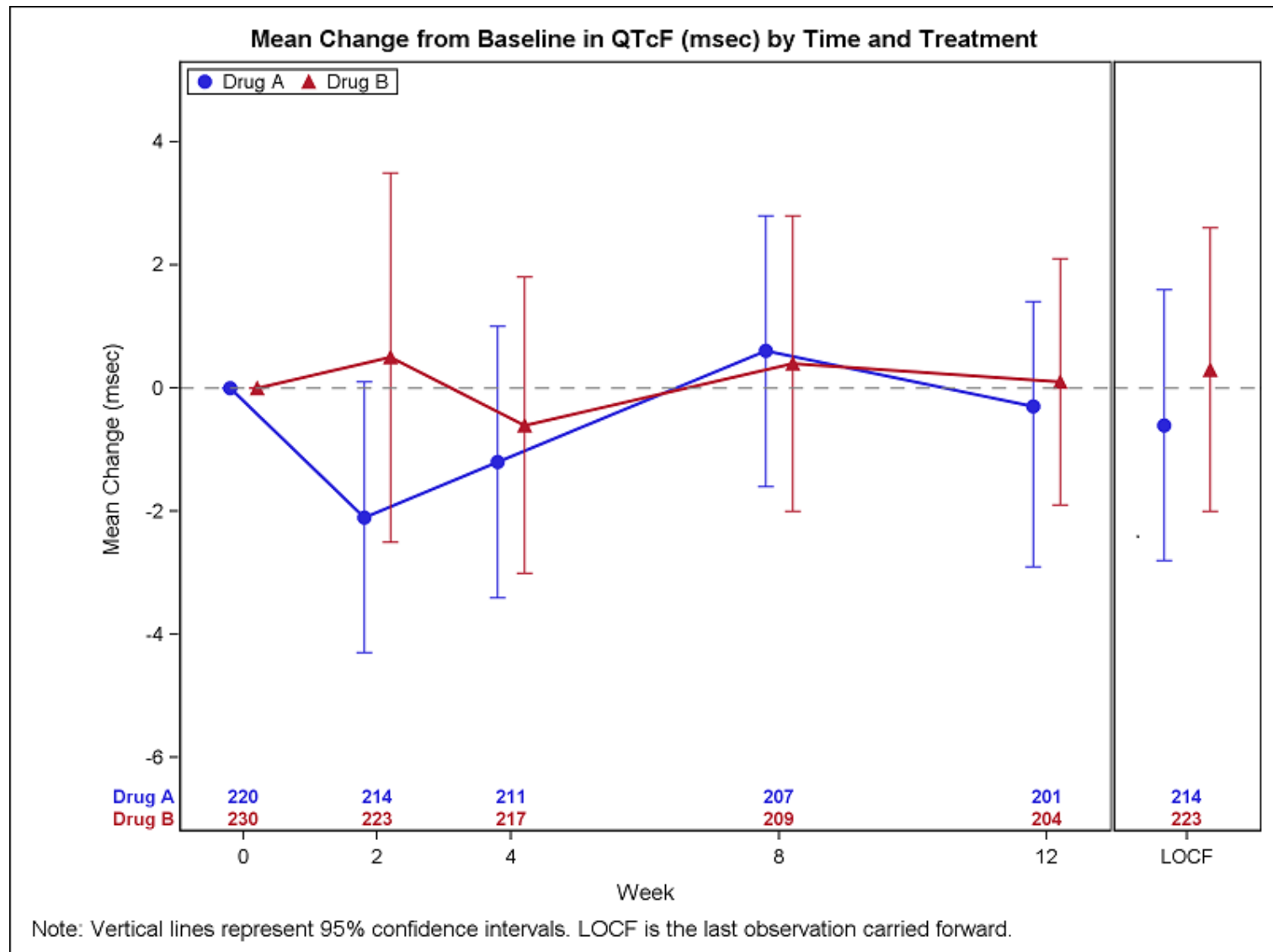
ECG Monitoring : Graph 1



Code

```
footnote j=left "Note: Increase < 30 msec 'Normal', 30-60 msec 'Concern', > 60 msec  
  'High' ";  
proc sgplot data=qtc2;  
  series x=qtc y=cpa / legendlabel='Drug A (N=220)' lineattrs=(thickness=2);  
  series x=qtc y=cpb / legendlabel='Drug B (N=260)' lineattrs=(thickness=2);  
  keylegend / location=outside position=bottomcenter across=2;  
  xaxis values=(-30 to 90 by 10);  
  yaxis grid values=(0 to 100 by 10);  
  refline 0 / axis=X lineattrs=(pattern=solid color=green);  
  refline 30 / axis=X lineattrs=(pattern=solid color=orange);  
  refline 60 / axis=X lineattrs=(pattern=solid color=red);  
run;  
quit;
```

ECG Monitoring : Graph 2



Code

```
proc template;
  define statgraph safety3;
    begingraph / designwidth=8in designheight=6in;
      entrytitle 'Mean Change from Baseline in QTcF (msec) by Time and
      Treatment';
      layout lattice / columns=2 columnweights=(0.87 0.13)
      rowdatarange=union;
      rowaxes;
        rowaxis / label='Mean Change (msec)' offsetmax=0.1
        linearopts=(viewmin=-6 viewmax=4);
      endrowaxes;
      layout overlay / xaxisopts=(label='Week' linearopts=(tickvaluelist=(0 2 4 8
      12)
        tickdisplaylist=('0' '2' '4' '8' '12'))))
        yaxisopts=(label='Mean Change (msec)' offsetmax=0.1
        linearopts=(viewmin=-6 viewmax=4));
      seriesplot x=eval(week-0.2) y=AMean / /*discreteoffset= -0.1*/
      lineattrs=graphdata1(thickness=2);
```

Code

```
scatterplot x=eval(week-0.2) y=AMean / YErrorLower=ALow
            YErrorUpper=Ahigh
            markerattrs=graphdata1(symbol=circlefilled size=9)
            errorbarattrs=graphdata1
            name='a' legendlabel='Drug A';
seriesplot x=eval(week+0.2) y=BMean / lineattrs=graphdata2(pattern=solid
            thickness=2);
scatterplot x=eval(week+0.2) y=BMean / YErrorLower=BLow
            YErrorUpper=BHigh /
            markerattrs=graphdata2(symbol=trianglefilled size=9)
            errorbarattrs=graphdata2(pattern=solid)
            name='b' legendlabel='Drug B';
referenceline y=0 / lineattrs=(pattern=dash);
discretelegend 'a' 'b' / location=inside halign=left valign=top;
innermargin;
```

Code

```
blockplot x=week block=BN / display=(label values) valuehalign=start
         repeatedvalues=true filltype=Alternate labelattrs=graphdata2
         valueattrs=graphdatatext(color=graphdata2:contrastcolor size=8
weight=bold)
         labelattrs=graphvaluetext(color=graphdata2:contrastcolor size=8
weight=bold);
blockplot x=week block=AN / display=(label values) valuehalign=start
         repeatedvalues=true filltype=Alternate labelattrs=graphdata1
         valueattrs=graphdatatext(color=graphdata1:contrastcolor size=8
weight=bold)
         labelattrs=graphvaluetext(color=graphdata1:contrastcolor size=8
weight=bold);
endinnermargin;
endlayout;
layout overlay / yaxisopts=(linearopts=(viewmin=-6 viewmax=4) label='Mean
Change (msec)')
```

Code

```
xaxisopts=(linearopts=(tickvaluelist=(99) tickdisplaylist=('LOCF')) display=(line
    ticks tickvalues));
seriesplot x=eval(week2-1) y=AMean2 /lineattrs=graphdata1(thickness=2);
scatterplot x=eval(week2-1) y=AMean2 / YErrorLower=ALow2
    YErrorUpper=AHigh2 markerattrs=graphdata1(symbol=circlefilled size=15)
    errorbarattrs=graphdata1;
seriesplot x=eval(week2+1) y=BMean2 / lineattrs=graphdata2(pattern=solid
    thickness=2);
scatterplot x=eval(week2+1) y=BMean2 / YErrorLower=BLow2
    YErrorUpper=BHigh2
    markerattrs=graphdata2(symbol=trianglefilled size=15)
    errorbarattrs=graphdata2(pattern=solid);
referenceline y=0 / lineattrs=(pattern=dash);
innermargin;
```

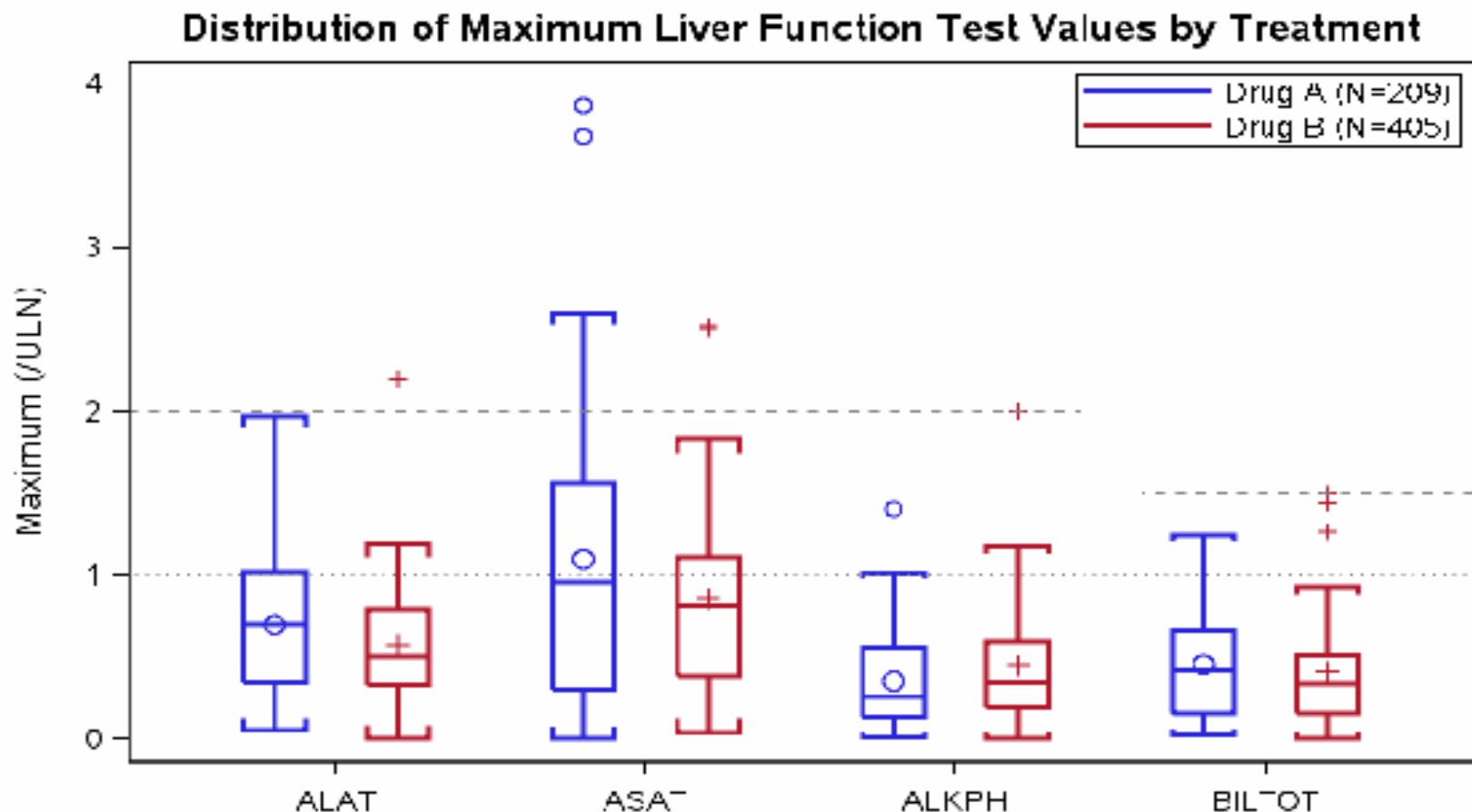
Code

```
blockplot x=week2 block=BN2 / display=( values) valuehalign=start
    repeatedvalues=true filltype=Alternate labelattrs=graphdata2
    valueattrs=graphdatatext(color=graphdata2:contrastcolor size=8
weight=bold)
    labelattrs=graphvaluetext(color=graphdata2:contrastcolor size=8
weight=bold);
blockplot x=week2 block=AN2 / display=( values) valuehalign=start
    repeatedvalues=true filltype=Alternate labelattrs=graphdata1
    valueattrs=graphdatatext(color=graphdata1:contrastcolor size=8
weight=bold)
    labelattrs=graphvaluetext(color=graphdata1:contrastcolor size=8
weight=bold);
endinnermargin;
endlayout;
endlayout;
```

Code

```
entryfootnote halign=left "Note: Vertical lines represent 95% confidence  
    intervals. LOCF is the last observation carried forward." ;  
endgraph;  
end;  
run;  
  
goption reset= all device=SASEMF target=SASEMF;  
  
proc sgrender data = qtcmean template = safety3;  
run;
```

Lab Results Monitoring : Graph 3



For ALAT, ASAT and ALKPH, the Clinical Concern Level is 2 ULN;

For BILTOT, the CCL is 1.5 ULN: where ULN is the Upper Level of Normal Range

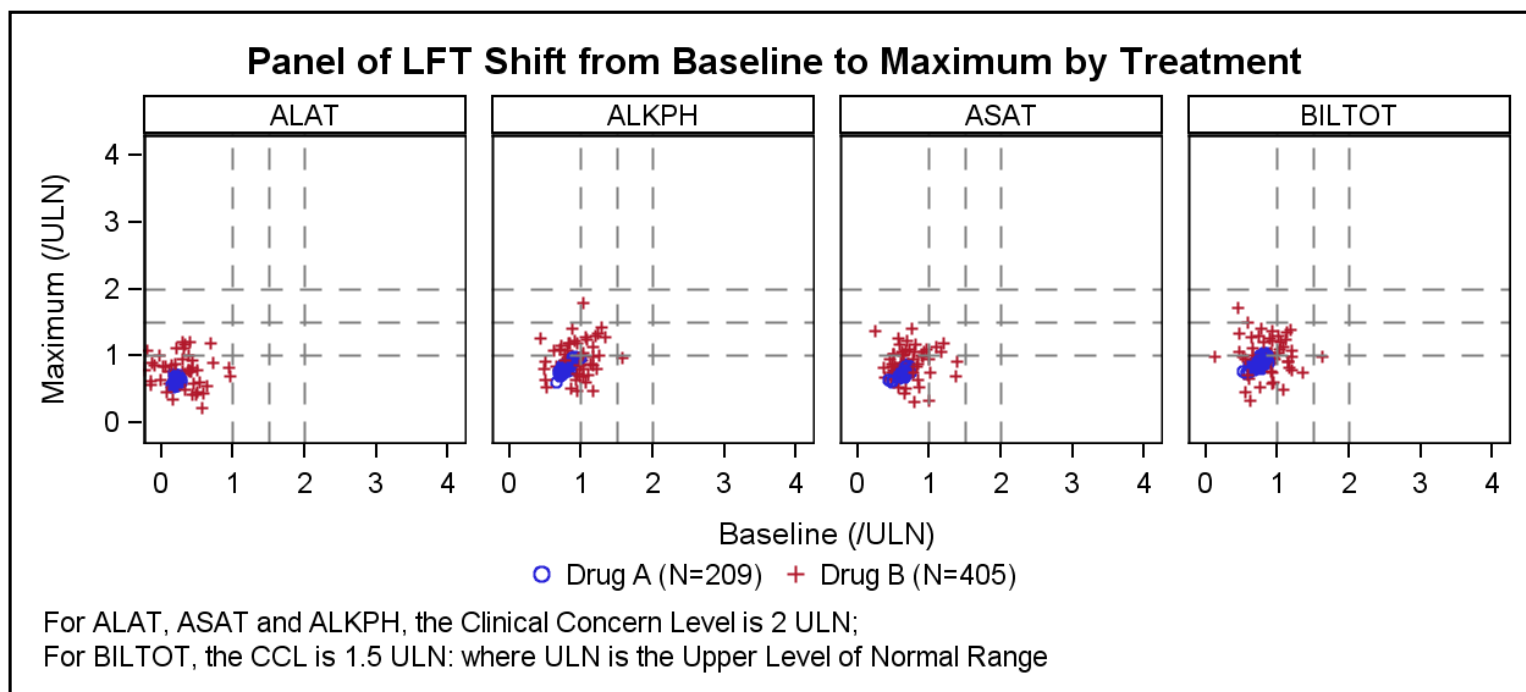
Code

```
layout overlay / yaxisopts=(linearopts=(viewmin=0 viewmax=4)
    label='Maximum (/ULN)')
y2axisopts=(linearopts=(viewmin=0 viewmax=4) display=(ticks))
xaxisopts=(display=(line ticks tickvalues));
boxplot x=Test y=A / display=(mean median outliers caps)
capshape=bracket discreteoffset=-0.2 boxwidth=.2 name='a'
legendlabel='Drug A (N=209)'
outlineattrs=graphdata1(thickness=2) outlierattrs=graphdata1
meanattrs=graphdata1
medianattrs=graphdata1(thickness=2) whiskerattrs=graphdata1
whiskerattrs=graphdata1(thickness=2);
```

Code

```
boxplot x=Test y=B / display=(mean median outliers caps)
    capshape=bracket yaxis=y2
    discreteoffset=0.2 boxwidth=.2 name='b' legendlabel='Drug B (N=405)'
    outlineattrs=graphdata2(pattern=solid thickness=2)
    outlierattrs=graphdata2 meanattrs=graphdata2
    medianattrs=graphdata2(pattern=solid thickness=2)
    whiskerattrs=graphdata2(pattern=solid thickness=2);
    referenceline y=1 / lineattrs=(pattern=dot);
    dropline x='BILTOT' y=1.5 / dropto=Y yaxis=y2 discreteoffset=-.4
    lineattrs=(pattern=shortdash);
    dropline x='ALKPH' y=2.0 / dropto=Y yaxis=y discreteoffset=.4
        lineattrs=(pattern=shortdash);
    discretelegend 'a' 'b' / location=inside valign=top halign=right
across=1;
    endlayout;
```

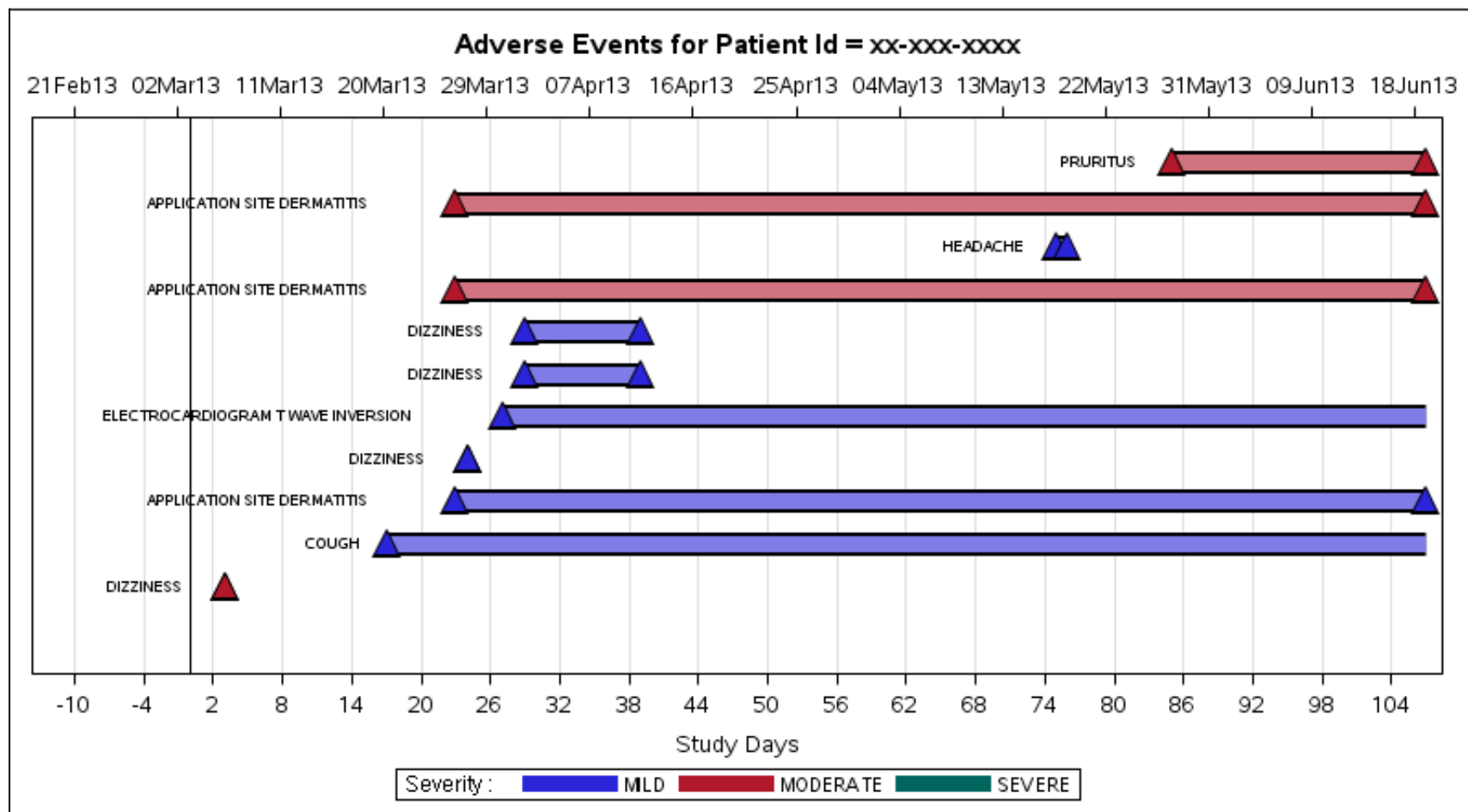
Lab Results Monitoring : Graph 4



Code

```
footnote1 j=l "For ALAT, ASAT and ALKPH, the Clinical Concern Level is 2
ULN;";
footnote2 j=l "For BILTOT, the CCL is 1.5 ULN: where ULN is the Upper Level
of Normal Range";
proc sgpanel data=Safety6;
    panelby group / layout=panel columns=4 spacing=10 novarname; scatter
    x=pl y=sl / group=drug;
    refline 1 1.5 2 / axis=Y lineattrs=(pattern=dash);
    refline 1 1.5 2 / axis=X lineattrs=(pattern=dash);
    rowaxis integer min=0 max=4; colaxis integer min=0 max=4; keylegend /
    title="" noborder;
run;
```

AE Monitoring : Graph 5



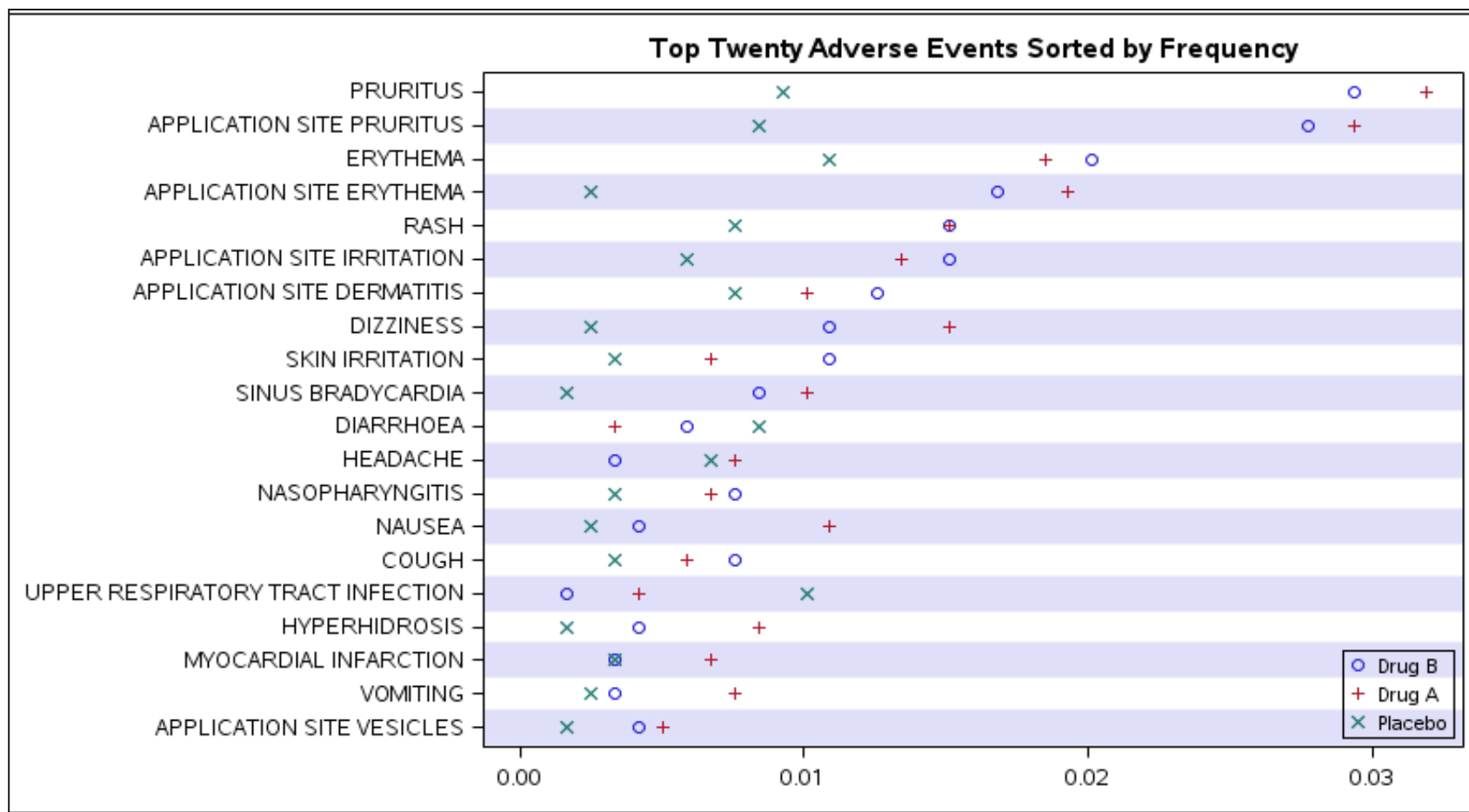
Code

```
title "Adverse Events for Patient Id = xx-xxx-xxxx";
proc sgplot data=ae noautolegend nocycleattrs;
    refline 0 / axis=x lineattrs=(thickness=1 color=black);
    vector x=xs y=ys / xorigin=-110 yorigin = -110 group=aesev /*--Used to populate
the Legend--*/
    lineattrs=(thickness=9px pattern=solid) name='sev';
    vector x=lastday y=y / xorigin=aestdy yorigin=y noarrowheads /*--Used to draw
the black borders--*/
    lineattrs=(thickness=13px pattern=solid color=black) group=aesev;
    vector x=lastday y=y / xorigin=aestdy yorigin=y noarrowheads /*--Used to clear
the inner region--*/
    lineattrs=(thickness=9px pattern=solid color=white) group=aesev;
    vector x=lastday y=y / xorigin=aestdy yorigin=y noarrowheads /*--Used to draw
the event interval--*/
    lineattrs=(thickness=9px pattern=solid) transparency=0.4 group=aesev;
    scatter x=aestdy y=y / markerattrs=graphdatadefault(size=15px
symbol=trianglefilled color=black);
```

Code

```
scatter x=aestdy y=y / markerattrs=(size=11px symbol=trianglefilled)
group=aesev;
scatter x=aeendy y=y / markerattrs=graphdatadefault(size=15px
symbol=trianglefilled color=black);
scatter x=aeendy y=y / markerattrs=(size=11px symbol=trianglefilled)
group=aesev;
scatter x=xc y=y / markerchar=aedecod markercharattrs=(size=6);
scatter x=aestdate y=y / markerattrs=(size=0) x2axis; yaxis
display=(nolabel noticks novalues) min=0;
xaxis grid label='Study Days' offsetmin=0.03 offsetmax=0.02
values=(&minday2 to &maxday by 2);
x2axis notimesplit display=(nolabel) tickvalueformat=date7.
offsetmin=0.03 offsetmax=0.02
values=(&mindate2 to &maxdate);
keylegend 'sev' / title='Severity :';
run;
```

AE Monitoring : Graph 6



Code

```
/*--Render the graph--*/
```

```
title 'Top Twenty Adverse Events Sorted by Frequency';
```

```
proc sgplot data=aerev;
```

```
  reframe reframe / lineattrs=graphdata1(thickness=20) transparency=0.85;
```

```
  scatter y=aedecod x=percent / group=arm name='scatter';
```

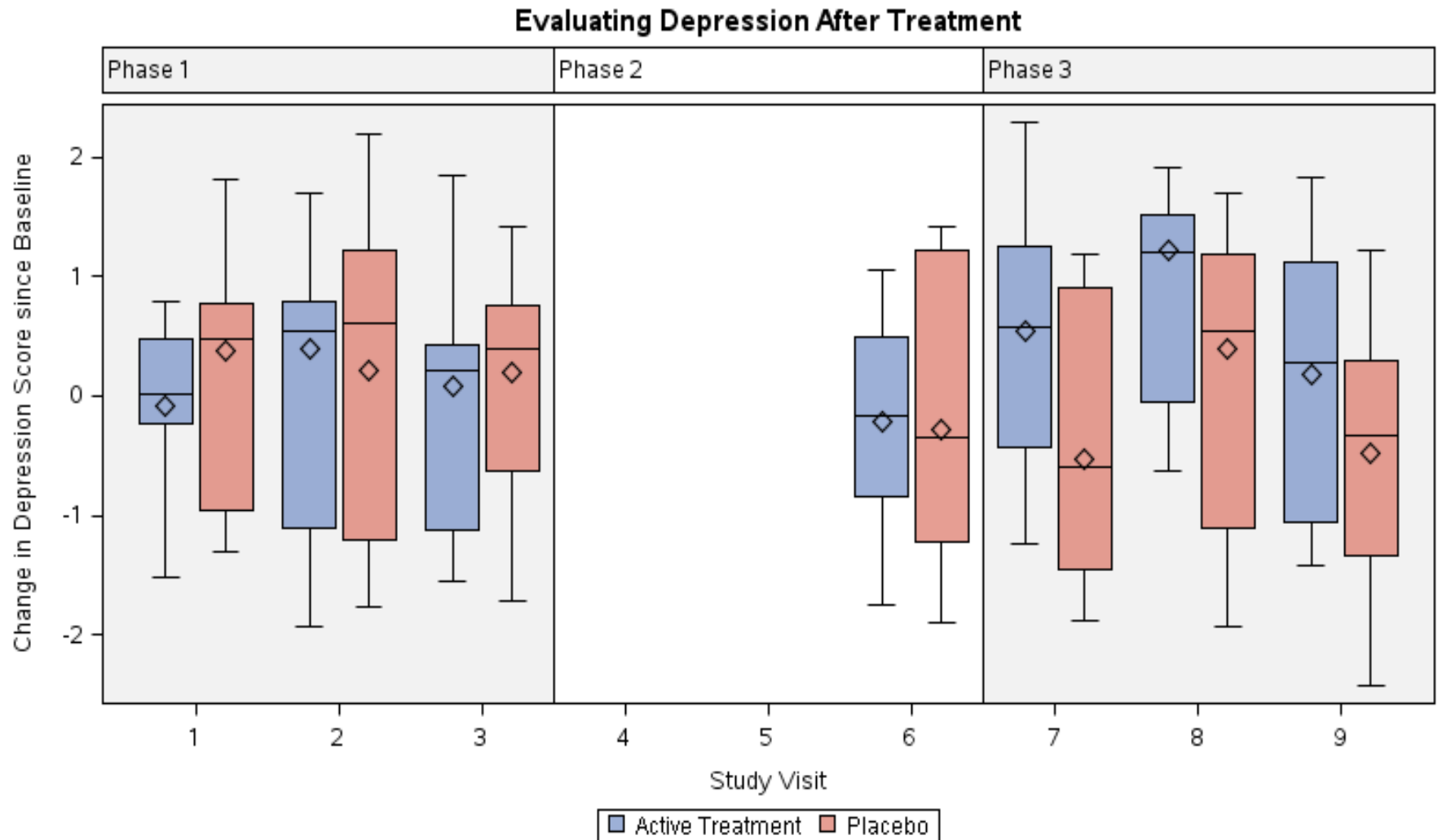
```
  keylegend / location=inside position=bottomright across=1;
```

```
  xaxis display=(nolabel);
```

```
  yaxis display=(nolabel) offsetmin=0.03 offsetmax=0.03;
```

```
run;
```

Monitoring Efficacy Scores : Graph 7



Code

```
data depress;
    set depress;
    if visit in ("1", "2", "3") then phase="Phase 1";
    else if visit in ("4", "5", "6") then phase="Phase 2";
    else if visit in ("7", "8", "9") then phase="Phase 3";

run;

proc template;
    define statgraph change;
        begingraph / designwidth=7in designheight=4.5in;
        layout lattice / columns=1 rowgutter=5 rowweights=(0.06 0.94);
    entrytitle "Evaluating Depression After Treatment";
    cell;

        blockplot x=visit block=phase /
        display=(outline fill values) filltype=alternate
        fillattrs=(color=cxf2f2f2) altfillattrs=(color=cxffffff)
        outlineattrs=GRAPHREFERENCE;

    endcell;
cell;

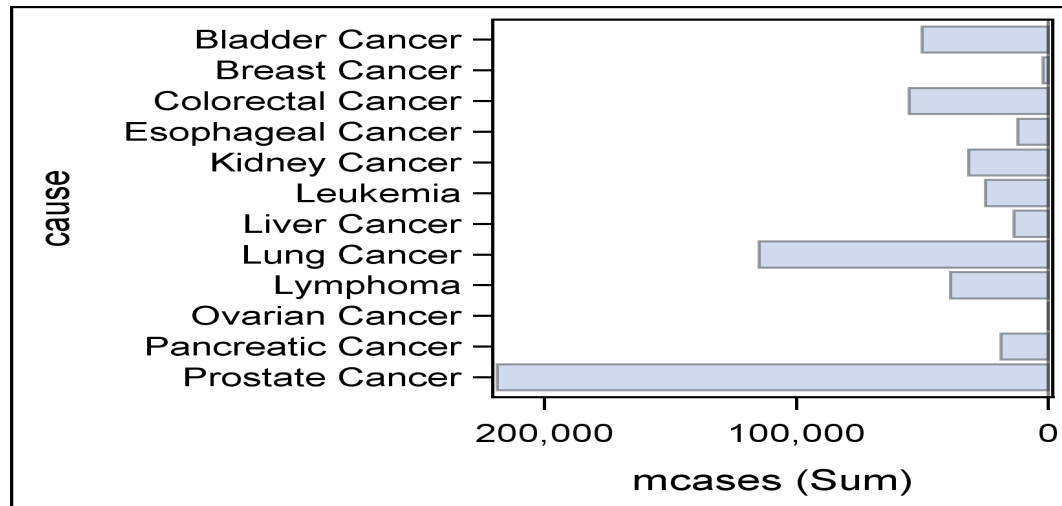
    layout overlay / cycleattrs=true yaxisopts=(label="Change in Depression Score since Baseline")
    xaxisopts=(label="Study Visit" display=all offsetmin=0 offsetmax=0);
```

Code

```
blockplot x=visit block=PHASE /  
display=(outline fill) filltype=alternate  
fillattrs=(color=cxf2f2f2) altfillattrs=(color=cxffffff) outlineattrs=GRAPHREFERENCE;  
boxplotparm x=visit y=base_change_grp1 stat=stat / name="Active Treatment"  
fillattrs=(transparency=0.25) discreteoffset=-.21 boxwidth=.37;  
boxplotparm x=visit y=base_change_grp0 stat=stat / name="Placebo"  
fillattrs=(transparency=0.25) discreteoffset=.21 boxwidth=.37;  
discretelegend "Active Treatment" "Placebo";  
endlayout;  
endcell;  
endlayout;  
endgraph;  
end;  
run;
```

Butterfly plot : Graph 8

```
proc sgplot data=cancer;  
    format mcases mdeaths fcases fdeaths positive. ;  
    hbar cause / response=mcases fillattrs=graphdata1  
    transparency=.65  
    legendlabel="New Cases (Male)"    name="mcases" ;  
run;
```



(a) Layer 1

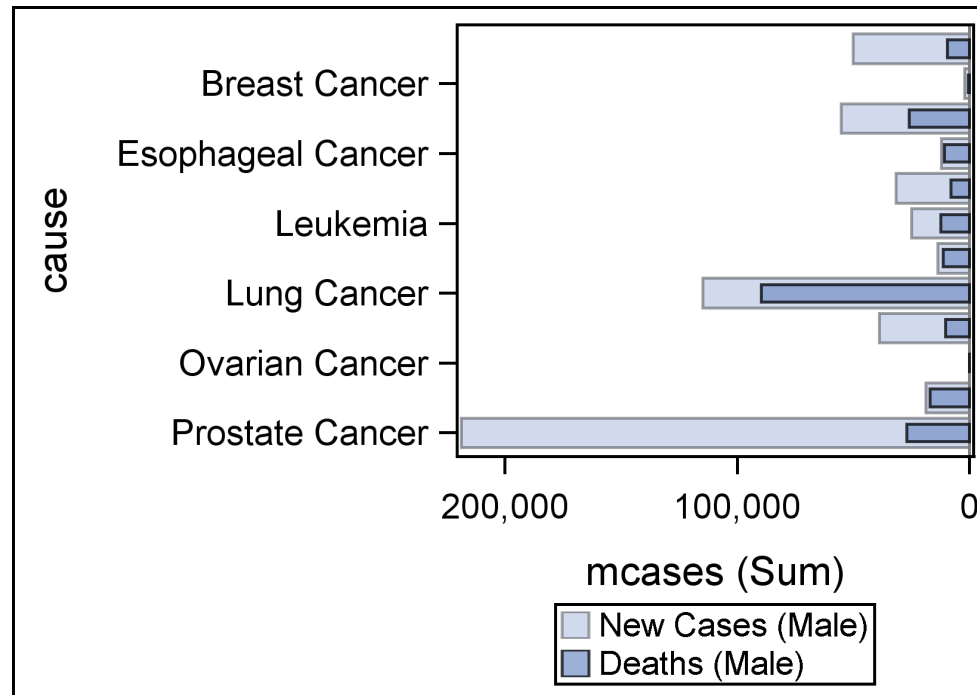
Butterfly Plot contd..

hbar cause / response=mdeaths barwidth=.5

fillattrs=graphdata1

transparency=.25

legendlabel="Deaths (Male)" name="mdeaths" ;



(b) Layer 2

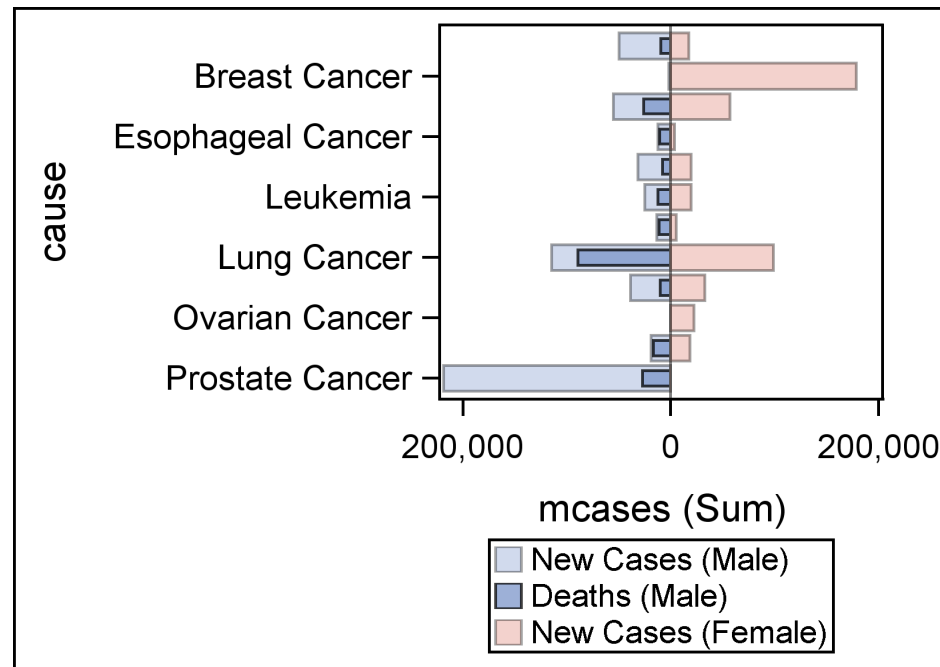
Butterfly Plot contd..

hbar cause / response=fcases fillattrs=graphdata2

transparency=.65

legendlabel="New Cases (Female)"

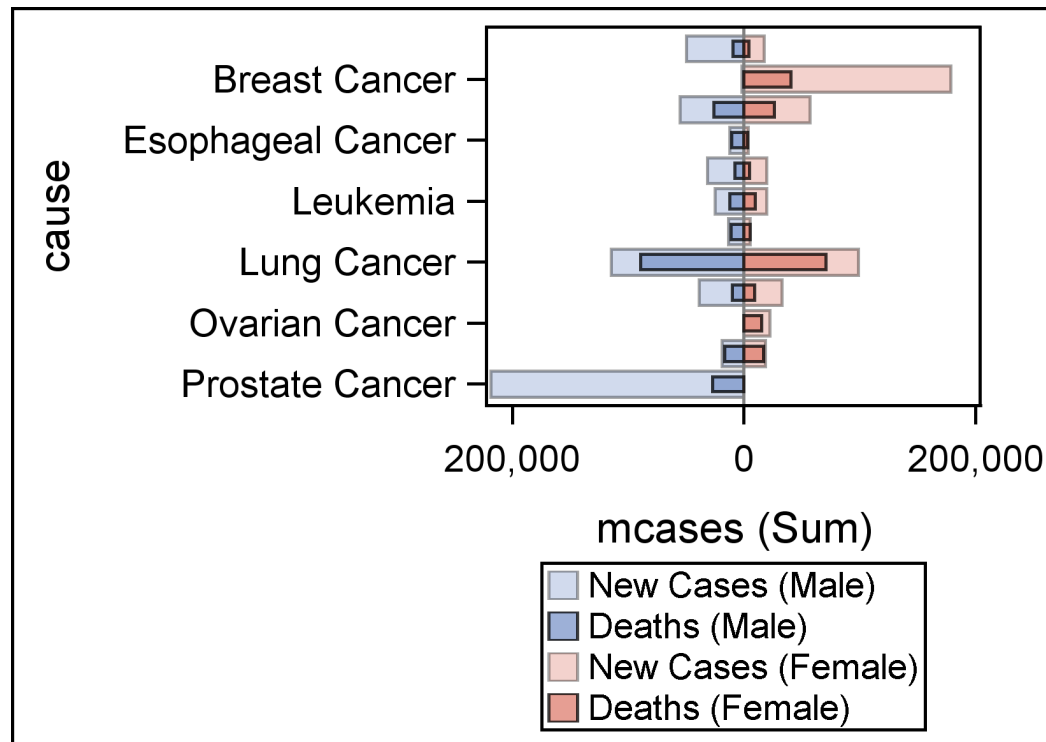
name="fcases" ;



(c) Layer 3

Butterfly Plot contd..

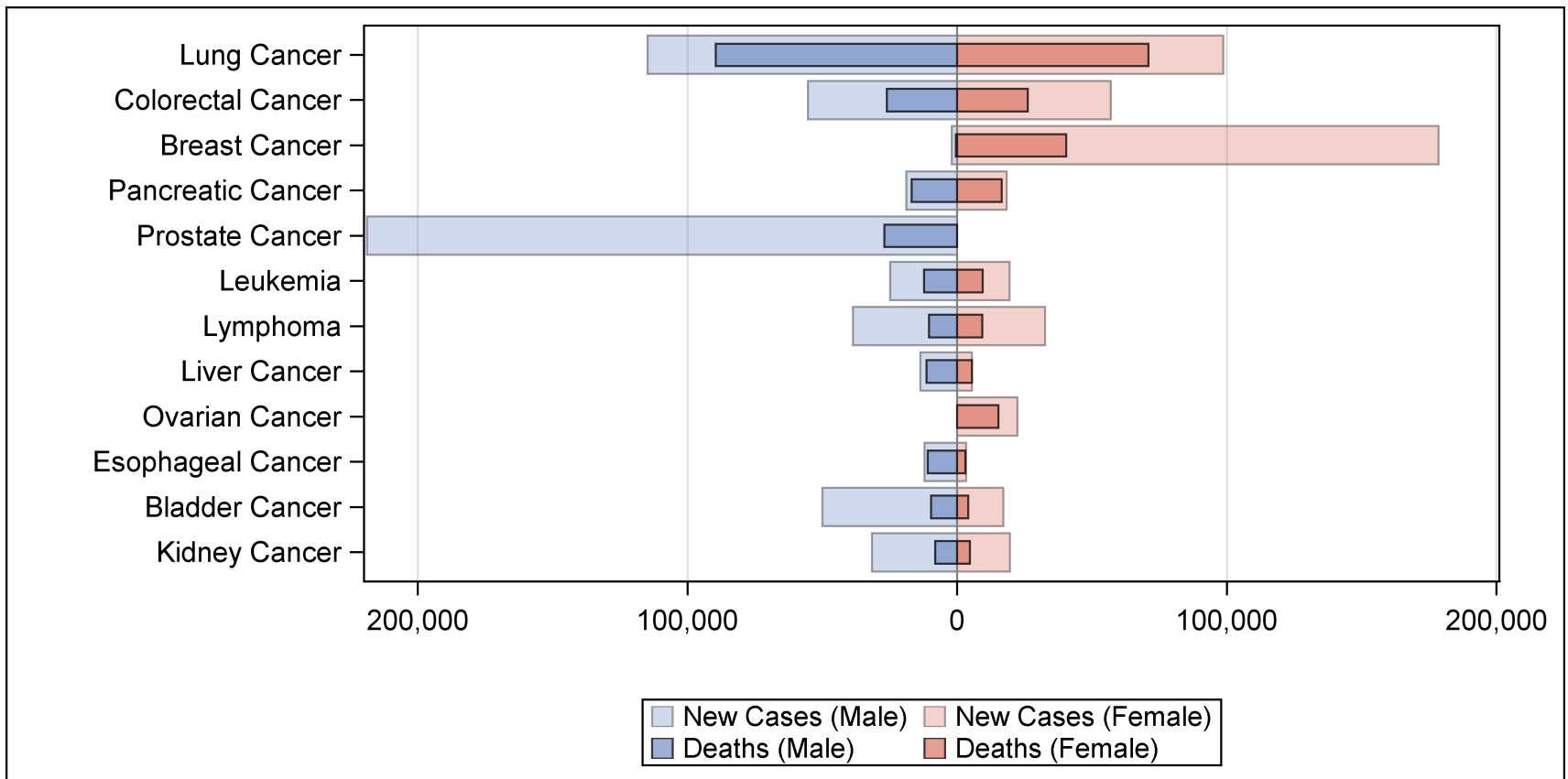
```
hbar cause / response=fdeaths barwidth=.5  
fillattrs=graphdata2 transparency=.25  
legendlabel="Deaths (Female)"  
name="fdeaths";
```



(d) Layer 4

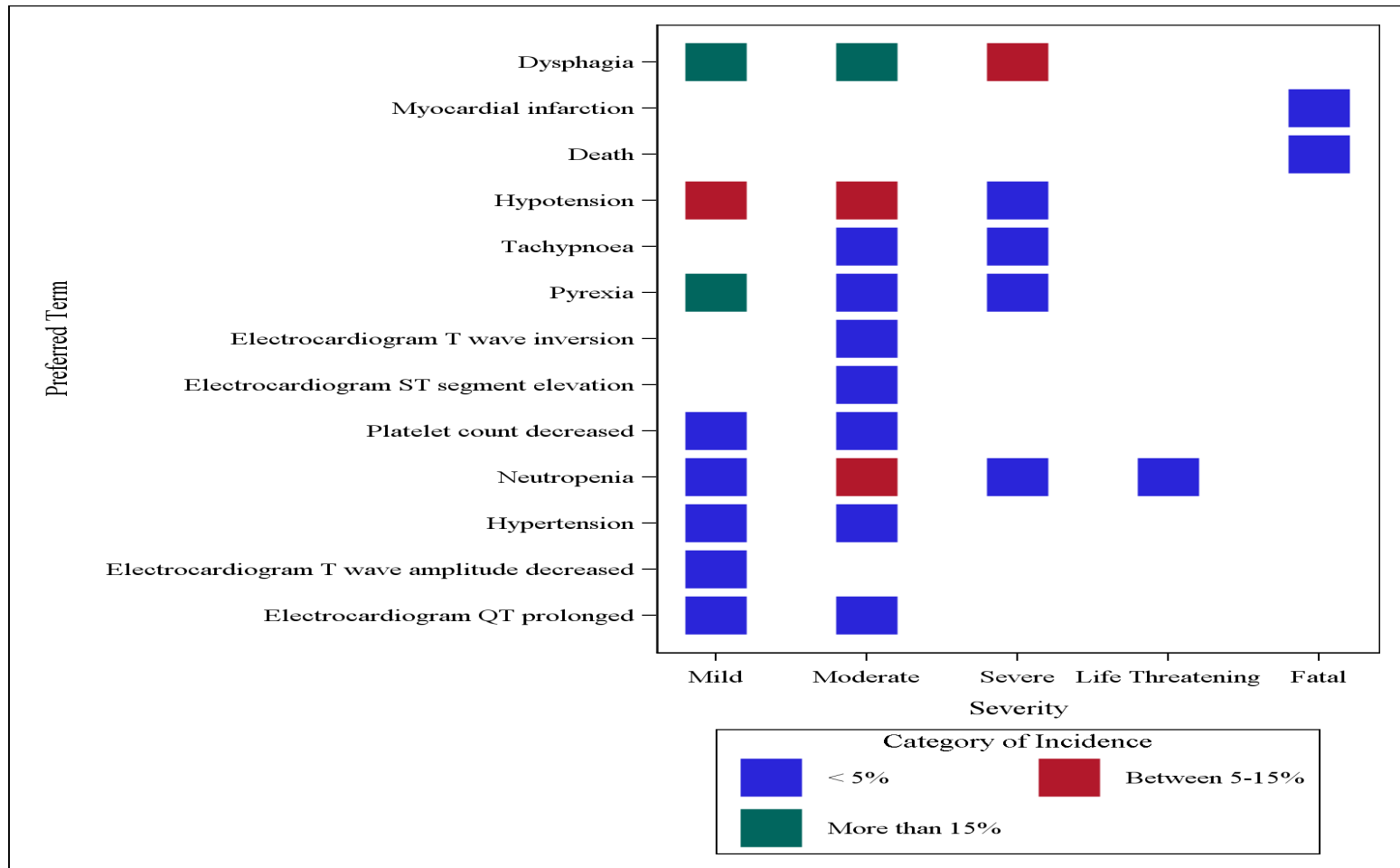
Butterfly Plot contd..

keylegend "mcases" "fcases" "mdeaths" "fdeaths" /
across=2; yaxis label=" " discreteorder=data;
xaxis label=" " grid;



(e) Example 7b Complete - Layer 5

HeatMap showing Incidence Rate of Adverse Event by Severity: Graph 9

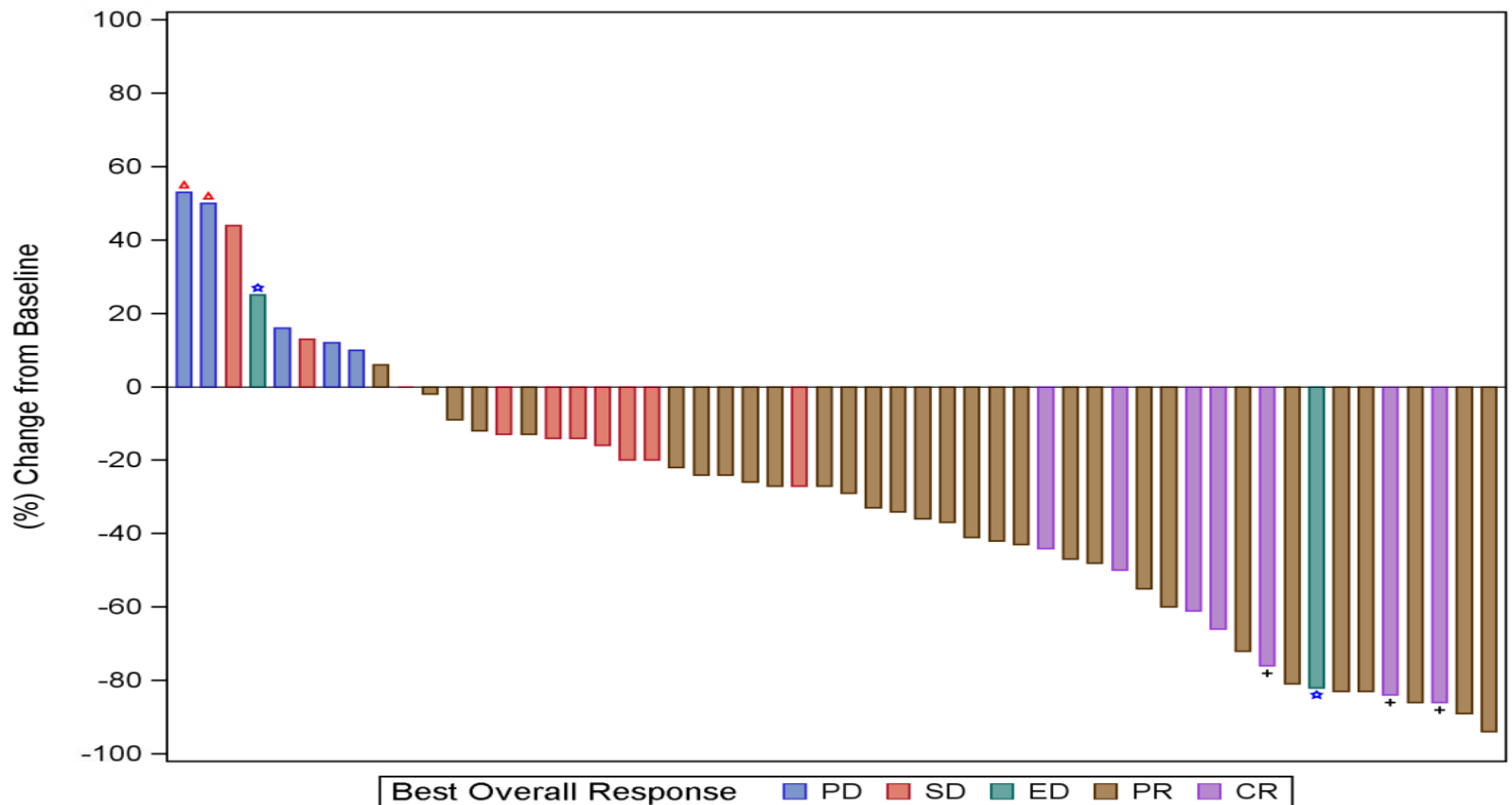


HeatMap - Code

```
proc sgplot data=grp;  
  scatter x=aesev y= aedecod /  
    markerattrs=(size=0.15in symbol=squarefilled )  
    group=cat;  
  label aesev="Severity" aedecod="Preferred Term"  
  cat="Category of Incidence";  
run;
```

Waterfall Charts – Response & Tumor Size

– Graph 10



Waterfall Charts - Code

```
/* define the variables with values to be plotted on y axis for  
special cases */
```

```
data lspchg;  
  set lspchg;  
  if lsresp = 'cr' and lspchg <= -75 then  
    cr_y = lspchg + ((lspchg/abs(lspchg))*2);  
  if lsresp = 'ed' then  
    ed_y = lspchg + ((lspchg/abs(lspchg))*2);  
  if lspchg >= 50 then  
    ge50_y = lspchg + ((lspchg/abs(lspchg))*2);  
run;
```

Waterfall Chart - Code

```
/* Create waterfall chart */  
proc sgplot data=lspchg;  
    vbar n / response=lspchg group =lsresp barwidth = 0.6;  
    vline n / response=cr_y markers markerattrs =( symbol=plus size =4 color  
=black) lineattrs =( thickness =0);  
    vline n / response=ed_y markers markerattrs =(symbol =star size =4 color  
=blue) lineattrs =( thickness =0);  
    vline n / response=ge50_y markers markerattrs =( symbol =triangle size  
=4 color =red) lineattrs =( thickness =0);  
    xaxis display=none;  
    yaxis values=(-100 to 100 by 20) label="(%) change from baseline";  
run;
```

References

- Niraj J. Pandya , “Waterfall Charts in Oncology Trials - Ride the Wave”, Element Technologies Inc., Piscataway, NJ , PharmaSUG 2012 - Paper DG13.
- Hans-Rainer Pauli, David J Garbutt, “TS11 Clinical Trial Reporting with SAS ODS Graphics” 20 October 2009 PhUSE.
- Sanjay Matange, “Clinical Graphs using ODS Graphics”.

Questions

Thank You