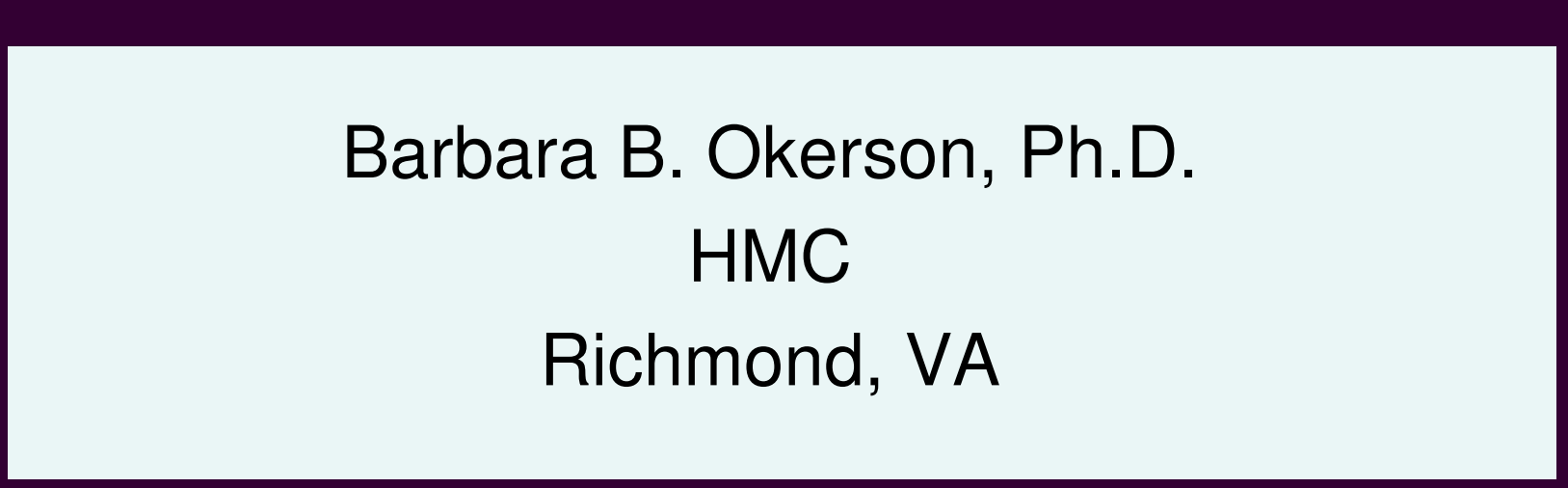




# Using SAS® Graphics to Explore Behavioral Health Cost Risk



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# Abstract

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Behavioral health disorders result in significant economic loss through costs associated with inpatient admissions, lost work days and reduction in at-work productivity. Additionally, over 30% of health plan members with complex health issues have at least one behavioral health issue driving cost risk. This paper looks at graphical representations of cost as part of an effort to develop an overall methodology for prediction of future cost risk from selected behavioral health issues.

# HMC

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HMC is one of the nation's largest, most experienced providers of integrated care and total health solutions. Since 1983, HMC has offered comprehensive programs and services intended to empower members to take control of their health and see positive results. Through a population-based approach, HMC's care management programs provide solutions for prevention, chronic condition support, lifestyle management and complex condition care. HMC's mission is to help improve the health and financial outcomes through innovative health solutions that consider every single member at his/her level of care.

# Behavioral health focus conditions

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- Alcohol Abuse
- Anxiety Disorder
- Bipolar
- Depression
- Eating Disorder
- Other Substance Abuse
- Personality Disorder
- Schizophrenia

# Included graphics

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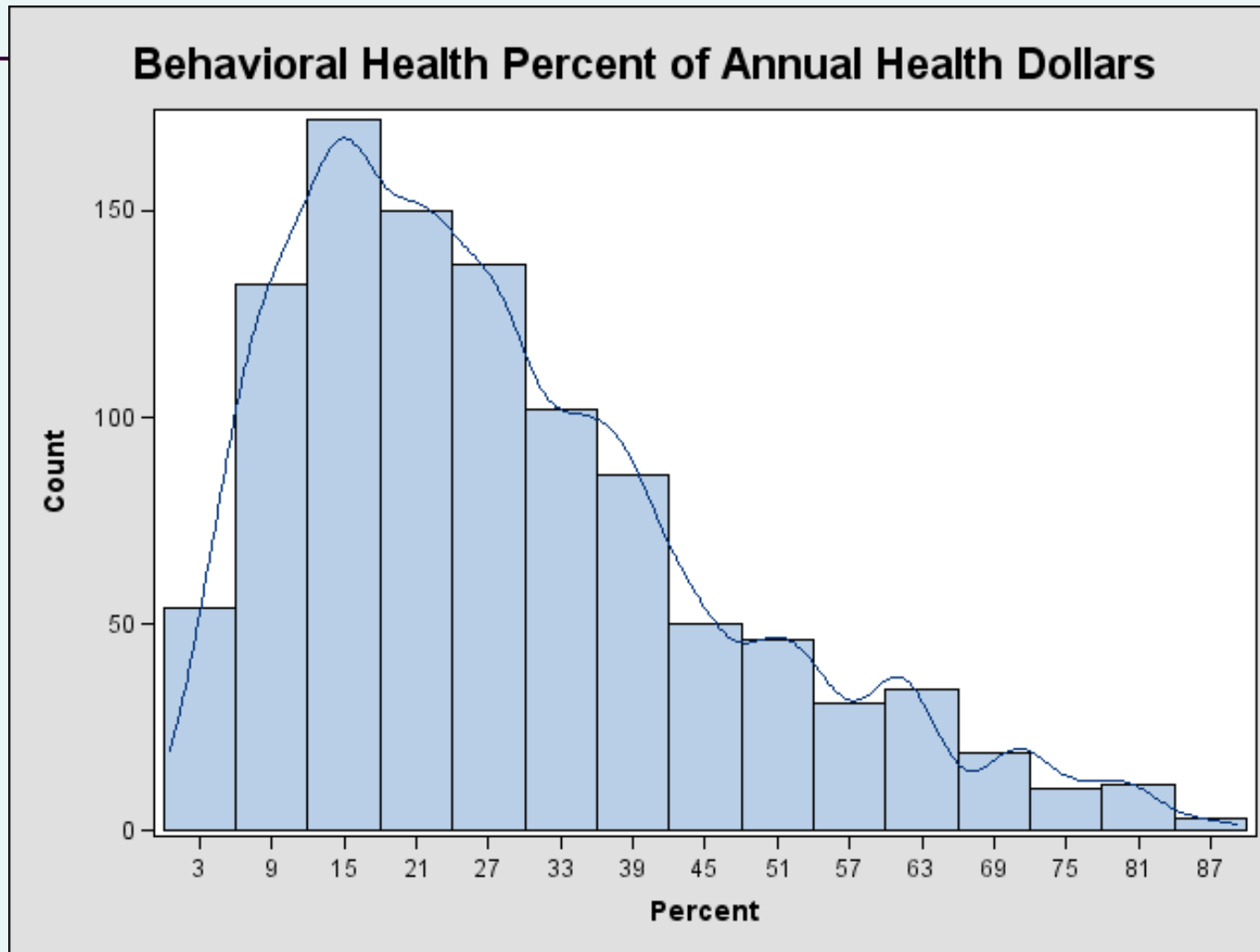
- Behavioral health dollars distribution;
- Behavioral health admissions over time;
- Proportion of total medical costs;
- Differences in number and timeframe of encounters by age group;
- Geographical distribution of behavioral health referral percentages; and
- Referral rates versus expected rates.

# Behavioral health dollars distribution

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- Proc KDE
- Smoothed histogram
- Overlaid kernel density estimate
- Inpatient dollars impacted by “at risk” admissions

# Proc KDE graphic example



# Proc KDE SAS code

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```
ods noproctitle;
ods html path='r:\bokerson\sas global forum\test\'
  body='kde.htm';
ods graphics on;
Proc KDE data=samplebh;
  univar PCT_Annual_Dollars_BH_Dollars / method=sjp
  plots=histdensity bwm=.8;
run;
ods graphics off;
ods html close;
```

# SAS KDE template

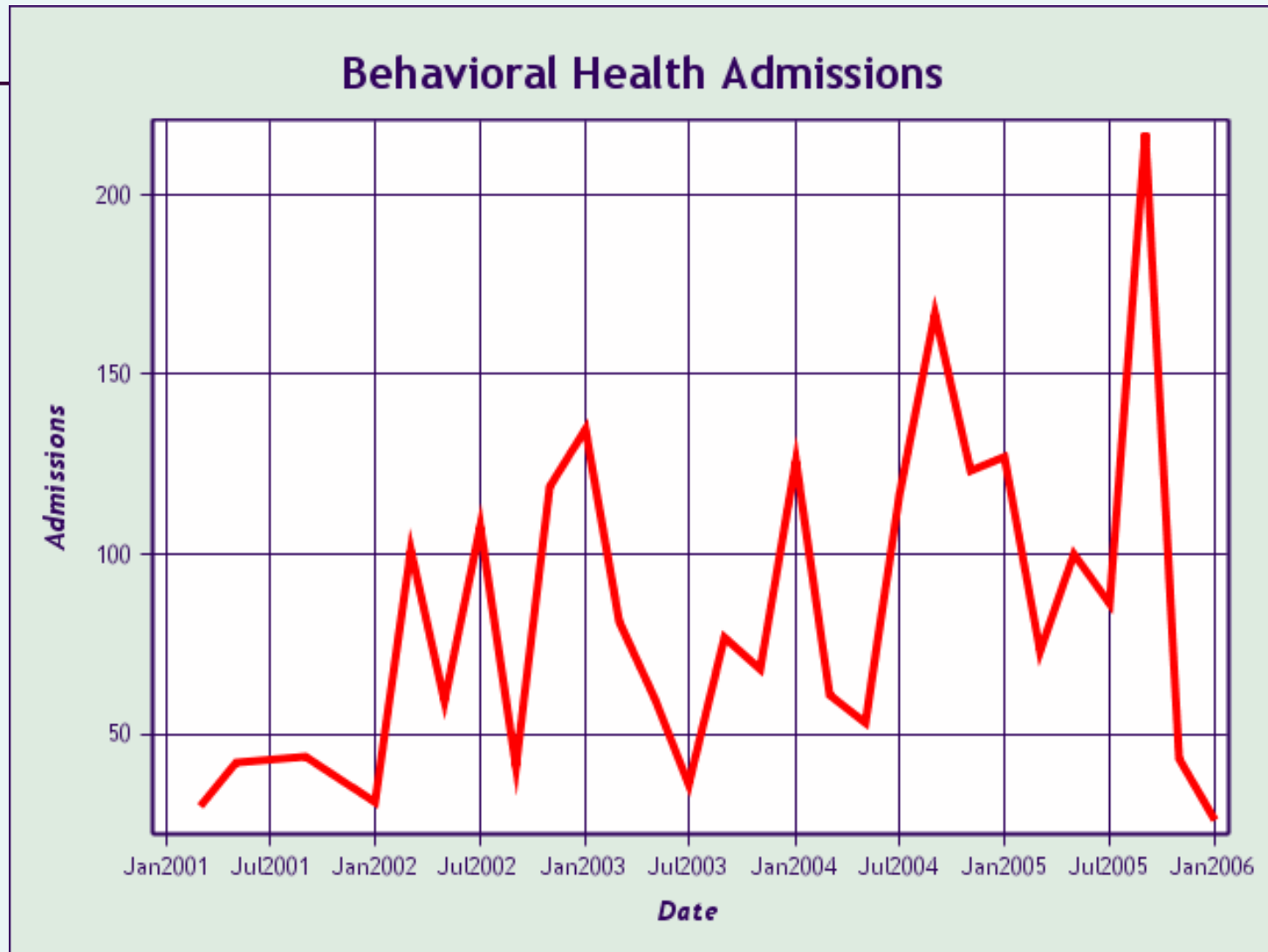
```
Proc TEMPLATE;
  Define statgraph Stat.KDE.Graphics.HistDensity;
  Dynamic _HISTOGRAM _DENSITY _DEPLABEL;
  Layout Gridded;
    Layout Overlay / padbottom=5;
    Layout Gridded / columns=3 valign=top;
      entrytitle _DEPLABEL /fontsize=20 padbottom=5 padtop=5;
    EndLayout; EndLayout;
  Layout Overlay/ XAXISOPTS=(LABEL='Percent') ;
    if (_HISTOGRAM=1) HistogramParm x=BINX
      y=BINCOUNT/fillcolor=GraphDataDefault:foreground;
    endif;
    if (_DENSITY=1) series x=DENSITYX
      y=DENSITYCOUNT/linecolor= StatGraphFitLine:contrastcolor;
    endif;
  EndLayout;
EndLayout;
end; run;
```

# Behavioral health admissions time series

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- Proc TIMESERIES
- Identification of seasonality
- Upswing near year-end suggests need for further analysis

# Proc TIMESERIES graphic



# Proc TIMESERIES SAS code

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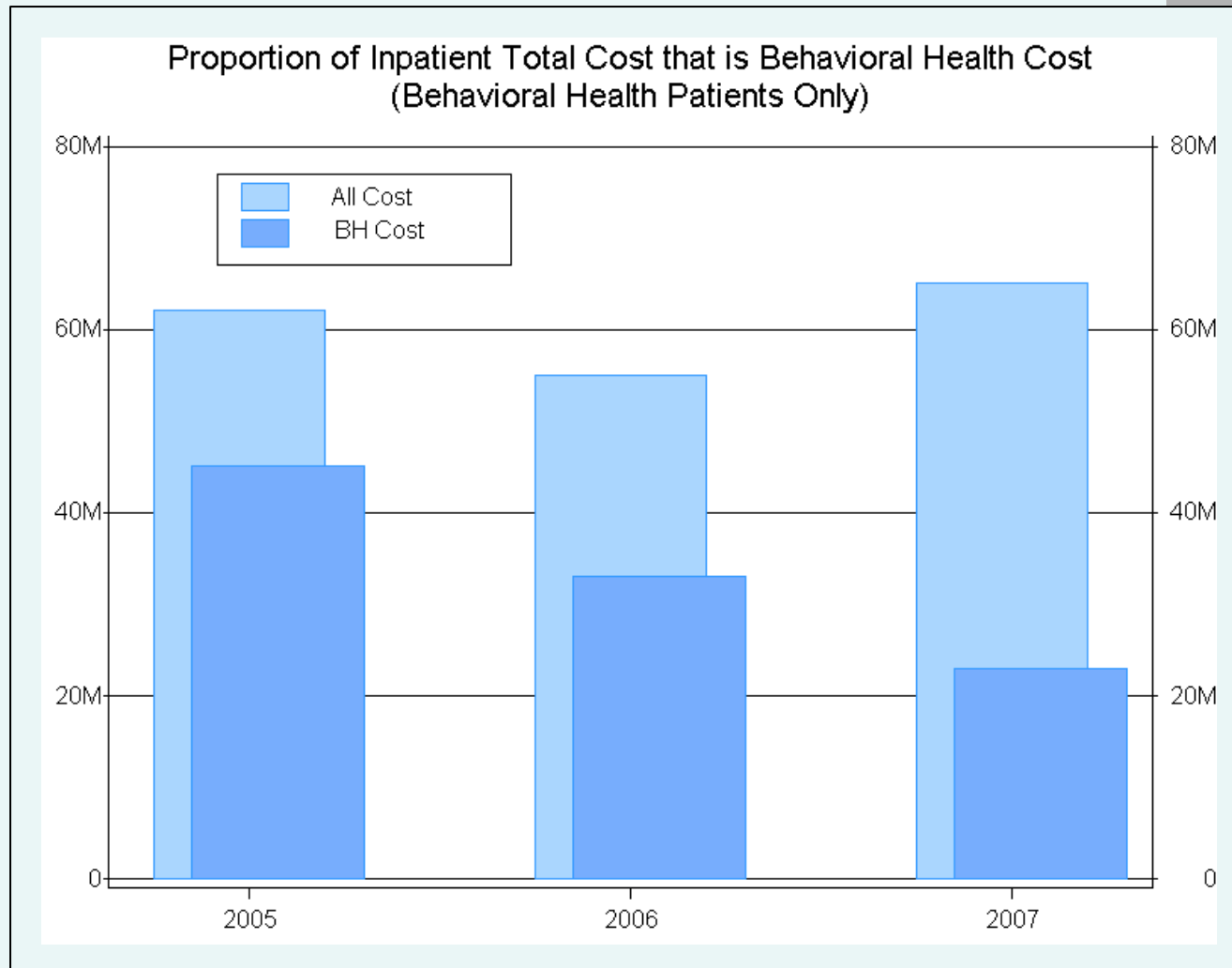
```
ods noproctitle;  
ods html path='r:\bokerson\sas global forum\test\  
  body='timeplot.htm' style=analysis;  
ods graphics on;  
Proc TIMESERIES data=admit plot=(series);  
  id Date interval=month2;  
  var Admissions;  
run;  
ods graphics off;  
ods html close;
```

# Behavioral health inpatient dollars proportion

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- Proc GPLOT with %bar macro
- Bar-bar overlay chart
- Increase in overall cost
- Decline in % cost from behavioral health conditions

# SAS overlay graph example



# Overlay graph SAS code

```
/*Overall cost bar*/  
data anno_bh1;  
set b;  
  by year bh all;  
  retain xsys ysys '2' when 'a';  
  %bar(year-.25,0, year+.2,all,CXAAD6FE,0,solid);  
run;  
/*BH cost bar*/  
data anno_bh2;  
set b;  
  by year bh all;  
  retain xsys ysys '2' when 'a';  
  %bar(year-.15,0, year+.3,bh,CX77ADFD,0,solid);  
run;
```

# Overlay graph SAS code (cont.)

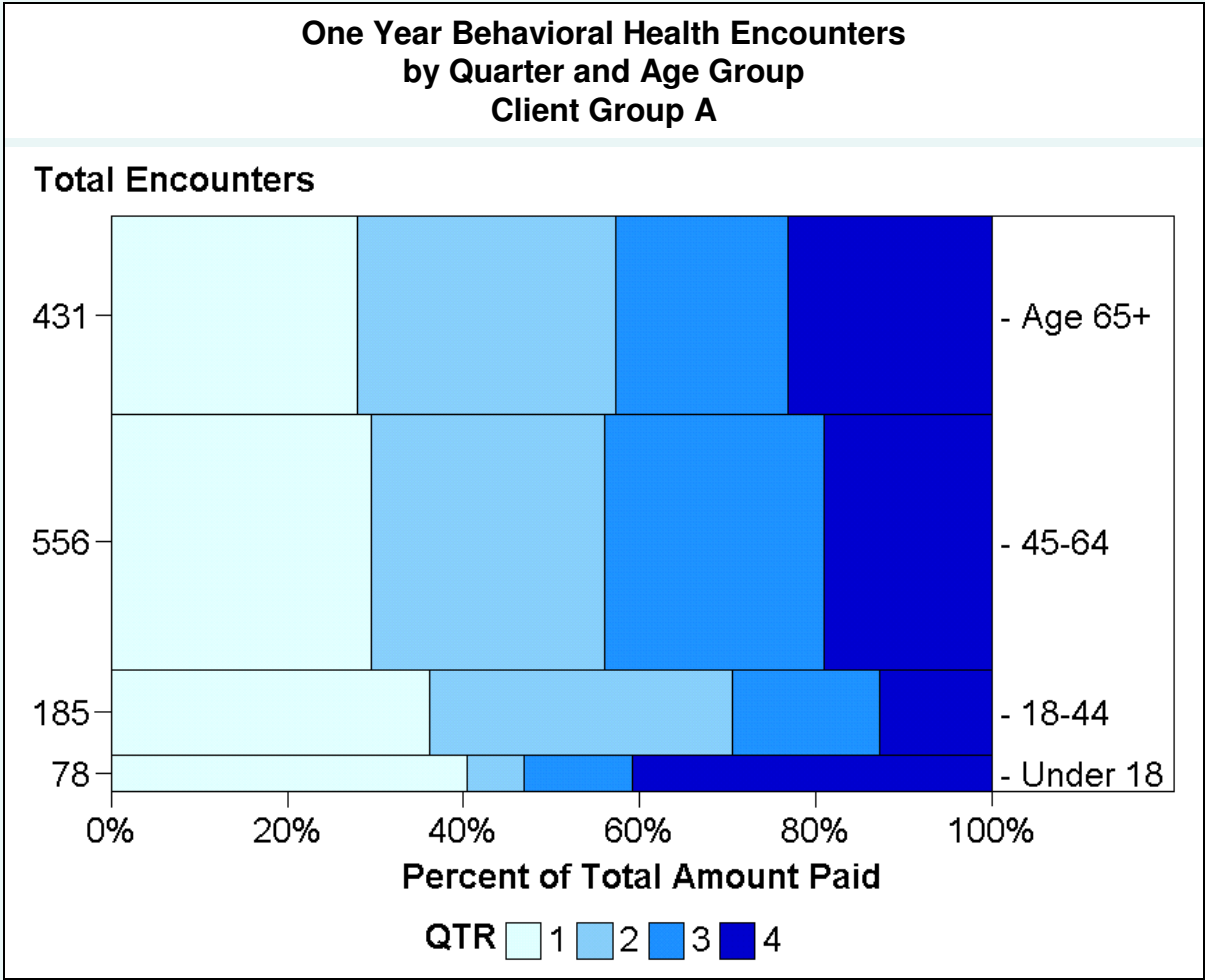
```
/*GPLOT*/  
title "Proportion of Inpatient Total Cost that is Behavioral  
Health Cost"  
    j=c "(Behavioral Health Patients Only)";  
Proc GPLOT data=b anno=anno_legend;  
plot all*year/ anno=anno_bh1 overlay noframe nolegend  
    haxis=axis1  
    vaxis=axis2 vref=20 to 60 by 20 autovref;  
plot2 bh*year / anno=anno_bh2 vaxis=axis3;  
run; quit;
```

# Behavioral health cost by quarter and age group

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- Proc GAREABAR
- Width of bars represent data elements
- Under 18 age group – different characteristics

# Proc GAREABAR example



# Proc GAREABAR SAS code

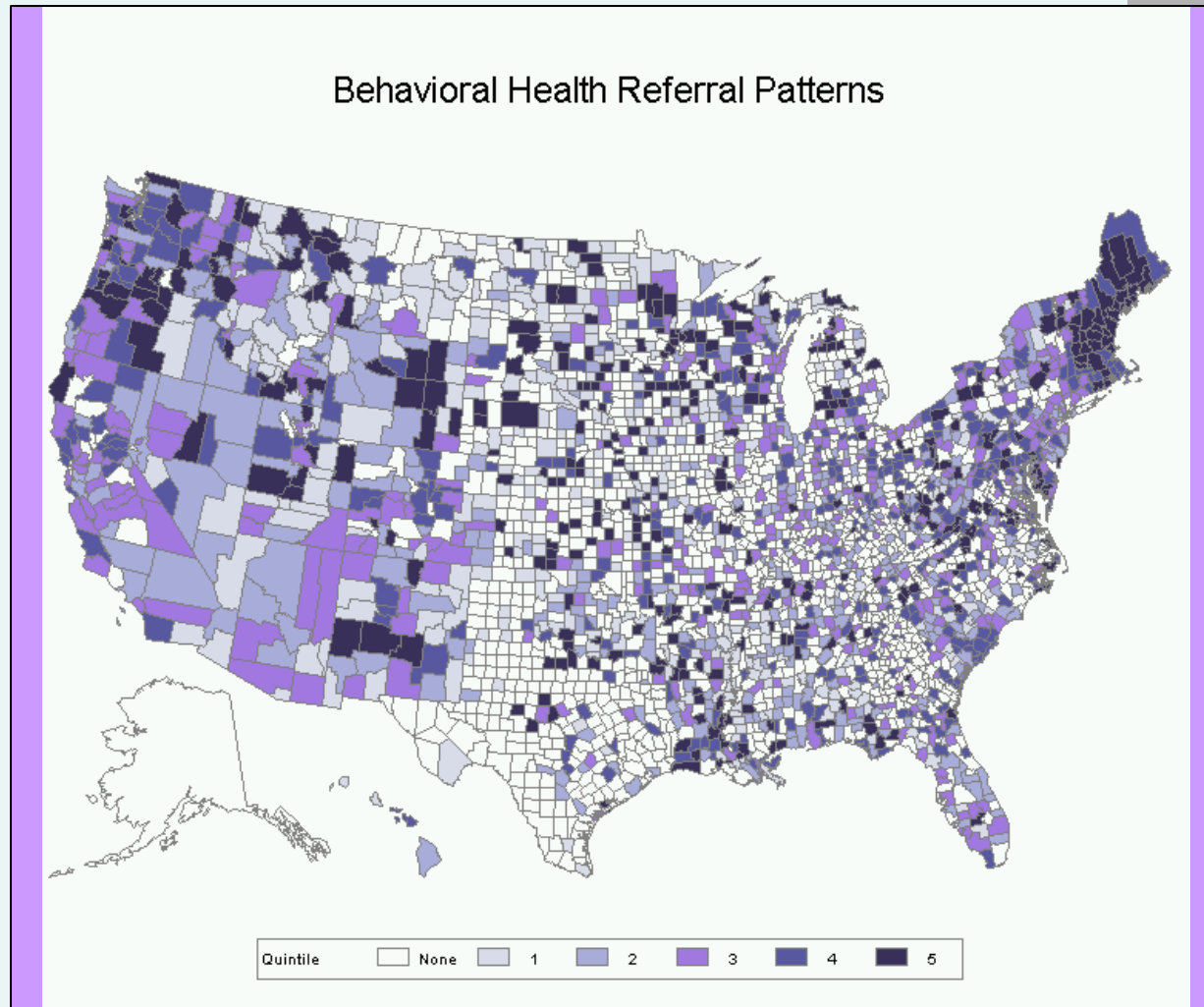
```
/*Set GOPTIONS*/
filename odsout 'r:\bokerson\sas global forum\test\gareabar.htm';
ods html file=odsout;
goptions reset=all dev=activex border ftitle='Arial Italic' cback=white
  hsize=8.42 vsize=6 ftext='Arial' htext=1.8 colors=(cxe0ffff
  cx87cefa cx1e90ff cx0000cd ) transparency ;
title j=c h=2 "One Year Behavioral Health Encounters by Quarter
  and Age Group";
/*GAREABAR Code*/
Proc GAREABAR data=house_bh;
hbar age_group*n /sumvar=sum subgroup=quarter rstat=pct
  discrete;
format age_group afmt.;
label sum="Percent of Total Amount Paid" n="Total Encounters"
  quarter="QTR";
run; quit;
ods html close;
```

# Behavioral health referral patterns

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- Proc GMAP
- Zip codes mapped to counties
- Geographic differences in referrals

# SAS Proc GMAP example



# Map SAS code

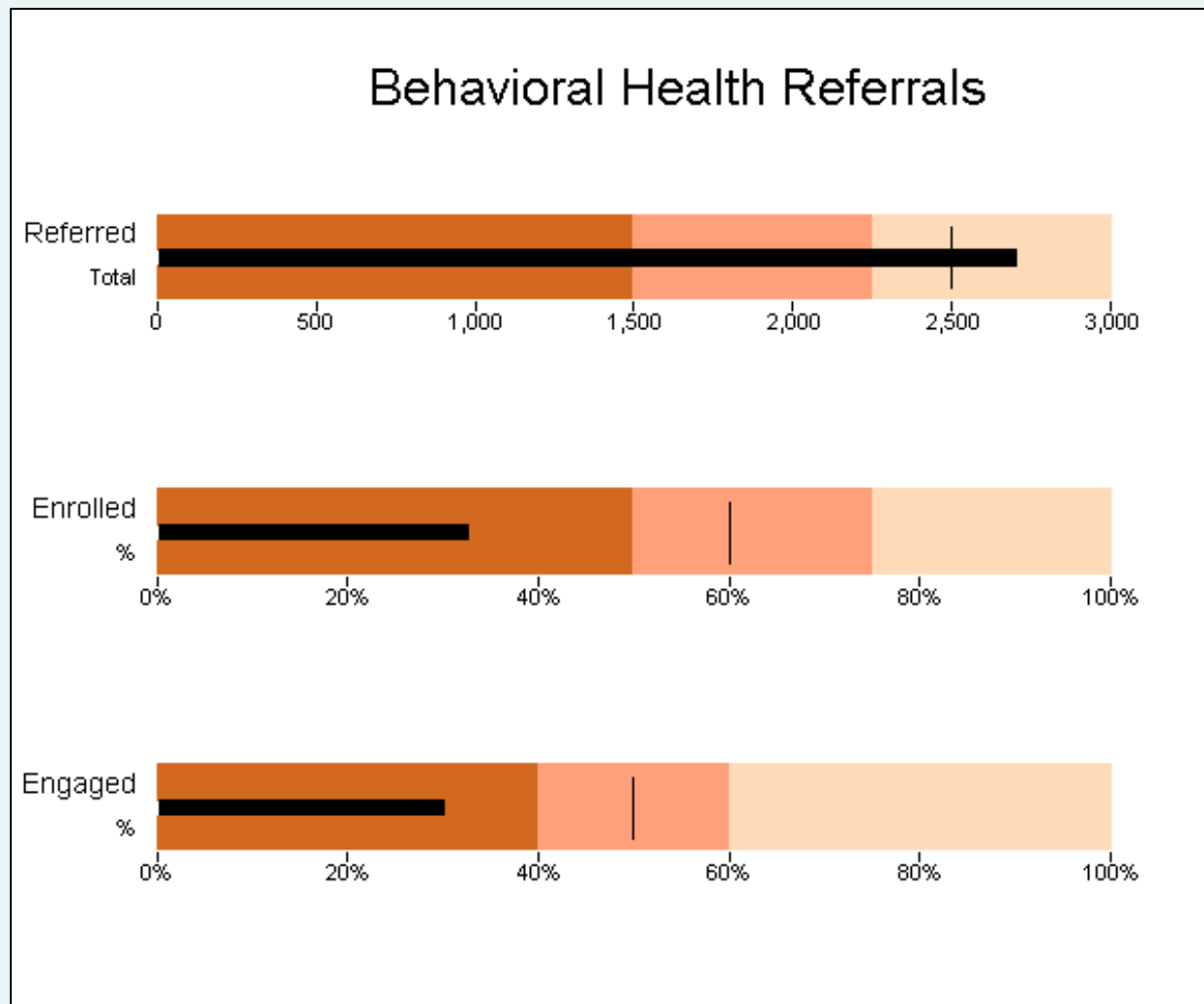
```
goptions colors=(white BWH VPAB VLIPB LIB MOPB)
  ftext='Arial' ctext=black;
legend cborder=gray label=("Quintile ")
  value=("None" "1 " "2 " "3 " "4 " "5 ");
title;
title3 h=2 'Behavioral Health Referral Patterns';
Proc GMAP map=maps.uscounty data=bhdatamap;
  id state county;
  choro pctbhgrp / legend=legend coutline=gray;
run; quit;
```

# Behavioral health dashboard

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- Proc GCHART and GREPLAY
- SAS Annotate
- Enrollments and engagements not meeting expectations

# Dashboard example



# Dashboard SAS code

```
data myanno;
  set temp_data;
  length function $8 color $12 style $20 text $20;
  hsys='3';
  xsys='2'; ysys='1'; style='solid'; when='b';

/*Annotate bars*/
x=0; y=0; function='move'; output;
x=range1; y=100; function='bar'; color="&c1"; output;
x=range1; y=0; function='move'; output;
x=range2; y=100; function='bar'; color="&c2"; output;
x=range2; y=0; function='move'; output;
x=range3; y=100; function='bar'; color="&c3"; output;
```

# Dashboard SAS code (cont.)

```
/* Annotate a thick line representing the expected value. */  
x=target; y=15; function='move'; output;  
x=target; y=85; function='draw'; line=1; size=1.7; color="&barc";  
output;  
  
/* Annotate the midpoint value label */  
xsys='1'; ysys='1';  
x=-2; y=85; function='label'; when='a'; position='4'; style="&ftitle";  
size=12; text=trim(left(label1)); output;  
x=-2; y=30; function='label'; when='a'; position='4'; style="&ftext";  
size=10; text=trim(left(label2)); output;  
  
run;
```

# References

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HMC website. <http://www.choosehmc.com>.

Rodriguez, R. "An Introduction to ODS for Statistical Graphics in SAS 9.1", *SUGI Proceedings*, 2003.

SAS Institute Inc. Data Visualization: SAS Dashboard Examples. <http://support.sas.com/rnd/datavisualization/dashboards/>. Accessed December 2007.

SAS Institute Inc. ODS Graphics Overview: ODS Graphics Style Elements and Attributes

<http://support.sas.com/rnd/base/topics/statgraph/proctemplate/a002791342.htm>. Accessed August 2007.

SAS Institute Inc., *SAS/GRAPH Software: Reference, Version 8, Volumes 1 and 2*. 1999.

Yeh, S. Customizing ODS Statistical Graphics, *SUGI Proceedings*. 2005.

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