

## Web Enabled Graphics with a SAS Data Warehouse

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### ABSTRACT

A Provider Profiling system for Saint John's Health System in Anderson, Indiana was developed using a SAS data warehouse which is used to generate graphical reports through a SAS/IntrNet based interface. This paper reviews the design and creation of the data warehouse, the SAS/IntrNet interface, and the macro driven SAS/GRAPH plots and bar charts. The data warehouse is built and stored on a Windows NT server which can be accessed by the hospital administrative staff as well as the physicians. SAS products used include Base SAS, SAS/GRAPH, and SAS/IntrNet.

### INTRODUCTION

The Provider Profiling System for Saint John's Health System provides information which will enable physicians to make adjustments in their practice patterns; thereby controlling both costs and quality of care. Individual physician utilization can be compared three normative tables; Saint John's Overall, Saint John's Specialty Peers, and Saint John's Top Specialty Cases, as determined from cases below the median charge and length of hospital stay. The Provider Profiling System consists of two graphic outputs; a scatter diagram and a bar chart. Both graphs can be presented in a variety of ways through data drill down presented as pick lists to the user. The graphs are generated and viewed through the Microsoft Internet Web Browser.

### TECHNICAL OVERVIEW

Mainframe data is downloaded to a Windows NT server. A series of SAS programs are used to verify the input data and build a SAS Data Warehouse to support the application. A Web based graphical user interface prompts the user for a password and presents the user with pick lists to adjust the graphic output. The SAS/IntrNet product is used for this functionality. The resulting graphs are generated and viewed through the Microsoft Internet Web Browser. The SAS products required on the NT server include Base SAS, SAS/Graph, and SAS/IntrNet.

### DATA WAREHOUSE

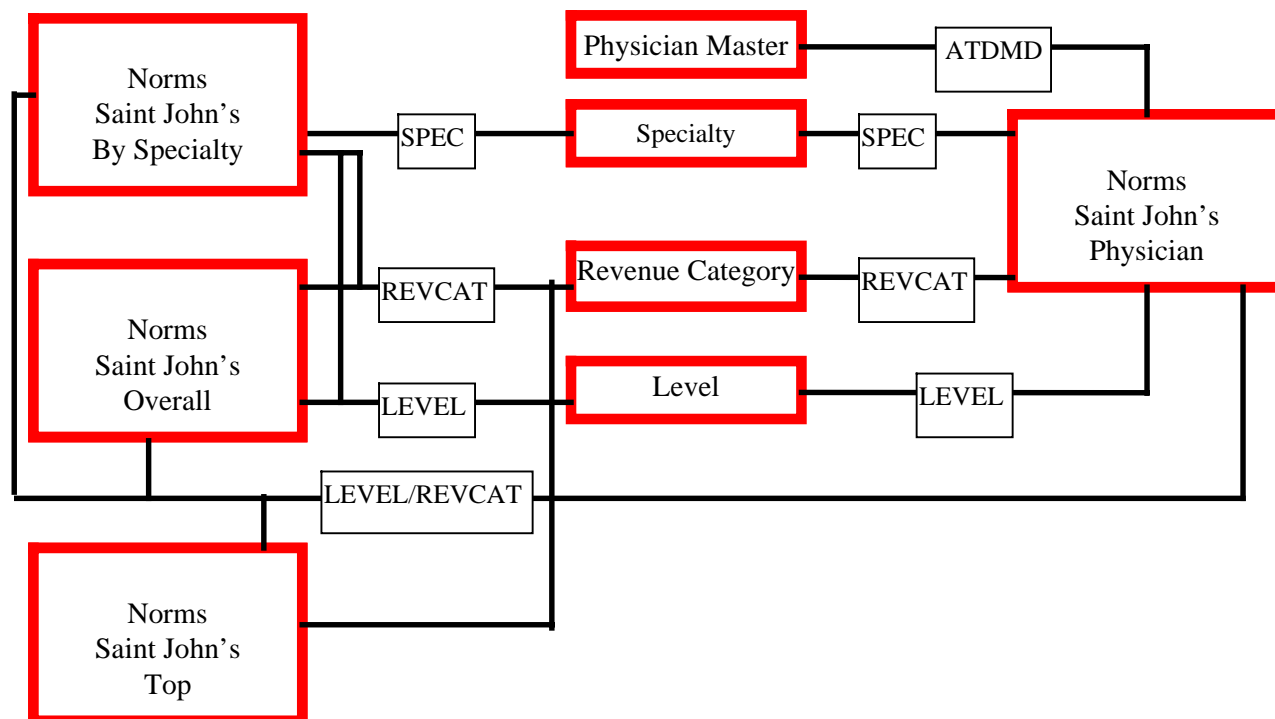
Data for this project will come primarily from the DSS (Decision Support System) which is mainframe based and contains approximately 9,000 cases per year. This data is summarized by patient, case and DRG (Diagnosis Related Group).

The DSS file contains basic demographic data such as age and sex, and medical services rendered with breakdowns by revenue code, ancillary, lab, drugs, and supplies which were provided during the inpatient stay. Additional data sources include the Provider Master file and DRG code text descriptions and their associated MDC's (Major Disease Category).

From these operational data sources, a SAS Data Warehouse is built to support the requirements of the Provider Profiling System. The primary tables are summary SAS data sets for the Physician Utilization and normative tables used for comparison. The unique key for the Physician Utilization table is attending physician, revenue category, and level. Level is a variable built from DRG, MDC'S, lists and ranges of DRG's, and groups of roll ups of DRG's. This variable was designed specifically to define analytic combinations of DRGs. To build this as a unique key required using a single input case multiple times, as a specific DRG can fall into more than one level value. Three normative comparison tables are built; the Saint John's Overall, Saint John's Specialty, and Saint John's Top Specialty Cases. These normative tables are built excluding cases where the charges and length of stay are outside 2.5 standard deviations from the mean. Saint John's Overall is based on unique keys revenue category and level. Saint John's Specialty Peers and Saint John's Top Specialty Cases are based on unique keys, specialty, revenue category, and level. A physician master table provides physician demographics and a format library is built for text description translations. Three tables; Normative Comparison, Revenue Category, and Level are used for the GUI pick lists. The warehouse is refreshed quarterly.

The following diagram shows the SAS Data Warehouse and the table relationships:

### Saint John's Health System - Provider Profiling SAS Data Warehouse



Note: The Saint John's Overall normative table does not appear in the remainder of this document, but is planned for a future release of the Provider Profiling System.

#### SAS/GRAPH OUTPUT

Two graphic outputs are available, a plot and a bar chart. The plot shows a scatter diagram where each point represents a physician, the x axis showing the hospital length of stay and the y axis the hospital charges. The plot point of the physician logging into the system is shown as a square and all other physician's are shown as dots. In addition, the square and the dots are shown in different colors. Vertical and horizontal reference lines are shown for the 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentiles for charges and length of stay. By default, these reference lines represent values determined by Saint John's overall data. The user can change these reference lines to be based on his specialty peers or top cases using the specialty pick list. The user can also drill down to generate the plot based on DRG's, groups of DRG's, or MDC's from the level pick list. Another type of drill down is based on the revenue category pick list, allowing the plot to represent one of the revenue categories; emergency room, intensive care unit, laboratory, pharmacy, radiology, room supplies, surgery, therapy, or other. The fourth pick list allows the user to change statistics from median to mean. If mean is selected, one horizontal and one vertical reference line is shown representing the average charge and average length of stay.

The bar chart shows a bar for the physician who logged into the system, along with a bar for each comparison group; Saint John's overall, the physician specialty peer, and the top cases. Each bar is divided into slices representing the percent of hospital charges for each revenue category. The length of stay statistic is not shown on the bar chart. The pick lists valid for the bar chart include the revenue category, the level, and the median/mean statistic. These are the same pick lists as used for the plot output previously described. The specialty pick list is not valid for the bar chart, as a bar is produced for each specialty comparison group.

The following examples of each of these graphs are shown below:

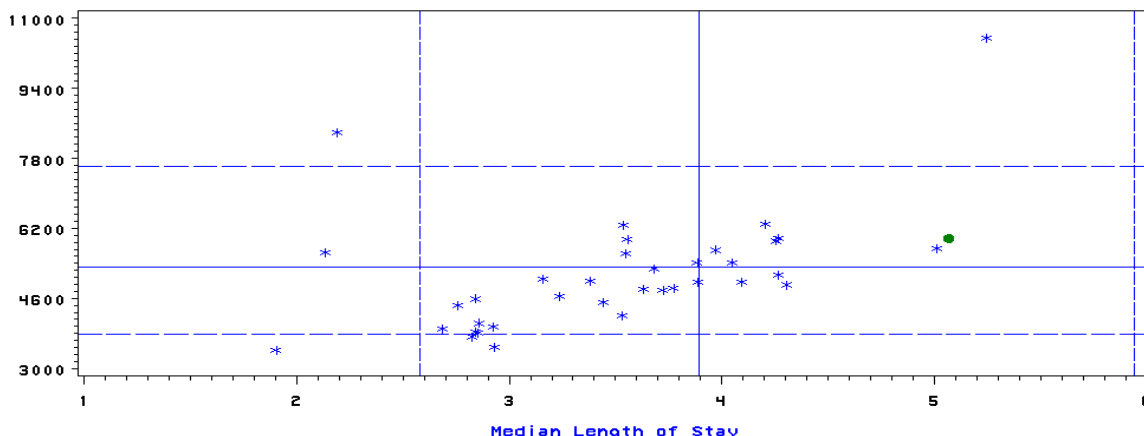
### Saint John's Health System - Provider Profiling Plot Output Example

9612 / 9805

St. John's Health System  
 Physician Profile for: Doctor: 21  
 DRG's Included: Overall  
 Comparison Group: All Family Practice Physicians

08/03/1998

Median Charges  
 All Charge Categories



Median Normalized Charges and Length of Stay For the Physician: 5972, 5.07  
 Median Normalized Charges and Length of Stay For the Comparison: 5316, 3.89  
 Cases: Doctor: 21 n=153, Comparison n=2106

### Saint John's Health System - Provider Profiling Bar Chart Output Example

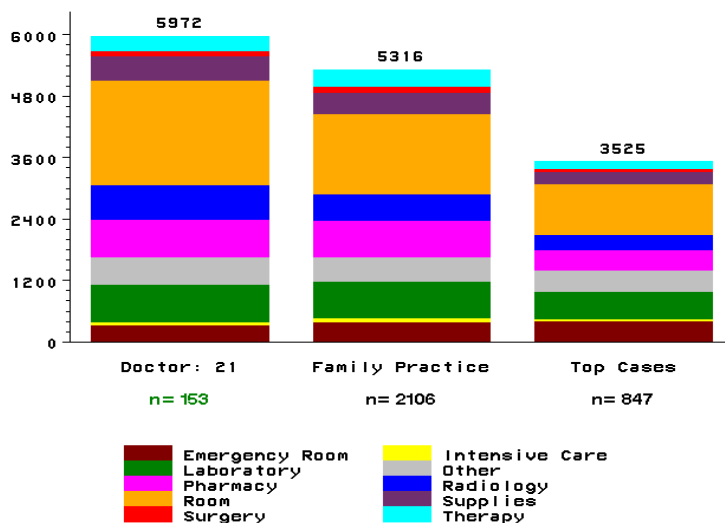
9612 / 9805

St. John's Health System  
 Physician Profile for: Doctor: 21  
 DRG's Included: Overall

08/03/1998

Median Charges

Normalized for Severity

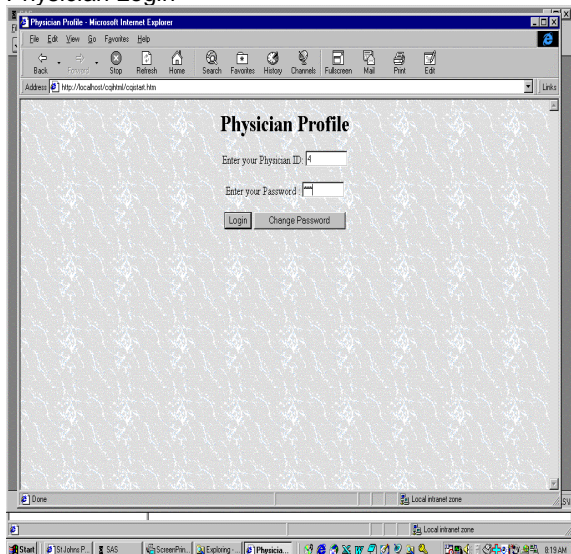


## SAS/IntrNet GUI

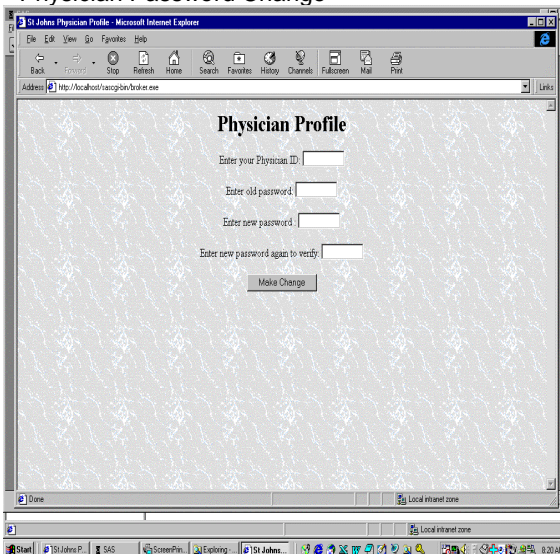
The graphical user interface (GUI) is written using the SAS/IntrNet product. HTML is used to build the Web screens, password prompts, and pick lists.

The physician can login using his assigned id and can change his password.

### Physician Login

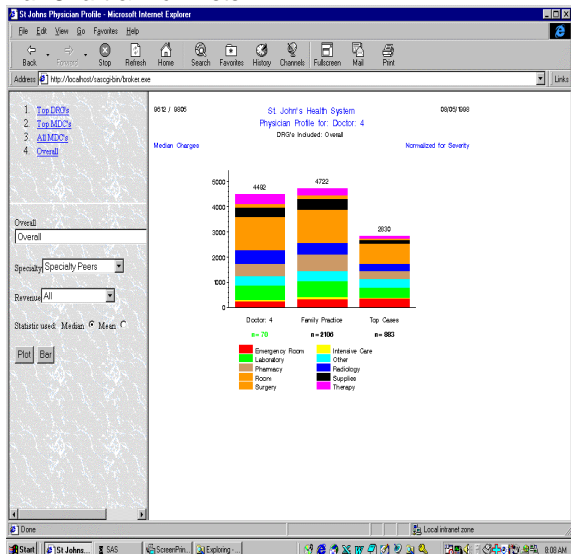


### Physician Password Change

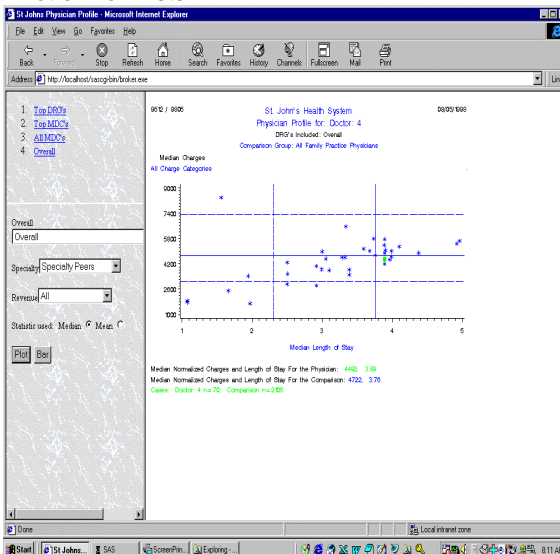


After successful login, a physician can view only his information as compared to Saint John's normative data. A bar or plot can be selected. On the plot, the physician's data point is shown as a different colored square. On the bar chart, the first bar represents the physician's utilization. The graph is displayed using default values for the pick lists. The user can generate a similar graph based on the pick list shown on the left.

### Bar Chart & Pick Lists

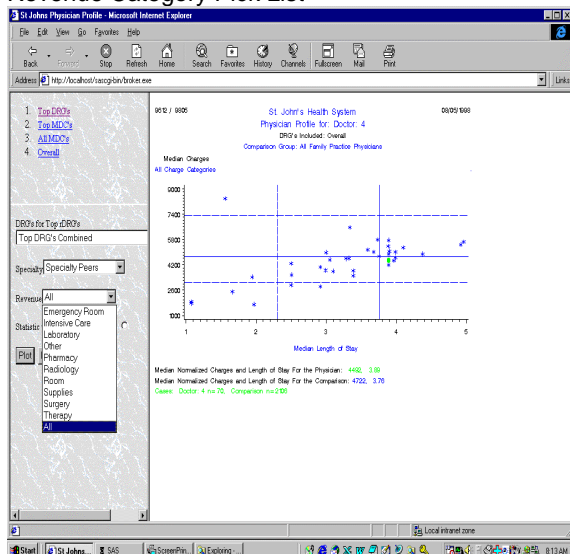


### Plot & Pick Lists

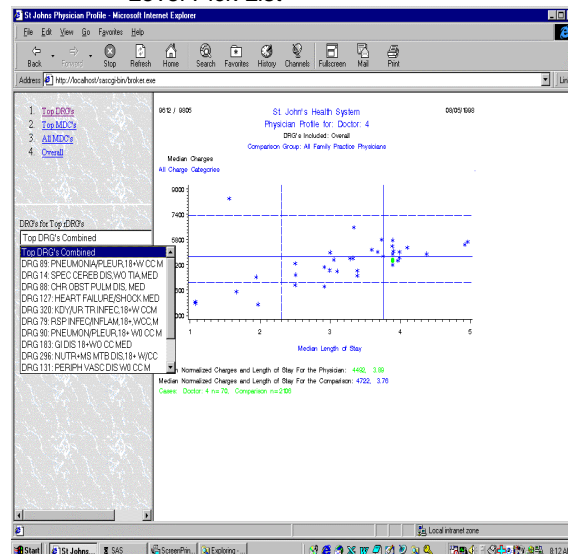


The following illustrates the use of pick lists to produce a plot based on user selected values. The Level pick list is sorted in descending order of the number of cases and level values for which the physician has not rendered services do not appear in the pick list:

### Revenue Category Pick List

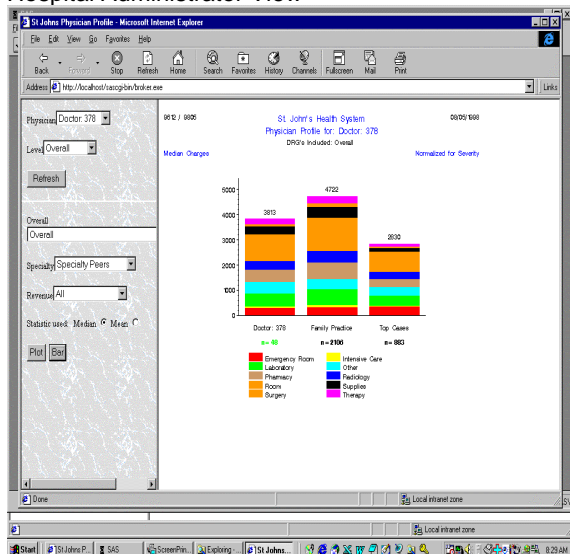


### Level Pick List

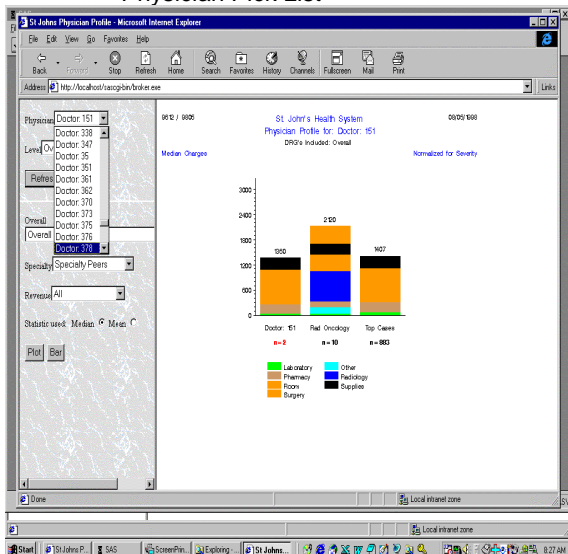


Hospital administrators have the ability to view profiles on any physician. A table is maintained for each login id which specifies the security level available. If the security level is that of a hospital administrator, a pick list of physicians is displayed, which is hidden when an individual physician logs in.

### Hospital Administrator View



### Physician Pick List



Default or user supplied parameters are passed as macro variables to SAS/GRAPH source code which generates the graphical output. This following shows the call to the SAS/GRAPH plot macro. The parameters, NORMMD, NORMTOP, MDMSTR, SPEC, RCATDATA, NORMSPEC all point to data warehouse tables. These are internal macro variable parameters and allow the application to access test and production data warehouses. The remaining parameters; ATDMD (physician login id), SELLEV (level), PICSPEC (normative table for comparison), STATTYPE (mean or median), and REVCAT (revenue category) are user pick list values or the default values for the initial display.

```
%CQILOT(NORMD=&NORMMD,
        NORMTOP=&NORMTOP,
        MDMSTR=&MDMSTR,
        SPEC=&SPEC,
        RCATDATA=&RCATDATA,
        NORMSPEC=&NORMSPEC,
        LEVDATA=&LEVDATA,
        ATDMD=&ATDMD,
        SELLEV=&SELLEV,
        PICSPEC=&PICSPEC,
        STATTYPE=&STATTYPE,
        REVCAT=&REVCAT)
```

## CONCLUSION

The SAS Data Warehouse is designed to support the Provider Profiling System with very little processing required. This reduces the complexity of the SAS/GRAPH source code and maximizes interactive response time. Future development areas for this application include the addition of tabular style reports to support the identification of physician outliers when compared to the normative tables and to supply detail case level information for final analysis.

## ACKNOWLEDGEMENTS

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