

Using SAS ® to Analyze Data Submitted to the National Healthcare Safety Network (NHSN)

Michelle Hopkins, Stratis Health, Bloomington, MN

ABSTRACT

Hospitals in the U.S. are required by the Centers for Medicare & Medicaid Services (CMS) to submit data on a variety of Healthcare-Associated Infections (HAIs). These are infections that are acquired in the course of receiving care for other health conditions. These HAIs include Central Line-Associated Bloodstream Infections (CLABSI), Catheter-Associated Urinary Tract Infections (CAUTI), Surgical Site Infections (SSI), Clostridium difficile Infections (CDI), and others. The number of HAIs in the United States is alarming, costly, and can be deadly. Hospitals report this data to the Center for Disease Control's National Healthcare Safety Network (NHSN). Using SAS ® 9.2, this paper will show how you can use the data found on NHSN for analysis. This analysis includes importing data, summarizing infection rates, and using the data to drive much needed improvement.

INTRODUCTION

A Healthcare-Acquired Infection (HAI) is an infection that a patient develops during the course of treatment for another healthcare issue. It is estimated that there are about 1.7 million infections and almost 100,000 deaths annually in the United States. For approximately every 20 hospitalizations, 1 will result in an HAI.

The National Healthcare Safety Network (NHSN) is the most widely used healthcare-associated infection (HAI) tracking system in the country. There are over 11,000 medical facilities tracking HAIs through NHSN. This system helps many organizations monitor current HAI rates, identify areas to focus on, and ultimately eliminate HAIs. Prospective Payment System (PPS) hospitals are required by the Centers for Medicare & Medicaid Services (CMS) to report to NHSN on several HAIs. Many states also require this and some are also requiring this for Critical Access Hospitals (CAHs).

Consumers can view HAI data to get an overview of a Medicare-certified hospital's HAI rates, and compare hospitals on the CMS Hospital Compare Website www.medicare.gov/hospitalcompare.

While many healthcare organizations are submitting data to NHSN, other entities are working with that data to be able to drive improvement in HAI reduction. This paper will briefly explain some of the different HAIs that are being reported on NHSN, how to access that data, and the SAS code that was used to calculate infection rates.

TYPES OF HEALTHCARE ASSOCIATED INFECTIONS

Currently PPS hospitals are required to report data on 5 HAIs: Central Line-Associated Bloodstream Infections (CLABSI), Catheter-Associated Urinary Tract infections (CAUTI), Surgical Site Infections (SSI), C. difficile Infections (CDI), and Methicillin-resistant Staphylococcus Aureus (MRSA) infections.

Central line-associated bloodstream infections (CLABSI) cause thousands of deaths annually and billions of dollars in added healthcare costs. CLABSI are serious, preventable infections that occur when germs (usually bacteria or viruses) enter the bloodstream through the central line. A central line is a catheter that doctors often place in a large, major vein in the neck, chest, or groin to give medication, give fluids, or collect blood for medical tests. These can remain in place for long periods of time and can be much more likely to cause serious infection. Central lines are commonly used in intensive care units (ICUs).

A urinary tract infection (UTI) is an infection in the urinary system, which includes the bladder, and kidneys. UTIs are the most common type of healthcare-associated infection reported to NHSN. Catheter-Associated Urinary Tract infections (CAUTI) account for approximately 75% of UTIs acquired in the hospital.

A Surgical Site Infections (SSI) is an infection that occurs after surgery in the part of the body where the surgery took place. SSIs can range from superficial infections involving only the skin to more serious infections involving tissues under the skin, organs, or implanted material.

Most types of HAIs are declining. However, infections caused by the germ C. difficile, remain historically high. C. difficile Infections (CDIs) cause diarrhea linked to 14,000 deaths annually in the United States. People who take antibiotics and also get medical care, especially older adults, are most at risk.

Methicillin-resistant Staphylococcus Aureus (MRSA) is a type of antibiotic resistant staph bacteria. In the community, most MRSA infections are skin infections.

ACCESSING NHSN DATA

In order to access data reported to NHSN, there are a variety of steps required by the Centers for Disease Control and Prevention (CDC). These steps include but are not limited to training, acquiring a digital certificate, nomination by an existing NHSN reporting healthcare facility, and for one or more healthcare organization(s) (i.e. hospitals) to confer rights to their reported data. Once these steps are completed, one can run reports and export data for further analysis. The following screen shots show how to pull SAS ® datasets, in particular, the CAUTI datasets.



Figure 1. First Screen on NHSN after Login

Click on "NHSN Reporting" on the left side of the screen.



Figure 2. NHSN Landing Page

Select the group for which you wish to access data. An organization may have one or more group(s). Select either a specific healthcare facility or "All Facilities" for which you wish to pull data for. Select the "Patient Safety" component to access HAI data. Click "Submit".

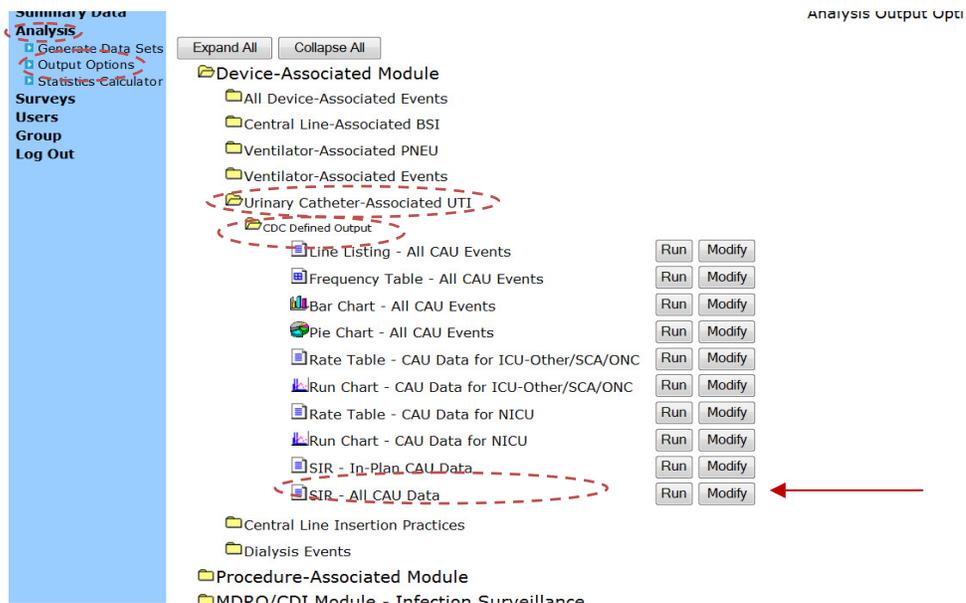


Figure 3. Analysis Output Options

Click on “Analysis” on the left side of the screen. Click on “Output Options”. Click on “Device-Associated Module”. Click on “Urinary Catheter-Associated UTI”. Click on the “Modify” button next to “SIR – All CAU Data”.

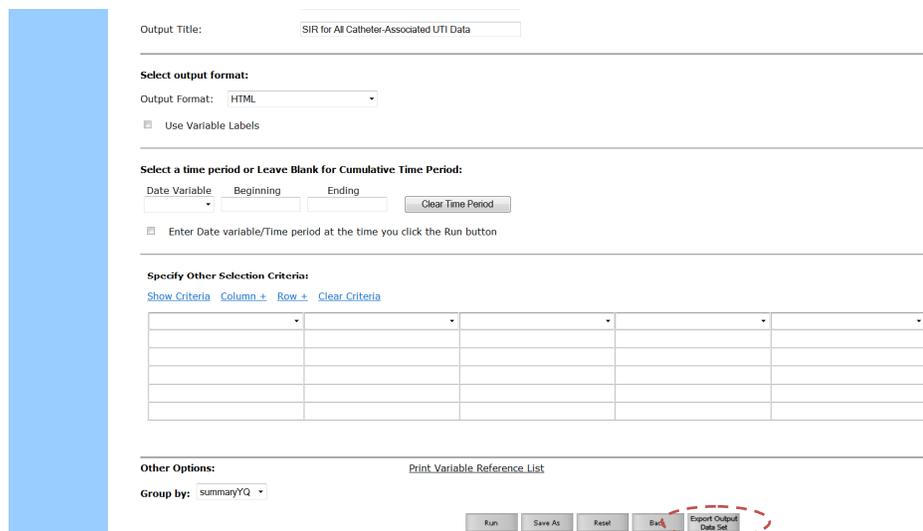


Figure 4. Modify Screen

Click on the “Export Output Data Set” button.

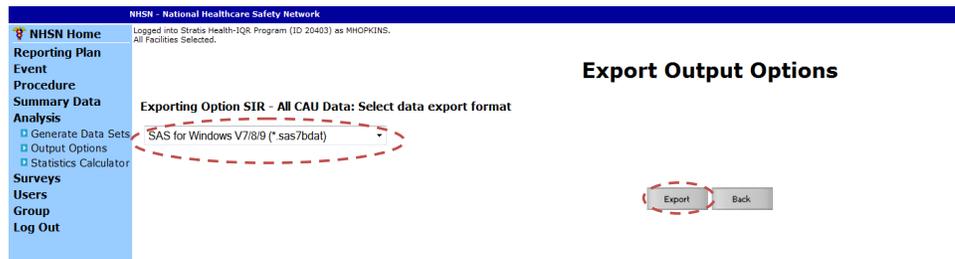


Figure 5. Export Output Options Screen

From the dropdown, select “SAS for Windows V7/8/9 (*.sas7bdat)”. Click “Export”.

SAS CODE

Very basic SAS ® code was written to read the SAS dataset generated by NHSN, create new variables, and print the data. This data can then be used to look at how each hospital is doing with their CAUTI rate, Standardized Infection Ratio (SIR), and Catheter Utilization Rate. Monitoring the data while hospitals are implementing various interventions for improvement created the need for using SAS ® to analyze the data from NHSN.

READING THE DATA

After exporting the "SIR_In_PlanCAUDData" dataset from NHSN, it was stored in the folder referenced by the HAI libname in the code below. The SQL procedure is then used to read the dataset and create a table called CAUTI in the temporary library called WORK. Using PROC SQL, only the variables needed are pulled from the SAS ® dataset and placed in the newly formed CAUTI table. The options statement at the top of the code lets the maximum number of observations be processed, makes sure the date is displayed on the output, and that the page number always starts with 1. Although some hospitals report CAUTIs for units outside of their ICU, the WHERE clause below is used to exclude the non-ICU units found in the data.

```
OPTIONS OBS=max date pageno=1;

LIBNAME HAI 'S:\10SOW\C7_QRI\Data\Raw_Data\Profile Reports\2013 Q1';
LIBNAME HAI2 'S:\10SOW\C7_QRI\Data\Working_Data\ProfileReports';

/* CAUTI Data from NHSN */
PROC SQL;
  CREATE TABLE WORK.CAUTI AS
  SELECT t2.infCount,
         t2.numucathdays,
         t2.numExp,
         t2.SIR,
         t2.summaryYQ,
         t2.orgid,
         t2.locationtype,
         t2.loccdc,
         t2.location,
         t2.months
  FROM HAI.SIR_In_PlanCAUDData t2
  WHERE t2.locationtype not = '' AND t2.loccdc not = 'IN:ACUTE:WARD:MS'
        AND t2.loccdc not = 'IN:ACUTE:WARD:REHAB'
        AND t2.loccdc not = ''; /* CHANGE/Verify each quarter */
QUIT;
```

ANALYSIS

To calculate the infection rate for CAUTIs occurring in each hospital, some basic calculations needed to be done in SAS ®. To do that, using the Sort procedure, it is first necessary to sort the CAUTI dataset by orgid (hospital) and by summaryYQ. SummaryYQ is the quarter and the year that the data is from. The Means procedure is then used to create new variables since each hospital could have multiple ICU units that they are reporting each quarter. Since it is not necessary to put the results of PROC MEANS in the output screen, the NOPRINT option is used. The variables from the CAUTI dataset that are analyzed include infCount (number of infections), numucathdays (number of urinary catheter days), and numExp (number of expected infections). Using the OUTPUT statement, the results are then put into a new SAS ® dataset named CAUTIsummary. For each hospital and each quarter, the sum of each variable in the VAR statement is also placed in that new dataset. These three new variables are CAUTIinfCount (the sum of infections across all ICU units in a hospital), CAUTinumucathdays (the sum of urinary catheter days across all ICU units in a hospital), and CAUTnumExp (the sum of the number of expected infections across all ICU units in a hospital).

```
/* Calculate CAUTI Numerator, Denominators, Rate, and SIR */
PROC SORT DATA = CAUTI;
  BY orgid summaryYQ;
RUN;
PROC MEANS DATA = CAUTI NOPRINT;
  VAR infCount numucathdays numExp;
  BY orgid summaryYQ;
  OUTPUT OUT = CAUTIsummary SUM=CAUTIinfCount CAUTinumucathdays CAUTnumExp;
RUN;
```

A new dataset called CAUTImaster is then created and stored in the HAI2 library referenced by the libname above. The SET statement assigns the CAUTIsummary dataset to the new dataset. The dataset option KEEP is used to only keep the five variables needed from CAUTIsummary and two newly created variables, CAUTRate and CAUTSIR. The CAUTI rate (CAUTRate) per 1,000 catheter days is calculated by dividing the number of infections by the number of urinary catheter days and multiplying it by 1,000. The SIR (CAUTSIR) is calculated by dividing the number of infections by the number of expected infections. The SIR adjusts for the fact that each healthcare facility treats different types of patients. The SIR compares the number of infections reported to NHSN in 2011 to the number of infections that would be expected based on national, historical baseline data. Although rare, it is possible to have 0 catheter days for a quarter within a hospital ICU. Since we can't divide by 0, an IF-THEN statement is used so that CAUTRate is only calculated if CAUTnumcathdays does not equal 0. Similarly, the IF-THEN statement is used so that CAUTSIR is only calculated if CAUTnumExp does not equal 0. The last IF-THEN statement is to assign the CAUTSIR a missing value (.) if the number of expected infections is less than 1. This is to allow for more precise comparisons.

```
DATA HAI2.CAUTImaster (KEEP=orgid summaryYQ CAUTinfCount CAUTnumcathdays CAUTnumExp
CAUTRate CAUTSIR);
  SET CAUTIsummary;
  IF CAUTnumcathdays ne 0 THEN
    CAUTRate = (CAUTinfCount/CAUTnumcathdays)*1000;
  IF CAUTnumcathdays ne 0 THEN
    CAUTSIR = CAUTinfCount/CAUTnumExp;
  IF CAUTnumExp < 1 THEN CAUTSIR = .;
RUN;
```

The Print procedure is then used to send the data to the SAS ® output screen. The CAUTImaster table is printed by orgid (hospital) and the data for the variables listed in VAR statement is displayed. The FORMAT statement formats both CAUTRate and CAUTSIR so that it has three decimal places since that is the typical way of expressing the CAUTI rate and SIR.

```
PROC PRINT DATA=HAI2.CAUTImaster;
  BY orgid;
  VAR orgid summaryYQ CAUTinfCount CAUTnumcathdays CAUTRate CAUTinfCount
CAUTnumExp CAUTSIR;
  FORMAT CAUTRate 7.3 CAUTSIR 7.3;
RUN;
```

CONCLUSION

This analysis done with SAS ® using the CAUTI data pulled from NHSN can be replicated for the other infections reported to NHSN. Rates and SIRs can be tracked over time in hopes that improvement will be shown and ultimately eliminating infections acquired during hospitalizations.

REFERENCES

- <http://www.hhs.gov/ash/initiatives/hai/training/>
- <http://www.cdc.gov/nhsn/index.html>
- <http://www.cdc.gov/hai/>

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Name: Michelle Hopkins
 Enterprise: Stratis Health
 Address: 2901 Metro Drive, Suite 400
 City, State ZIP: Bloomington, MN 55425
 Work Phone: 952-853-8573
 Fax: 952-853-8503
 E-mail: mhopkins@stratishealth.org
 Web: www.stratishealth.org

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