

# MAPPING: "WOULD YOU, COULD YOU..."

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## ABSTRACT

Managed Care Insurance has over 60 hospital and/or physician networks nationwide. As the number of networks grows, so does the necessity to develop graphic portrayal of the networks. PC SAS/GRAPH is used to produce maps of the networks by county for individual states as well as by national level. Benefits are realized through cost savings from the elimination of overlapping networks, and greater customer satisfaction due to expanding network services to contingent counties.

The project started with the VP's request "would you, could you...".

## INTRODUCTION

Managed Care Insurance spent the past 30 years developing its reputation for innovative products and unsurpassed customer service. Their commitment to managed care dates back to the mid 1980's when it contracted with its first network of physicians and hospitals. By the end of 1987, it had arrangements with 8 networks, and by 1992, it had over 60 contracted networks.

As the number of networks increased, manually tracking the arrangements in the various counties and states became cumbersome. As additional networks were added, duplicate services became more of a possibility.

SAS/GRAPH for the PC, with its state and county mapping capability was selected for its ease of use.

## PROCEDURE

Data files containing managed care networks by county were created from production batch files resident on the IBM mainframe using SAS/BASICS. The data files were downloaded via IRMAWIN to a PC with SAS/BASICS PC and SAS/GRAPH PC software.

A generic PC SAS program produces unique yet standardized maps.

See the APPENDIX for the program.

## DISCUSSION

Three major issues are addressed in this paper: (1) show only the major cities; (2) county names needed coordinates, and (3) differentiation of counties by type of managed care service.

### 1. Show only major cities with clearly labeled names on the maps.

Major cities were selected using the variable POP on the SAS/GRAPH map data set USCITY. POP represents the 1990 census population in thousands. It was used in this application only as a relative size indicator, not for analysis. A minimum population of 100,000 was chosen to define a major city. However, the minimum population was lowered to 50,000 for some states with low population concentrations.

The function SUBSTR was used to eliminate any cities with names beginning with "WEST", "EAST", "SOUTH" or "NORTH".

In order to comply with the clearly labeled requirement, the variables X and Y, which are used to plot the city location, were amended. Based on the final map size (5"x7") the optimum tolerance for overlapping cities was determined to be .01. Therefore, the X,Y coordinates were rounded to the nearest hundredth resulting in two new variables named X3, Y3.

The city data set was then sorted by the rounded coordinates X3, Y3 and POP. LAST.BYVARIABLE processing was used to select the city with the highest population within the coordinate "block" of X,Y rounded to hundredths.

### 2. Label counties with county names.

SAS/GRAPH 6.04 does not have a map data set with county center coordinates to be used with the SAS/GRAPH map data set CNTYNAME. In order to locate the county center, it was determined that it would be defined as the center of the polygon formed by the boundaries of the county. The coordinates for the counties are contained on the SAS/GRAPH map data set USCOUNTY and COUNTY. The SAS/GRAPH map data set USCOUNTY was selected for this calculation. In order to determine the center, first the STATE, COUNTY, X, Y and SEGMENT variables are selected. Then PROC GREduce is applied to the data, using as ID variables, STATE, COUNTY, and SEGMENT. The output data set contains all coordinates required to plot the county polygon with the variable DENSITY added. DENSITY describes the importance of the coordinate to the clarity of the county's shape. A detailed county outline would appear, if all points with a DENSITY of 0 through 6

are plotted. However, if only the points with a density of 3 are plotted, then the county's shape would be vaguely similar, without detail. Trial and error found that the best density for calculating the county center was 4. PROC SUMMARY is run on the data set with the subset of all points with a density less than 4. The resulting single coordinate X,Y is used as the county center for purposes of labeling the county's name.

### 3. Differentiate counties by multiple managed care services.

The third issue was to differentiate between which counties had hospital agreements only, physician agreements only, or both service agreements. The hospital only counties were to be a solid color, while the physician only counties were to have an open pattern of lines. If a county had both services, then the county would have an open pattern of lines "overlying" a solid base color.

Again, consider the county a closed polygon. In order to create the physician polygon(lines) that overlay the hospital polygon(solid), PROC GREMOVE removed the county borders and combined the polygon areas. PROC GREMOVE was run against a subset of data created by matching physician counties with USCOUNTY. This created a new map data set of county coordinates with the same coordinates as the original data set. However, SAS considers this new data set as unique, so both polygons can be plotted, one on top of the other. The result was a map showing the various services available by county.

## CONCLUSION

PC SAS GRAPH was able to satisfy the business needs of management and the creative needs of the programmer.

## REFERENCES

SAS/GRAPH User's Guide, Release 6.03 Edition

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## APPENDIX

```
*6/25/99=====SESUGMAP.SAS=====;
%LET ST=CT;
%LET STNW=CTHC;
%LET NW=SELECTIVES;
FILENAME GSASFILE "C:\SASWIN\GMS&STNW..CGM";
LIBNAME MAPLIB "C:\SASWIN\MAPS";
LIBNAME GDEVICE0 "C:\SASWIN\GRAPH\SASHELP";
GOPTIONS GACCESS=GSASFILE GSLEN=80
DEVICE='CGMFL2C' GSFMODE=REPLACE; RUN;

**** READ IN MARKETING COUNTIES;
OPTIONS PS=58 LS=80 NOCENTER NUMBER;
DATA CLCTPHN(KEEP= STATE COUNTY SEGMENT SYSTEM)
  CLCTPPO(KEEP= STATE COUNTY SEGMENT SYSTEM);
  INFILE CARDS;
  INPUT @1 ST $2. @4 COUNTY 4. @9 PPOPHN $3.
        @13 NETNAME $15.;
  IF INDEX(NETNAME,"&NW");
  IF ST="&ST";
  SEGMENT=1;
  STATE=STFIPS(ST);
  IF PPOPHN='PHN' THEN DO;
    SYSTEM=COUNTY;
    OUTPUT CLCTPHN;END;
  IF PPOPHN='PPO' THEN DO;
    SYSTEM=SUM(COUNTY,(1000));
    OUTPUT CLCTPPO;END;
  CARDS;
CT 1 PPO SELECTIVES
CT 1 PHN SELECTIVES
CT 3 PPO SELECTIVES
CT 3 PHN SELECTIVES
CT 5 PHN SELECTIVES
CT 7 PPO SELECTIVES
CT 9 PPO SELECTIVES
CT 9 PHN SELECTIVES
CT 11 PPO SELECTIVES
CT 11 PHN SELECTIVES
CT 13 PPO SELECTIVES
CT 13 PHN SELECTIVES
CT 15 PPO SELECTIVES
CT 15 PHN SELECTIVES; RUN;
PROC SORT NODUPKEY DATA=CLCTPHN;
  BY STATE SEGMENT COUNTY; RUN;
PROC SORT NODUPKEY DATA=CLCTPPO;
  BY STATE SEGMENT COUNTY; RUN;

**** SELECT COUNTY COORDINATES;
DATA CNTYMAP (KEEP= STATE COUNTY X Y SEGMENT);
  SET MAPLIB.USCOUNTY (KEEP= STATE COUNTY X Y
  SEGMENT);
  ST=FIPSTATE(STATE);
  IF ST="&ST" AND SEGMENT=1;
  OUTPUT CNTYMAP; RUN;
PROC SORT DATA=CNTYMAP;
  BY STATE SEGMENT COUNTY;RUN;
PROC GREDUCE DATA=CNTYMAP OUT=CNTYRED NORETRY;
  ID STATE COUNTY SEGMENT;RUN;
```

```

**** CALCULATE COUNTY LABEL COORDINATES;
DATA CNTYSNK;
  SET CNTYRED;
  IF DENSITY < 4; RUN;
PROC SUMMARY NWAY MISSING DATA=CNTYSNK;
  CLASS STATE COUNTY SEGMENT;
  VAR X Y; OUTPUT OUT=SUMPOINT MEAN=; RUN;
PROC SORT DATA=SUMPOINT; BY STATE COUNTY; RUN;

```

```

**** SELECT CITY LABELS/COORDINATES;
DATA READCITY
  (KEEP= STYLE SIZE Y3 X3 STATE POSITION COLOR
   X Y YSYS XSYS FUNCTION TEXT WHEN POP);
LENGTH COLOR FUNCTION $8;
SET MAPLIB.USCITY;
ST=FIPSTATE(STATE);
IF ST="&ST";
IF POP GE 100;
COLOR='RED'; FUNCTION='LABEL';
WHEN='A';
XSYS='2'; YSYS='2';
X3=ROUND(X,.01); Y3=ROUND(Y,.01);
TEXT=CITY; POSITION='5';
STYLE='HWCGM002'; SIZE=.70;
IF INDEX(CITY,'East ' ) |
  INDEX(CITY,'West ' ) |
  INDEX(CITY,'North ' ) |
  INDEX(CITY,'South ') THEN DELETE;
OUTPUT READCITY;
KEEP STYLE SIZE Y3 X3 STATE POSITION COLOR POP
  X Y YSYS XSYS FUNCTION CITY TEXT WHEN; RUN;
PROC SORT DATA=READCITY; BY X3 Y3 POP; RUN;

```

```

**** PREVENT OVERLAPPING CITY NAMES;
DATA CITYLABL;
  SET READCITY;
  BY X3 Y3 POP;
  KEEP='NO';
  IF LAST.Y3 THEN KEEP='YES';
  IF KEEP='NO' THEN DELETE; RUN;

```

```

**** SELECT COUNTY LABELS;
DATA READCNTY;
  LENGTH COLOR FUNCTION $8;
  SET MAPLIB.CNTYNAM;
  ST=FIPSTATE(STATE);
  IF ST="&ST";
  XSYS='2'; YSYS='2'; WHEN='A';
  COLOR='BLACK'; FUNCTION='LABEL';
  TEXT=COUNTYM; RUN;
PROC SORT DATA=READCNTY; BY STATE COUNTY; RUN;

```

```

**** MERGE COUNTY LABELS/COORDINATES;
DATA CNTYLABL
  (KEEP= POSITION SIZE STYLE STATE COLOR X Y
   YSYS XSYS FUNCTION TEXT WHEN COUNTY);
MERGE READCNTY (IN=C) SUMPOINT(IN=S);
  BY STATE COUNTY;
  IF C;
  STYLE='HWCGM002'; SIZE=.4; POSITION='5'; RUN;

```

```

**** CALCULATE NETWORK COORDINATES;
DATA PPOMAP;
  MERGE CLCTPPO
    (IN=L KEEP= STATE SEGMENT COUNTY SYSTEM)
    CNTYMAP (IN=Q);
  BY STATE SEGMENT COUNTY; RUN;
PROC SORT DATA=PPOMAP;
  BY STATE SEGMENT SYSTEM; RUN;
PROC GREMOVE DATA=PPOMAP OUT=PHYSICAN;
  BY STATE SEGMENT SYSTEM; ID COUNTY; RUN;

```

```

**** SET TOG NETWORK COORDINATES;
DATA MOVEIT;
  SET CNTYMAP(IN=M) PHYSICAN(IN=D);
  IF D THEN SYSTEM=SYSTEM;
  ELSE IF M THEN SYSTEM=COUNTY; RUN;
PROC SORT; BY STATE SEGMENT SYSTEM; RUN;

```

```

**** SET TOG NETWORK AREAS;
DATA TOG (KEEP= STATE COUNTY SEGMENT SYSTEM
SERVICE);
  LENGTH SERVICE $9;
  SET CLCTPHN (IN=H) CLCTPPO (IN=P);
  IF H THEN SERVICE='HOSPITAL';
  ELSE IF P THEN SERVICE='PHYSICIAN'; RUN;
PROC SORT;
  BY STATE SEGMENT SYSTEM SERVICE; RUN;

```

```

**** SET TOG CITY AND COUNTY LABELS/COORDINATES;
DATA CITYCNTY;
  SET CNTYLABL (IN=T) CITYLABL (IN=U);
  SEGMENT=1; RUN;

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**** SET LEGEND FOR MAP;
LEGEND1 ACROSS=2 LABEL=NONE
  VALUE= (C=BLUE F=HWCGM002 H=.60 J=L); RUN;

```

```

**** PRODUCE MAPS;
PROC GMAP DATA=TOG MAP=MOVEIT ALL ;
  ID STATE SEGMENT SYSTEM;
  CHORO SERVICE/DISCRETE
    EMPTY=BLUE COUTLINE=BLUE
    ANNOTATE=CITYCNTY LEGEND=LEGEND1;
  PATTERN1 C=YELLOW V=S;
  PATTERN2 C=RED V=M3N135;
  TITLE1 J=C C=RED F=HWCGM009 H=.6 CM "HEALTHCARE NETWORK";
  TITLE3 J=C C=BLUE F=HWCGM002 H=.7 CM "&ST - &NW";
  FOOTNOTE1 J=C C=BLUE F=HWCGM002 H=.3 CM "GMS&STNW &SYSDATE";
  RUN; QUIT; FILENAME GSASFILE CLEAR;

```

