

Creating a Map within a Map with SAS/GRAPH®

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ABSTRACT

Quality Improvement Organizations (QIOs) are tasked with assisting healthcare providers in making changes to healthcare delivery that improve patient outcomes. As we try to maximize available resources to improve healthcare for multiple concurrent national clinical priorities, geographic analyses are used to identify variations in performance (especially areas of poor compliance) at both national and statewide levels. To do this, it is advantageous to look at multiple levels of detail simultaneously, using the larger geographic area as reference.

While SAS does not provide a procedure to do this directly, SAS/GRAPH GMAP, in combination with the SAS Annotate facility, provides the functionality to create this type of map. This presentation details this process as part of national and statewide physician office campaigns. The first example shows national rate of compliance for diabetes lipid profile rates, while simultaneously displaying the same rates by county for the state of concern. An additional example used as part of a health information technology (HIT) promotion campaign, compares the number of physician office primary group practices to the number of Medicare beneficiaries by geographic area. These maps within a map provide visual representation of how states rank among other states, while also providing this information at the county level within a state. The application can be adapted for other levels of display, e.g. zip code level data.

Examples were developed with version 9.1 of SAS executing on a Windows XP platform, but are not platform specific and can be adapted by both beginning and advanced SAS users.

INTRODUCTION

The Virginia Health Quality Center (VHQC), three-time winner of U.S. Senate Productivity and Quality Award for Virginia, functions as both a health care quality improvement organization and a patient safety organization. The VHQC assists healthcare providers in making successful and meaningful changes in the way care is delivered and in improving outcomes of that care, especially for the Medicare community of Virginia.

The VHQC, in its national role as the Physician Office Quality Improvement Organization Support Center (QIOSC), supports QIOs in each state, territory and the District of Columbia by providing interventions support with literature and tools, facilitating the sharing of tacit knowledge, and developing and supporting national partnerships and external communications. The Physician Office QIOSC has aided QIOs in improving performance measures for the outpatient/physician office setting in three clinical topics: chronic care for diabetes, breast cancer screening and adult immunizations. Moving forward, the QIOSC role has expanded to include additional clinical topic areas as well as support for the implementation of electronic health records (EHRs) in physician office practices throughout the country.

In addition to the examples presented here, geographical analyses using SAS/GRAPH Proc GMAP are used in these physician office campaigns to geographically represent: 1) clinical condition prevalence, 2) geographical patterns of compliance, 3) participation in quality improvement efforts, and 4) non-geographic failure/success rates.

APPLICATION

Viewing of spatial data at two different levels can be accomplished by exploding a section of a map and providing additional data detail for the exploded section. While SAS does not provide a procedure or option for this presentation type, it can be achieved by adding the following steps to the production of a choropleth map.

- ☐ Reset GOPTIONS.
- ☐ Create a mapping variable at two levels (e.g. state and county)
- ☐ Add a new id variable for the exploded area.
- ☐ Subset exploded area and combine with detailed data set .
- ☐ Calculate and set the desired height and width of exploded area.
- ☐ Move the exploded area to the right of the map.
- ☐ Add coordinates to force a larger graphic area.
- ☐ Create the path to exploded area (triangle to rectangle).
- ☐ Combine the two maps to be created simultaneously, including the variable to be mapped.
- ☐ Set the number of data levels to be output.
- ☐ Output the exploded section map.

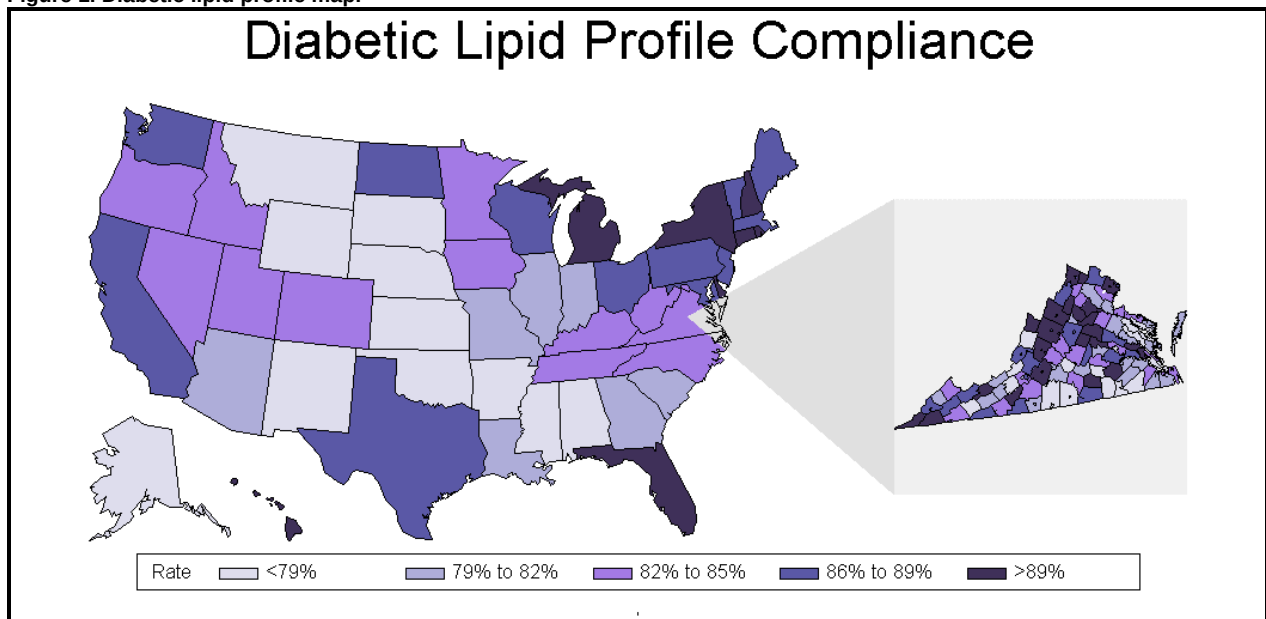
EXAMPLE ONE – EXPLODED SECTION DIABETES MAP

One of the areas of focus in the physician office setting is diabetes care. Diabetes is a major public health problem and is becoming more prevalent in all age groups. Over 150,000 Americans die each year from diabetes and its complications; these complications include blindness, kidney failure, nerve damage and cardiovascular disease. For most persons with diabetes, many of these complications can be prevented or delayed with appropriate monitoring and treatment; however, studies in both fee-for-service and managed care settings indicate that care is suboptimal.

The Centers for Medicare & Medicaid Services (CMS) has asked QIOs to participate in the promotion of diabetes care for Medicare beneficiaries. This initiative is designed to improve these outcomes by management of risk factors through early detection and disease management and includes the following indicators for quality improvement: 1) biennial eye examination 2) biennial lipid profile, and 3) annual hemoglobin A1C. The VHQC is tasked both with improving rates on these quality indicators for the state of Virginia, and, as part of their national contract role, providing support to other QIOs in their efforts. At both levels geographical analyses are used to identify providers and provider areas most in need of improvement.

The map below (figure 1) shows national rate of compliance with biennial lipid profiling for diabetics while simultaneously displaying the same rates by county for the state of Virginia. The display provides a graphical representation of both how states rank among other states, while providing the same information for counties within Virginia.

Figure 1. Diabetic lipid profile map.



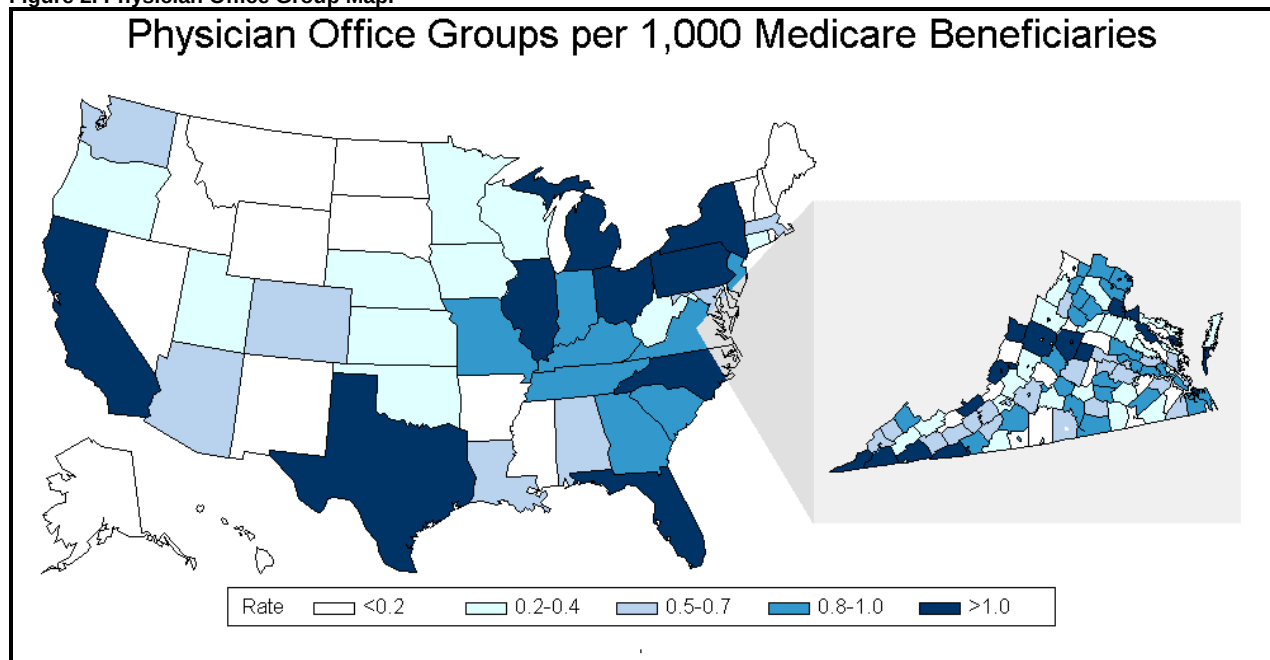
In this example, an area is set aside to the right of the map for the exploded map. The code below illustrates creation of this area, followed by the joining of the result with both the base and exploded map.

```
data exploded_area;  
  x=.75;      y=.26;      st='__'; county=.; output;  
  x=x+.001;   y=y+0;      st='__'; county=.; output;  
  x=x+0;      y=y+.001;   st='__'; county=.; output;  
  x=x-.001;   y=y+0;      st='__'; county=.; output;  
run;  
  
data all_maps;  
  set us state exploded_area;  
run;
```

EXAMPLE TWO – EXPLODED SECTION PHYSICIAN GROUP MAP

By educating physician offices on electronic health record (EHR) system solutions and alternatives as well as providing implementation and quality improvement assistance, the goal is to assist physician offices in migrating easily from paper-based health records to EHR systems that suit the needs of their office. While the ultimate objective of the current initiative is to assist both solo and group practices in this transformational change, much of the early focus is on physician office groups. Identifying the groups and their location is the first step in this process. The map that follows (figure 2) shows the number of physician office groups in each state per 1,000 Medicare beneficiaries and then explodes Virginia to show the same information by county.

Figure 2. Physician Office Group Map.



This map increases the size of the exploded area to increase the emphasis on the state map. To create the maps above, the SAS provided USCENTERS map data set is used to calculate the center of the state for positioning. The code below shows how this information is combined with the height and width to rescale the state for the exploded location and to set the location for the display box beginning point..

```
Proc Sql;
create table state_data as
  select unique id1, state, st, county
  from work.state
  where fipsstate(state)="VA";

/* Find the width and height of that state */
select abs(max(x)-min(x)) into :st_x_width from work.state;
select abs(max(y)-min(y)) into :st_y_width from work.state;
quit; run;

/* Resize the state to fit into the box */
data work.state; set work.state;
/* Since VA is widest in x direction, scale it to fit x-width */
if &st_x_width >= &st_y_width then do;
  x=x*((.3-.10)/&st_x_width);
  y=y*((.3-.10)/&st_x_width);
end; run;

proc sql;
/* Find the center of that state in the moved/scaled subset */
select min(x)+((max(x)-min(x))/2) into :st_x_center from work.state;
select min(y)+((max(y)-min(y))/2) into :st_y_center from work.state;
/* Find the approx center of that state in maps.us */
select x into :explode_x from maps.uscenter where fipstate(state)="VA";
select y into :explode_y from maps.uscenter where fipstate(state)="VA";
/*
quit; run;

/* Move the state to new location to the right of map using the calculations*/
data work.state; set work.state;
  x=x+ (.55-&st_x_center);
  y=y+(0-&st_y_center);
run;
```

The same variable is mapped on both the US map and the state map, with state rates calculated for the US map and county rates calculated for the state map. Two annotate data sets are used: one for the exploded area box and one to redraw the state lines over the portion of the triangle coming out from the center of the state.

CONCLUSION

This paper presents two applications using SAS/GRAPH GMAP to create a map within a map as part of physician office quality improvement initiatives. Through these and other applications, healthcare and social marketing campaigns are enabled to focus on the areas of greatest need, allowing for the most efficient use of quality improvement dollars and providing a foundation for further analyses to identify additional relationships and critical factors to enhance the quality improvement process. As the focus for QIO work in the physician office setting shifts to the adoption of health information technology (HIT), new applications for the spatial display tools already developed will be explored, expanded and adopted.

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