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H·CUP
HEALTHCARE COST AND UTILIZATION PROJECT

METHODS FOR PRODUCING RAPID CYCLE ESTIMATES
DELIVERABLE #1325.04C

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EXECUTIVE SUMMARY

This report evaluates and recommends methods for generating projections using quarterly data for the Healthcare Cost and Utilization Project (HCUP). HCUP is a family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). Among HCUP's objectives are to:

- Create and enhance a powerful source of national, state, and all-payer health care data.
- Produce a broad set of software tools and products to facilitate the use of HCUP and other administrative data.
- Enrich a collaborative partnership with statewide data organizations aimed at increasing the quality and use of health care data.
- Conduct and translate research to inform decision making and improve health care delivery.

The goal of this task is to improve the timeliness of inpatient estimates at the National, Regional, and State level and addresses all four of these goals. Within this report, we describe and assess techniques for creating previous-year and present-year estimates for inpatient statistics using quarterly data from selected Healthcare Cost and Utilization (HCUP) Partners. The terms “previous-year” and “present-year” are relative to the release date of the Nationwide Inpatient Sample (NIS). The data contained in the NIS lags the current calendar year by about 17 months. For example, the expected release dates for the 2009 and 2010 NIS are during May of 2011 and 2012, respectively. Rather than wait until 2011 to calculate 2009 inpatient statistics and wait until 2012 to calculate 2010 inpatient statistics, our objective is to produce estimates in August of 2010 using historical State Inpatient Data (SID) data along with any “early” 2009 and 2010 quarterly data available from Partners by June or July of 2010. The goal of this task is to improve the timeliness of estimates of inpatient statistics at the National, Regional, and State level.

AHRQ initiated this study to further these objectives. In particular, this study’s objective was to create more timely information on trends in hospitalizations. The HCUP’s premiere resource for national-level hospital discharge information is the annual Nationwide Inpatient Sample (NIS), with inpatient data from a national sample of approximately 1,000 hospitals, released in May of each year. However, the NIS data content predates the NIS release by two years. For example, the NIS released in May 2010 will contain data for 2008. Consequently, the most recent NIS always represents a lag of at least 17 months.

This study proved the feasibility of generating quarterly projections of hospital discharge information to bridge the 17-month gap and beyond. For example, using the methods explained in this report, projections for quarterly discharge statistics covering 2009 and 2010 will be generated in August 2010.

This was not viable at an earlier date for three reasons.

1. The number of HCUP Partners has expanded over the years to include an ever-larger percentage of hospital discharges nationwide. Thus, HCUP now has a long history of discharge information with adequate national coverage required to fit statistical time series models.

2. Several HCUP Partners agreed to supply up to five “early” quarters of data to extend the historical time series even further with more recent information. For example, some Partners have agreed to supply quarterly inpatient data during 2010 covering some or all of 2009 and the first quarter of 2010.
3. SAS released a Time Series Forecasting System™ with Version 9.2 of its Economic Time Series software. This system automatically fits and assesses up to 30 different time series methods for fitting time series models. This was critically important because it reduced the time necessary to choose the best statistical model for each time series. This study automatically fitted and selected the best time series model for 128 different time series.

We developed models and produced quarterly national projections for four inpatient outcomes:

- average length of stay
- mortality rate
- average charges
- count of discharges.

These outcomes were projected for 19 different patient diagnoses (e.g. asthma and septicemia), seven different procedures (e.g., hip and knee replacements), and six different patient safety indicators (e.g., postoperative sepsis and iatrogenic pneumothorax) selected by AHRQ staff for this study.

We generated projections according to five different methods distinguished by the extent to which data for the five early quarters were used in the time series forecasting model and in the projections:

1. A “baseline” model was generated from a time series model that did not incorporate any early data.
2. An “Early Four” model incorporated four quarters of early data into the time series model.
3. An “Early Five” model incorporated five quarters of early data into the time series model.
4. An “Impute Four” model substituted imputed values for the first four quarters of projections from the “Early Four” model.
5. An “Impute Five” model substituted imputed values for the all five quarters of projections from the “Early Five” model.

Through simulation, we evaluated the performance of these projection models by comparing the projections against known values for the outcomes over a two-year projection period. Although the best projection method varied from outcome to outcome and from condition to condition, the “Early Four” and “Impute Four” models tended to outperform the other models. The fifth quarter of early data tended to provide unstable estimates because it was based on the fewest states. However, the first four quarters of early data tended to improve the projections compared with those from the baseline model, which employed no early data.

Average errors for the best projection models were frequently in the 1 to 2 percent range for average lengths of stay, average charges, and discharge counts. The average errors for the best mortality projections were similarly low.

As a result, we recommend replicating the estimation process described in this report to generate 2009 and 2010 national-level projections in August of 2010. These projections will give analysts and policymakers more timely information concerning trends for inpatient outcomes nationally. Moreover, at AHRQ’s request it would be relatively straightforward to generate individual state-level projections for 2009 and 2010 for all of the HCUP Partners with an adequate history of inpatient data contributions.

INTRODUCTION

The Healthcare Cost and Utilization Project (HCUP, pronounced "H-Cup") is a family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of patient-level health care data (HCUP Partners). HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State, and local market levels.

HCUP's objectives are to:

- Create and enhance a powerful source of national, state, and all-payer health care data.
- Produce a broad set of software tools and products to facilitate the use of HCUP and other administrative data.
- Enrich a collaborative partnership with statewide data organizations aimed at increasing the quality and use of health care data.
- Conduct and translate research to inform decision making and improve health care delivery.

This report describes and assesses methods for creating previous-year and present-year estimates for inpatient statistics using quarterly data from selected Partners. The terms “previous-year” and “present-year” are relative to the release date of the Nationwide Inpatient Sample (NIS). The data contained in the NIS lags the current calendar year by about 17 months. For example, the expected release dates for the 2009 and 2010 NIS are during May of 2011 and 2012, respectively. Rather than wait until 2011 to calculate 2009 inpatient statistics and wait until 2012 to calculate 2010 inpatient statistics, our objective is to produce estimates in August of 2010 using historical State Inpatient Data (SID) data along with any “early” 2009 and 2010 quarterly data available from Partners by June or July of 2010. The goal of this task is to leverage the breadth of states (more than 40) and longitudinal data (over 20 years) to improve the timeliness of estimates of inpatient statistics at the National, Regional, and State level.

We plan to leverage the current HCUP Partner relationships to obtain quarterly data available from HCUP Partners shortly after a quarter’s end. Prior to constructing estimates, we will process the data and assess their quality and completeness. We mention these tasks only to acknowledge their importance. This report focuses on plans and issues of using the processed data to generate estimates. We will refer to these estimates as “projections,” consistent with the U.S. Census Bureau’s “projections” of population statistics for past, present, and future years based on the 2000 census.

Unlike previous efforts, this report recommends methods for generating projections using quarterly data. Earlier efforts in this direction using “early” annual data were disappointing. Nevertheless, the HCUP inpatient databases encompass a long history covering hospitalizations in a large number of states. The Agency for Healthcare Research and Quality (AHRQ) and Thomson Reuters were convinced that broadening the early data pool through quarterly data and incorporating the richness of the historical SID data would improve both the accuracy and the timeliness of early projections over projections generated in the previous effort.

The methods described in this report assume access to quarterly data anticipated to be available from selected states over the next few years. However, the methods may differ in 2010 because of data shortfalls. We expect to process quarterly data for only five states in 2010.

BACKGROUND

In 2008, as part of the broader Rapid Cycle Estimates Task, the HCUP team was tasked with evaluating the feasibility of collecting quarterly discharge data from HCUP Partners. For the quarterly data feasibility study, conducted in November 2008, the HCUP Team surveyed all 40 HCUP Partners to determine the availability, quality, and consistency of quarterly data. Thirty-six out of 40 Partners responded to the survey and approximately 80 percent of HCUP Partners (32 states) indicated that they are collectors of quarterly inpatient data. Twenty-six percent of the respondents reported that the quality of their quarterly data differs from that of their annual data, and 32 percent reported that their quarterly data are less complete than their annual data. Our biggest concerns relate to the Partners' ability to obtain all of the records in a timely manner, given frequent hospital submission delays and subsequent resubmissions. The evaluation report[1] summarized the findings and recommended strategies for pursuing quarterly data from HCUP Partners. A subsequent report[2] estimated costs and examined infrastructure requirements for obtaining and processing quarterly data.

A separate task attempted to generate national estimates of selected statistics *for the previous year* based on annual inpatient discharge data from a subset of states that were expected to supply data "early" (before August or September). The focus of this effort was to develop estimates using existing data streams of annual inpatient data. We tested methods for predicting average charges, average lengths of stay (ALOS), average mortality rates, and the total number of discharges for 28 diagnosis and procedure categories, as well as for four patient safety indicators[3]. These projections were found wanting. Rather than attempt to fit more complicated models to improve estimates using annual data, AHRQ and Thomson Reuters researchers concluded that resources would be better spent by shifting efforts to developing estimates using early quarterly data expected to be available from a broader array of states.

RAPID CYCLE PROJECTIONS

In the previous study, we attempted to develop projections for the *prior* year. In this study, we develop projections for the *present* year. For example, in August of 2010 we will deliver

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[1]Deliverable #825.21A "State Quarterly Data Evaluation Report"
http://www.hcup-us.ahrq.gov/team/pd/deliv2/deliverable825_21Afinal.pdf

[2]Deliverable # 825.21B "Quarterly Data Infrastructure and Recommendation Report"
http://www.hcup-us.ahrq.gov/team/pd/deliv2/deliverable825_21B.pdf

[3]Deliverable #825.11B "Rapid Cycle Estimates Test Methods Report"
http://www.hcup-us.ahrq.gov/team/pd/deliv2/deliverable825_11BV2.pdf

estimates of average 2010 charges for patients hospitalized with asthma using previous year State Inpatient (SID) data in combination with 2009 quarterly data and 2010 first quarter data obtained from states with quarterly data available by July of 2010.

We foresee same-year projections as supplemental information that augments and enhances HCUP data. Estimates from annual Nationwide Inpatient Sample (NIS) files will remain the “gold standard” for hospital-based health care statistics. In descending order of importance, our goals are to generate:

- national or regional projections for the entire current year
- national or regional projections for Q1 of the current year
- State-specific projections for all of the current year.

Projections are more feasible now than at any time in the past for two reasons. First, most time series forecasting models require a long history in order to fit time series models. To address that concern we now have a long history of both NIS and SID databases on which to base forecasts. Second, time series forecasting has traditionally required large commitments of time to test and fit alternative models. However, earlier this year SAS released a new version of its forecasting software that includes an automated procedure for fitting up to 30 different forecasting models that have proven successful over a wide range of problems, and for selecting the best fitting model based on user-selected criteria. We are now able to estimate and implement satisfactory forecasting models efficiently for hundreds of outcomes, as explained below.

Methods

We developed models and produced quarterly projections for four inpatient outcomes:

- average length of stay
- mortality rate
- average charges
- number of discharges.

Although we produced estimates for all four outcomes, AHRQ places higher priority on estimates for average charges and numbers of discharges, which are expected to be particularly relevant to the present health reform debate.

Outcome Statistics and Patient Conditions

Table 1 lists the conditions, procedures, and patient safety indicators (PSIs) we selected for our analyses. These criteria were selected by AHRQ staff during development to represent a broad cross section of procedures, conditions and age groups. Most of the condition and procedure categories are defined by AHRQ’s Clinical Classification Software (CCS). Other categories are defined by specific ICD-9-CM diagnosis and procedure codes. Diagnosis category 14, Ventilator associated pneumonia, is listed as an important outcome for future reference. However, it is not used in our analyses because the code only became available in FY 2008.

Table 1: Patient Conditions and Procedures

	Single-CCS	Multi-CCS	ICD-9-CM codes
Diagnoses			
1. Asthma	128		
2. Cancer - Breast			174.x, 175.x, 233.0
3. Cancer - Colon			153.x,159.0, 230.3
4. Cancer - Lung			162.2-162.9, 231.2
5. Cancer - Prostate			185, 233.4
6. Diabetes	49, 50		
7. Acute Myocardial Infarction	100		
8. Depression (MHSA Mood disorders	657		
9. Decubitus Ulcers		12.3.1	
10. Stroke, ischemic			433.x1, 434.x1, 436
11. Dementia	653		
12. Methicillin-resistant *Staphylococcus Aureus* (MRSA)			See Table 2
13. Pneumonia	122		CCS 122 or ICD-9 code 487.0
14. Ventilator associated pneumonia			997.31 (implemented FY2008)
15. Postoperative infection			998.51, 998.59
16. Clostridium difficile			008.45
17. Peptic Ulcers			531.00-533.91
18. Septicemia			See Table 3
19. Cellulitis			681.00-681.9
20. Renal Failure, Acute	157		
Procedures			
21. Hip Replacements	153		
22. Knee replacements	152		
23. Bariatric Procedures			44.31-44.39, 44.68, 44.95-44.98
24. C-sections	134		
25. CABG	44		
26. PTCA	45		
27. Spinal fusion			81.00-81.09, 81.31-81.39, 81.64
Patient Safety Indicators[4]			
28. Selected infections due to medical care (Central line infections)			
29. Postoperative sepsis			
30. Accidental puncture or laceration			
31. Iatrogenic pneumothorax			
32. Postoperative hemorrhage or			
33. Postoperative respiratory failure			

[4]PSI specifications are available at http://www.qualityindicators.ahrq.gov/psi_download.htm

Table 2: Codes for Methicillin-Resistent *Staphylococcus Aureus* (MRSA)

MRSA requires 2 codes:
1. V09.0 (infection with microorganisms resistant to penicillins) plus a code for Staph aureus Infection.
2. Staph aureus infections:
482.41 Pneumonia due to Staphylococcus aureus
038.11 Staphylococcus aureus septicemia
041.11 Staphylococcus aureus infection in conditions classified elsewhere and of unspecified site

Table 3: Codes for Septicemia

Any of the following codes:
038.0 Streptococcal septicemia
038.10 Unspecified staphylococcal septicemia
038.11 Staphylococcus aureus septicemia
038.19 Other staphylococcal septicemia
038.2 Pneumococcal septicemia
038.3 Septicemia due to anaerobes
038.40 Septicemia due to unspecified gram-negative organism
038.41 Septicemia due to hemophilus influenzae (H. influenzae)
038.42 Septicemia due to Escherichia coli (E. coli)
038.43 Septicemia due to pseudomonas
038.44 Septicemia due to serratia
038.49 Other septicemia due to gram-negative organism
038.8 Other specified septicemia
038.9 Unspecified septicemia
003.1 Salmonella septicemia
054.5 Herpetic septicemia
036.2 Meningococcemia

Estimation Strategy

We used historical SID data to simulate the expected arrival of quarterly data availability (shown in Table 8), generate projections from those data, and then assess the accuracy of those projections, as we explain in this section.

We developed projections and tested their accuracy using historical data. In particular, we generated quarterly projections using discharges from all community hospitals in all available SID files for the base period 2001 through 2005. These projections were augmented simulated quarterly estimates for 2006 with SID data expected to be available in July of the current year. This was done for each patient condition listed in Table 1. We then compared those projections to the actual known national quarterly estimates provided by the entire SID for that year. This process was repeated for each of the four outcomes measured.

Our objective was to generate early projections, not create an early version of the NIS. Therefore, we did not sample hospitals as we do for the NIS. However, we did use the NIS hospital stratification scheme to derive SID discharge weights.

After splitting each of the annual SID files for the years 2001-2007 into separate quarterly files, we simulated the arrival of quarterly SID files for the years 2001-2007. Thus, we approximated the expected quarterly data available for projections, using 2001-2005 as historical baseline data and projected 2006 and 2007 quarterly statistics.

For example, to project quarterly ALOS for 2006 and 2007 we used:

1. SID quarterly ALOS from 2001 through 2005 using inpatient data from in all participating states for each of those years
2. SID quarterly ALOS from 2006 based only on states expected to have “early” data available for each individual quarter of the prior year (2009 in Table 8)
3. SID first-quarter data from 2007 for states expected to have “early” data available in the current year (2010 in Table 8).

While the NIS is based on a sample of hospitals, we had complete data from all 40 SID states. Therefore, we estimated outcomes using the historical SID data rather than using the historical NIS data. Consequently, the SID data contained a much larger “sample” of hospitals and generated more precise estimates. We used only SID hospitals in the NIS sampling frame for this purpose because the target population for projections remains the same. The hospital universe is defined by all hospitals that were open during any part of the calendar year and were designated as community hospitals by the American Hospital Association (AHA) Annual Survey of Hospitals, excluding rehabilitation hospitals. For the NIS, the definition of a community hospital is that used by the AHA: "all nonfederal short-term general and other specialty hospitals, excluding hospital units of institutions."

We developed discharge weights to weight SID discharges to the entire U.S. population of discharges using the same method used to calculate discharge weights to weight the NIS to the population of discharges. That is, we stratified the SID hospitals (using the NIS stratification scheme) and used population discharge counts based on data contained in the AHA survey files to calculate SID discharge weights.

Below, we describe the methods we recommend to produce projections from a combination of complete SID historical files and early quarterly data.

Statistical Methods

We developed estimates of quarterly trends based on full SID estimates beginning with the 2001 data year and ending with the 2005 data year. We then simulated the arrival of early quarterly data for data years 2006 and 2007 and then used statistical forecasting models to project quarterly statistics for 2006 and 2007.

For our analyses, we summarized outcomes by quarter for each condition listed in Table 1 (except ventilator-associated pneumonia). We calculated quarterly statistics such as ALOS for each state, NIS stratum, and condition (e.g., asthma) over the entire period 2001-2007. This allowed us to obtain stratified statistics separately for sets of early states in the simulations.

We employed the SAS® Forecast Studio, a time series forecasting application. SAS introduced this tool in 2009 with version 9.2 SAS® (this functionality was not available for earlier efforts to create early NIS estimates based on annual data).

The projections described in this report involve a large number of statistical forecasting models. In all, 128 forecasting models are required to project four separate outcomes for 32 different conditions. For demonstration and feasibility purposes we produced nationwide projections. However, these methods can also generate state-specific projections. The SAS® time series tool was designed for problems requiring some degree of automation such as this. Figure 1 represents one of the outputs from this tool, showing the average charge for Septicemia generated from a forecasting model fit to the historical time series (the black dots falling to the left of the heavy vertical dashed line in the graph).

In reading this graph:

- Black dots represent the historical quarterly observed SID values from 2001 through 2005.
- The blue line represents the forecast from the model fit to the observed values from 2001 through 2005. Note the historical within-year pattern replicated in the forecasts for 2006 and 2007.
- Hollow circles represent estimates from the forecasting model. These quarterly estimates represent one projection of average charges for 2006 and 2007 (shown after the heavy dashed vertical line).
- The purple lines represent the upper and lower ranges of a 95 percent confidence interval for each estimate. Notice that the confidence intervals steadily widen as the time period moves farther into the future, as should be expected.

The model shown in Figure 1 was fit to the logarithm of charges using the Winters (smoothing) method with additive seasonal factors, which was the best-fitting of many different statistical forecasting models evaluated by the software. The SAS® tool compares the results of approximately 30 different time series models based on user-supplied criteria and selects the most accurate model. As described in a SAS White Paper[5]:

> *The goal is to provide a list of candidate models that will forecast the large majority of the time series well. In general, when an analyst has a large number of time series to forecast, the analyst should use automatic forecasting for the low-valued forecasts; the analyst can then spend a larger portion of his/her time dealing with high-valued forecasts or low-valued forecasts that are problematic.*

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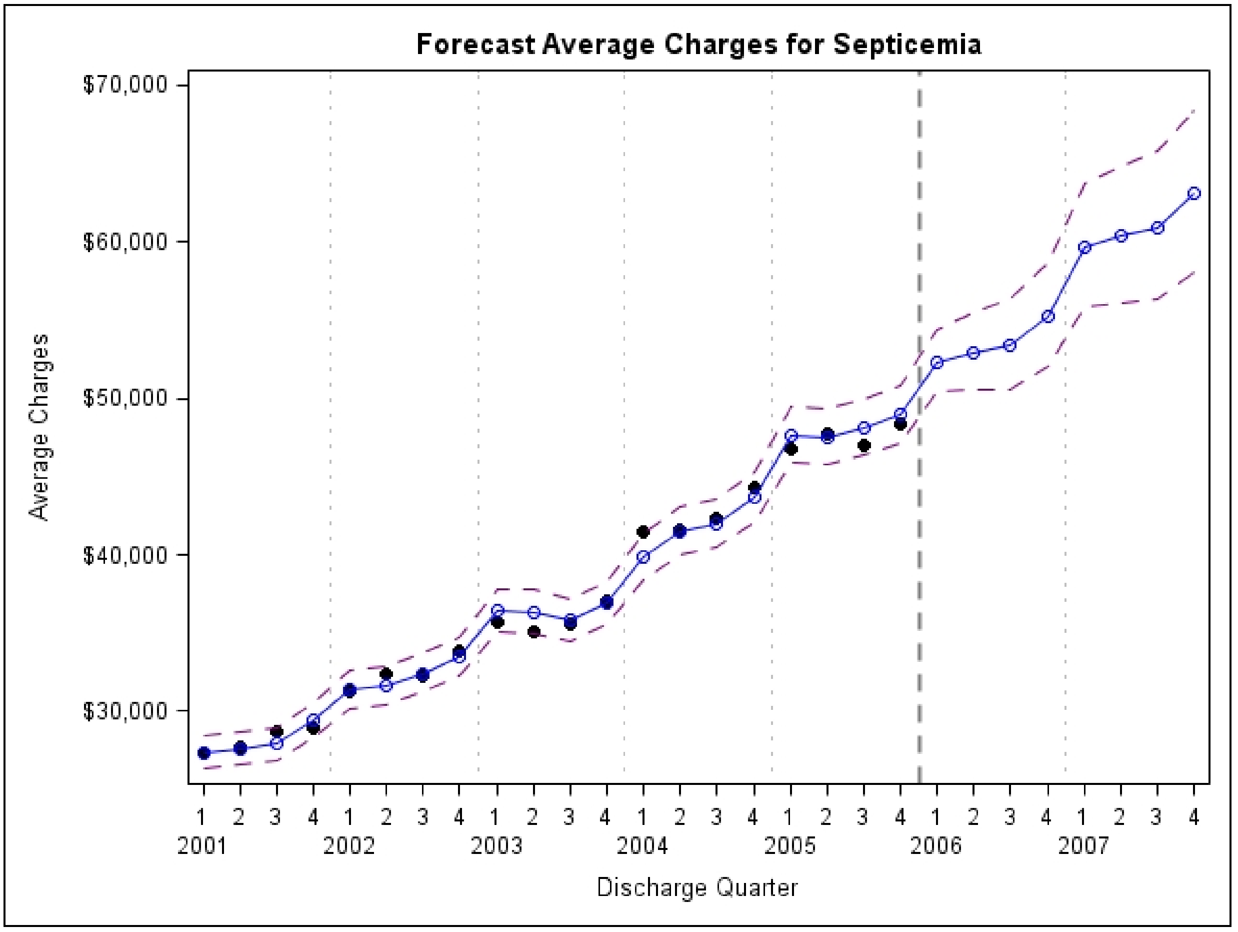
[5] *Large-Scale Automatic Forecasting Using Inputs and Calendar Events: A demonstrated technique for efficiently producing forecasts for millions of time series*. The SAS Institute

In this context, “high-valued” refers to estimates for the most important outcomes and conditions. For example, if it is highly important to obtain the very most accurate estimates possible for say, septicemia discharge counts, then extra time and effort can be devoted to refining the model generated by the forecasting system.

Figure 1: Septicemia Model for Average Charges



The types of models considered by the software ranged from relatively simple to very sophisticated and complex methods. These models decompose time series into:

- a level (mean) component,
- trend factors, and
- seasonal factors.

In addition, these models can identify inflection points where observed behavior changes, perhaps caused by changes in medical coding or treatments.

Figure 1 demonstrates the model’s ability to derive seasonal factors. Although Figure 1 shows the trend in unadjusted dollars, forecasts can be inflation-adjusted for reporting purposes.

Mean Absolute Percentage Error (MAPE)

For all outcomes except mortality, we calculated the mean absolute percentage error for evaluating the fit of each model. This was the criteria used by the forecasting system to select the best statistical time series forecasting model. Also, to compare the five projection methods we measured the MAPE over the eight quarters spanning 2006-2007. This is a common measure of forecasting model accuracy. Smaller values of MAPE are better. For mortality, zero mortality is possible, which would result in invalid values for MAPE (zero denominators). Therefore, we employed the mean absolute error (MAE) for mortality.

In practice, we will usually select the model with the lowest MAPE or MAE value. However, we will also consider second-best and third-best models if they appear to generate more reasonable projections compared with the “best” model based on an inspection of the graphs.

Incorporating Quarterly Data into the Models

The historical complete-year SID data can be used for projecting overall levels, trends, and seasonality for the various measures, as was shown in Figure 1. However, the complete-year data will lag the current year by at least six quarters. When the underlying trend factors are relatively constant, this should be sufficient for accurate and reliable projections. However, trends sometimes change. There can be inflection points when state or Federal policies change, when technology advances, or when clinical practice patterns change. We view “early” quarterly state data as a tool that will help alert us to these inflection points over the five quarters for which early data will be available.

For the simulation, we generate national projections for 2006 and 2007 using historical SID data covering 2001-2005 in combination with early quarterly SID data covering 2006 and Q1 2007. Since we have “known” SID estimates based on all SID data for 2006 and 2007, we compare the projections to the known values. In the following, we describe our approach for using the early data to estimate ALOS. *The approach for other outcomes is the same*.

First, separately for each condition in Table 1 we imputed national ALOS estimates for Q1-Q4 2006 and Q1 2007 as follows:

1. **Identify the early states**. In practice, we will know the states for which we have early data. For this simulation, we identified states expected to deliver “early” quarterly data from Table 8. For example in the simulation:
    a. We assume that we will have Q1-Q4 2006 data for AZ because, according to Table 8, we expect AZ to deliver Q1-Q4 2009 data during the summer of 2010.
    b. Similarly, for CA we assume that we will have Q1-Q2 2006 data, and for GA we assume that we will have Q1-Q4 2006 and Q1 2007 data.
2. **Calculate discharge weights for early states over the entire period 2001-2007**. Individually for each year and for each of the five sets of states corresponding to the five early quarters, we stratified the hospitals in the early states using the NIS stratification. We then calculated weights for each stratum as the ratio of discharges in the national universe to discharges in the early states. The number of discharges in the universe for each stratum was the same as the universe for the NIS (derived from the AHA survey). For quarters with fewer early states, it was necessary to collapse some strata due to a lack of discharges from the early states in those strata. This collapsing was a manual process.
3. **Calculate discharge weights for all SID states over the baseline period 2001-2005**. The process was the same for all SID states as that described in step 2 for the early SID

states. However, it was not necessary to collapse strata because of the large number of SID hospitals available each year.

4. **Calculate discharge-weighted quarterly ALOS for early states over the entire period 2001-2007**. Using each of the five sets of early states available for 1) Q1 2006, 2) Q2 2006, 3) Q3 2006, 4) Q4 2006, and 5) Q1 2007, calculate the discharge-weighted ALOS for every quarter for the years 2001-2007.
5. **Calculate discharge-weighted quarterly ALOS for all SID states over the baseline period 2001-2005**. Using all SID states, calculate the discharge-weighted ALOS for every quarter for the "historical" years 2001-2005.
6. **Calculate the average ratio of the all-state ALOS calculated in step 5 to the early-state ALOS calculated in step 4 over the baseline period 2001-2005**. For each quarter for the years 2001-2005 we calculated the average quarterly ratio of the all-state ALOS calculated in step 5 to the early-state ALOS calculated in step 4. For example, for the subset of states expected to have early Q1 data in 2006 we calculated the average of the ratios for Q1 2001, Q1 2002, Q1 2003, Q1 2004, and Q1 2005.
7. **Impute a full-SID estimate of ALOS for the five early quarters**. Separately for each quarter in Q1-Q4 2006 and Q1 2007, we imputed a full-SID estimate of ALOS by multiplying the early SID estimate for that quarter calculated in step 4 by the applicable ratio calculated in step 6. For example, suppose that the average historical ratio of ALOS for all states to ALOS for early states was 1.25 for Q1, indicating that the early states ALOS historically underestimated the all-state ALOS by about 25 percent for Q1. Then we would multiply the early-state ALOS for Q1 2006 by 1.25 to estimate the all-state ALOS for Q1 2006.

Second, we appended these five imputed quarterly SID estimates to the end of the historical SID time series (2001-2005). The statistical forecasting models treated the five imputed quarterly estimates as if they were SID estimates from the entire complement of SID states (not just the subset of states actually available for those quarters).

Third, we produced five sets of projections for 2006 and 2007:

1. **Baseline Projections**: forecasts from the best time series model based solely on historical 2001-2005 full SID values without any "early" quarterly imputed values.
2. **Early Four Projections**: forecasts from the best time series model based on historical 2001-2005 full SID values augmented by four imputed "early" quarterly values for Q1-Q4 2006.
3. **Early Five Projections**: forecasts from the best time series model based on historical 2001-2005 full SID values augmented by five imputed "early" quarterly values for Q1-Q4 2006 and Q1 of 2007.

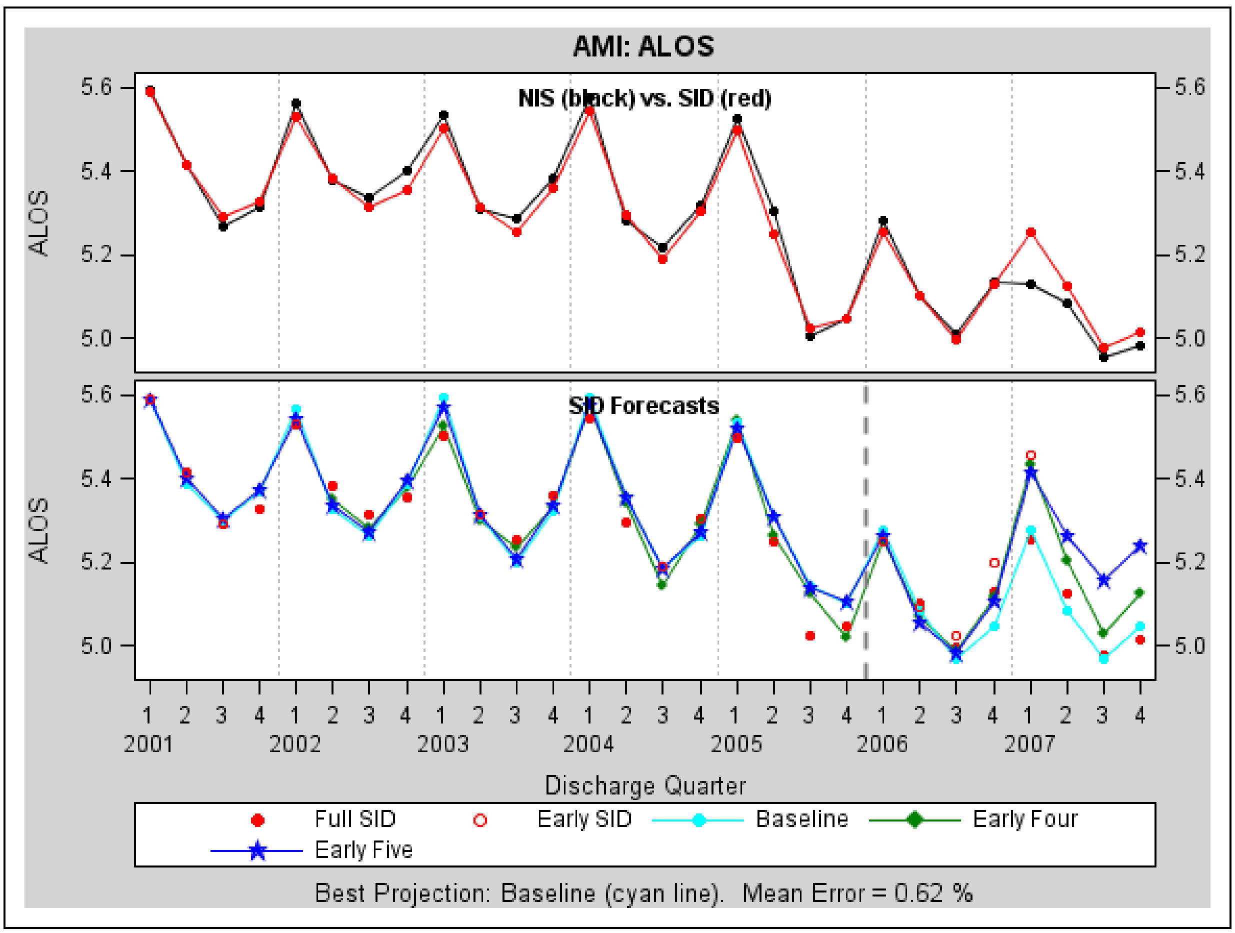
For projection # 2 and projection # 3 ("early four" and "early five," respectively), the imputed quarterly estimates *influenced* projections, but the imputed values *did not substitute* for the projections. Therefore, we considered two other sets of projections, which substituted the imputed quarterly estimates for the estimates from the time series forecasting model:

4. **Impute Four Projections**: time series forecasts for Q1-Q4 2007 based on projection model # 2 and substitute four imputed values to project for Q1-Q4 2006.
5. **Impute Five Projections**: time series forecasts for Q2-Q4 2007 based on projection model # 3 and substitute five imputed values to project for Q1-Q4 2006 and for Q1 2007.

Figure 2 illustrates the various projections for acute myocardial infarction (AMI) ALOS. The top graph compares the trend in AMI ALOS based on the NIS (black line) to the trend based on the SID (red line). The two trends are in close agreement, as we would expect. The bottom graph shows the projections. The red dots represent the all-state SID estimates in the "historical" time series from 2001 to 2005 and the known values for 2006 and 2007. The red circles represent the imputed values based on early state data for 2006 and 2007. The cyan line shows the "baseline" projections from the time series model based solely on historical data. The green line represents the "early four" projections from the time series model based on the combination of historical data and the Q1-Q4 2006 imputed values (red circles). The dark blue line represents the "early five" projections from the time series model based on the combination of historical data and all five imputed values (red circles). The red circles for 2006 and the green line for 2007 represent the "impute four" projection. The red circles for 2006 and Q1 2007, and the dark blue line for Q2-Q4 2007 represent the "impute five" projection. The text below the graph states which model was "best" (had the lowest MAPE or lowest MAE among the models shown) and displays its mean error.

The appendices contain similar graphs for all conditions and all outcomes.

Figure 2: ALOS Projections for Acute Myocardial Infarction



Outpatient Data

Our initial efforts focused on inpatient measures, although the task at hand is much broader. HCUP inpatient data, including the NIS spans nearly 20 years. There is obviously a rich and robust source of information and a long period of time series data. For outpatient data, however, the data are more limited. While some ambulatory surgery (AS) and emergency department (ED) data reach back more than 15 years, many state data files have more limited availability. In addition, there are no nationwide samples of AS data and only one year for Nationwide ED data. For that reason, we expect that national projections are unlikely until there are at least two, and possibly three or more years of Nationwide ED data. However, we expect that the approach for those data will be similar to this approach for inpatient data.

Results

An examination of the graphs reveals that plausible and useful projections were generated for nearly all of the conditions and outcomes tested in this study. Tables 4, 5, 6, and 7 summarize the results for projections of ALOS, mortality, average charges, and discharge counts, respectively. These four tables succinctly summarize the fit of a multitude of statistical models and projection methods generated by the modeling process described earlier.

Each table contains results for the five different projection methods:

- **Early Five**: This method generates projections for 2006 and 2007 from a time series forecasting model that incorporates the imputed values for all five early quarters (Q1-Q4 2006 and Q1 2007) into the historical data.
- **Baseline**: This method generates projections for 2006 and 2007 from a time series forecasting model that does not incorporate any imputed values into the historical data.
- **Early Four**: This method generates projections for 2006 and 2007 from a time series forecasting model that incorporates the imputed values for the four 2006 early quarters.
- **Imputed Four**: This method generates projections for 2006 by substituting the imputed 2006 SID values and generates projections for 2007 from the Early Four model.
- **Imputed Five**: This method generates projections for 2006 and for Q1 2007 by substituting the imputed SID values and generates projections for Q2-Q4 2007 from the Early Five model.

The “baseline” projection method is placed between the “early five” method and the “early four” method to more easily compare the performance of the model without early data to the models with early data, yielding some sense of the value of early data. Separate projections were estimated using four quarters of early data and five quarters of early data because the fifth quarter (Q1 2007) imputed value was based on data from only eight states (last column of Table 8), which made that imputed value less stable than the imputed values for the first four early quarters.

The columns labeled “MAPE” contain the mean absolute percentage error (MAPE) for that projection method. For example, in Table 4, the MAPE for projecting ALOS across all conditions (first row) for the “early five” projection is 2.51 percent. The columns labeled “Rank” contain each method’s rank across the five projection methods, with a rank of 1 being best and a rank of 5 being worst. In Table 2, the columns labeled “MAE” contain the mean absolute error for the mortality projections.

For ALOS (Table 4), the best models are usually those incorporating four quarters of early data ("early four" or the "imputed four"). The methods that incorporate all five quarters of early data tend to do worse than the other methods. Their mean MAPE values across all conditions (2.51 and 2.99) are higher than the mean MAPE values for the other methods (2.33, 1.32, and 1.26). Their mean ranks (3.53 and 4.13) also are also worse than the mean ranks for the other methods (3.28, 2.25, and 1.81).

Similarly, for the other outcomes the best models tend to be those incorporating four quarters of early data. This implies that the first four quarters of early data tend to improve projections over methods that use no early data and over methods that add a fifth quarter of early data (Q1 of the present year). In the simulation, the fifth quarter of early data tended to provide unstable estimates compared with the first four quarters (the early quarterly data from the previous year).

It is worth pointing out that the automatic time series forecasting process considered simple models, such as carrying the last value forward and simple linear regression. Most of the selected models were more complicated. Therefore, this approach usually produces results superior to a "one size fits all" approach that always carry the last value forward or that always forecasts from a simple linear regression fit to the historical data.

The projection errors (MAPE or MAE) using the best model for each condition are similar to the ones that can be expected if these same models were used to fit historical data from 2001 through 2008 to project quarterly statistics for 2009 and 2010. In fact, the errors could be smaller because the historical trend will span eight years (2001-2008) instead of five years (2001-2005). These estimated projection errors appear to be reasonably small for most conditions and outcomes.

Limitations

If a radical change occurs late in the time series then the projections will not foretell it. For example, Figure 3 shows the projections for PTCA discharge counts. The model could not have anticipated the downturn in 2007 (denoted by red dots) based on the historical time series, even with the early quarterly imputations (denoted by red circles).

Figure 3: Projections for PTCA Discharge Counts

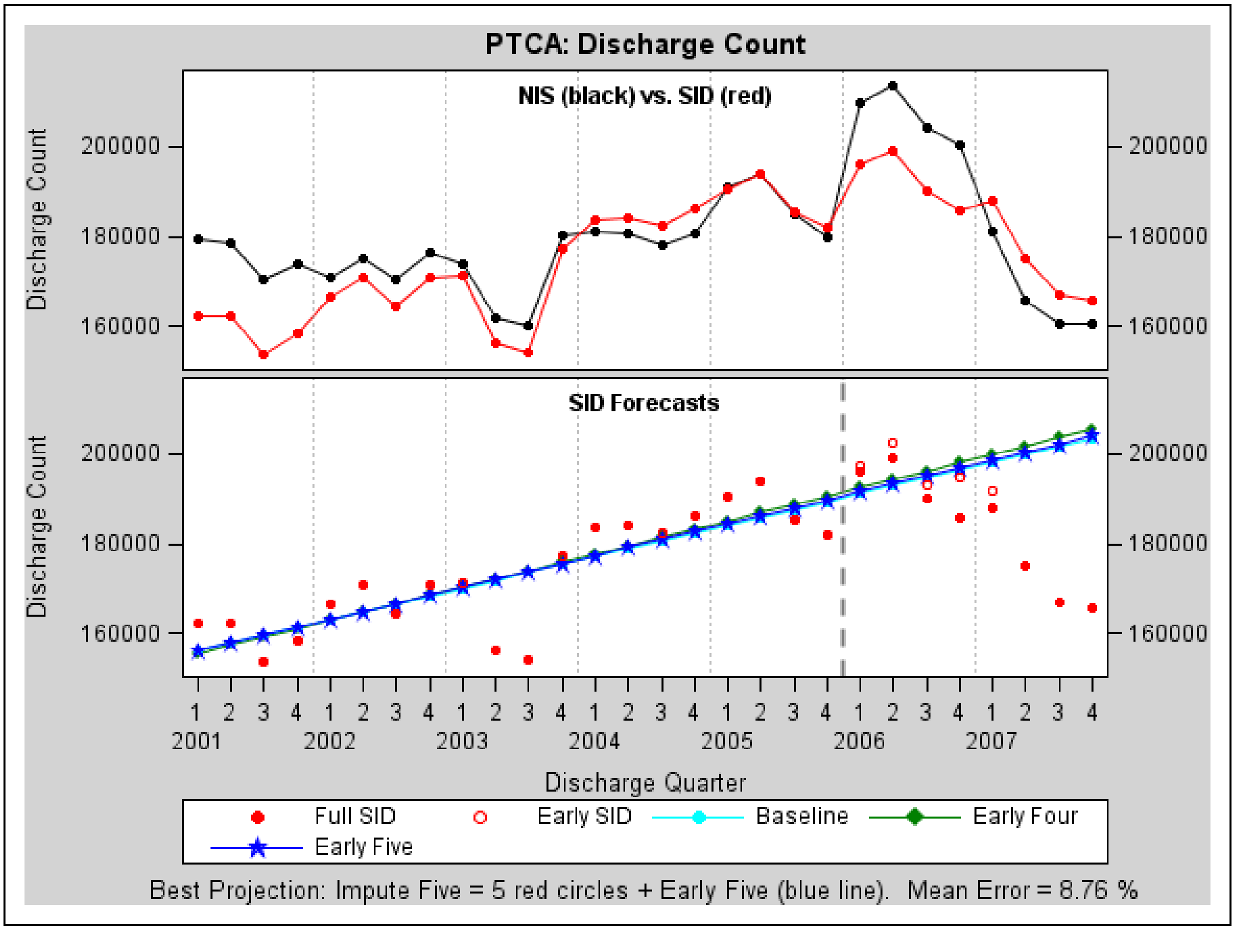


Table 4: Projection Results for ALOS

Condition or Procedure	Early Five Projection		Baseline Projection		Early Four Projection		Imputed Four Projection		Imputed Five Projection	
	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank
All Conds/Procs (mean)	2.51	3.53	2.33	3.28	1.32	2.25	1.26	1.81	2.99	4.13
AMI	1.94	4	0.62	1	1.14	2	1.29	3	2.09	5
Asthma	1.66	4	0.60	2	0.61	3	0.57	1	2.02	5
Bariatric	10.98	4	7.17	3	3.18	2	2.47	1	12.87	5
Breast Cancer	1.86	4	1.78	3	1.19	2	1.03	1	2.83	5
C-Section	0.47	4	0.46	3	0.29	1	0.40	2	0.64	5
CABG	0.89	3	0.95	4	0.88	2	0.67	1	1.36	5
Cellulitis	0.73	4	1.18	5	0.64	2	0.54	1	0.71	3
Clostridium Difficil	1.30	4	0.96	2	1.37	5	0.93	1	1.06	3
Colon Cancer	1.09	3	2.61	5	0.68	2	0.59	1	1.18	4
Decubitus Ulcers	3.02	4	1.92	1	2.64	2	2.87	3	3.68	5
Dementia	1.94	3	4.50	5	2.31	4	1.76	2	1.38	1
Depression	0.83	2	3.86	5	0.67	1	1.04	3	1.52	4
Diabetes	0.55	2	0.53	1	0.63	3	0.73	4	0.83	5
Hip Replacement	1.10	4	0.62	3	0.39	2	0.30	1	1.29	5
Ischemic Stroke	0.87	3	1.54	5	1.01	4	0.84	1	0.86	2
Knee Replacement	0.76	3	1.44	5	0.59	1	0.66	2	0.96	4
Lung Cancer	0.73	4	0.30	1	0.38	2	0.57	3	1.07	5
MRSA	0.98	1	3.18	5	2.59	4	2.16	2	2.45	3
PTCA	5.31	4	2.62	3	0.95	1	1.13	2	6.21	5
Peptic Ulcer	1.54	4	1.13	3	0.53	2	0.44	1	1.80	5
Pneumonia	0.68	3	0.82	5	0.70	4	0.53	2	0.43	1
Postop Infection	2.36	4	3.30	5	2.35	3	2.04	1	2.08	2
Prostate Cancer	4.15	4	7.60	5	1.18	2	1.08	1	3.92	3
Renal Failure	0.72	3	0.62	1	0.66	2	0.85	4	1.11	5
Septicemia	2.33	4	0.95	3	0.92	2	0.76	1	2.57	5
Spinal Fusion	2.58	4	1.00	1	1.58	2	1.80	3	3.17	5
PSI 11 - Postop	5.29	4	1.82	3	1.05	2	1.04	1	6.15	5
PSI 13 - Postop	4.10	4	3.84	3	1.86	1	2.16	2	5.22	5
PSI 15 - Acc	0.63	3	1.67	5	0.63	2	0.53	1	0.68	4
PSI 6 - Iatro	9.08	4	7.19	3	3.21	2	2.63	1	12.01	5
PSI 7 - Selected Inf	5.02	4	2.48	1	2.75	2	3.07	3	6.62	5
PSI 9 - Postop	4.98	4	5.24	5	2.59	1	2.83	2	4.79	3

This table summarizes and compared the accuracy of five models for all 33 tested categories.

Table 5: Projection Results for Mortality

Condition or Procedure	Projection Method									
	Early Five Projection		Baseline Projection		Early Four Projection		Imputed Four Projection		Imputed Five Projection	
	MAE (%)	Rank	MAE (%)	Rank	MAE	Rank	MAE (%)	Rank	MAE (%)	Rank
All Conds/Procs (mean)	0.27	3.25	0.27	3.44	0.24	3.28	0.22	1.88	0.27	3.16
AMI	0.14	3	0.14	3	0.14	3	0.12	1	0.18	5
Asthma	0.02	1	0.03	5	0.03	4	0.02	2	0.03	3
Bariatric	0.05	2	0.04	1	0.08	5	0.06	3	0.07	4
Breast Cancer	0.11	4	0.11	4	0.11	4	0.11	2	0.09	1
C-Section	0.00	4	0.00	4	0.00	4	0.00	2	0.00	1
CABG	0.13	4	0.21	5	0.09	1	0.10	2	0.13	3
Cellulitis	0.04	3	0.04	3	0.04	3	0.03	1	0.05	5
Clostridium Difficil	0.19	3	0.19	3	0.19	3	0.16	1	0.27	5
Colon Cancer	0.12	3	0.11	1	0.13	5	0.12	2	0.13	4
Decubitus Ulcers	0.29	4	0.29	4	0.29	4	0.22	2	0.22	1
Dementia	0.12	4	0.24	5	0.10	2	0.08	1	0.11	3
Depression	0.00	4	0.00	4	0.00	4	0.00	1	0.00	2
Diabetes	0.05	3	0.05	4	0.06	5	0.04	1	0.04	2
Hip Replacement	0.06	3	0.06	3	0.06	3	0.05	1	0.07	5
Ischemic Stroke	0.10	3	0.10	3	0.10	3	0.12	5	0.10	1
Knee Replacement	0.02	4	0.02	4	0.02	4	0.02	1	0.02	2
Lung Cancer	0.27	3	0.27	3	0.27	3	0.22	1	0.33	5
MRSA	0.37	1	0.41	3	0.50	4	0.57	5	0.41	2
PTCA	0.03	3	0.04	5	0.02	1	0.02	2	0.03	4
Peptic Ulcer	0.07	2	0.07	2	0.07	2	0.09	4	0.09	5
Pneumonia	0.17	4	0.17	4	0.17	4	0.16	1	0.16	2
Postop Infection	0.07	4	0.07	4	0.07	4	0.06	2	0.05	1
Prostate Cancer	0.14	3	0.14	3	0.14	3	0.14	1	0.17	5
Renal Failure	0.31	4	0.31	4	0.31	4	0.27	1	0.28	2
Septicemia	0.76	4	0.76	4	0.76	4	0.58	1	0.63	2
Spinal Fusion	0.02	4	0.02	4	0.02	4	0.01	2	0.01	1
PSI 11 - Postop	1.56	3	1.79	5	1.58	4	1.26	2	1.20	1
PSI 13 - Postop	0.59	3	1.16	5	0.48	1	0.56	2	0.74	4
PSI 15 - Acc	0.29	4	0.28	3	0.26	2	0.24	1	0.33	5
PSI 6 - Iatro	1.21	4	0.86	3	0.79	2	0.69	1	1.33	5
PSI 7 - Selected Inf	0.41	2	0.34	1	0.43	3	0.47	4	0.49	5
PSI 9 - Postop	0.76	4	0.31	1	0.46	3	0.37	2	0.88	5

This table summarizes and compared the accuracy of five models for all 33 tested categories.

Table 6: Projection Results for Average Charges

Condition or Procedure	Projection Method									
	Early Five Projection		Baseline Projection		Early Four Projection		Imputed Four Projection		Imputed Five Projection	
	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank
All Conds/Procs (mean)	2.46	3.19	2.96	3.66	1.82	2.56	1.70	2.06	2.64	3.53
AMI	2.22	2	1.20	1	2.23	3	2.40	5	2.36	4
Asthma	2.01	4	1.55	3	1.51	2	1.13	1	2.16	5
Bariatric	3.39	4	1.56	3	1.45	2	1.36	1	4.35	5
Breast Cancer	2.09	3	4.56	5	1.29	1	1.38	2	2.56	4
C-Section	0.77	3	0.47	1	1.26	4	1.33	5	0.62	2
CABG	1.02	1	2.33	5	1.80	3	2.11	4	1.58	2
Cellulitis	3.68	4	2.16	3	0.61	1	0.61	2	4.28	5
Clostridium Difficil	2.93	5	1.85	2	2.38	4	1.40	1	2.24	3
Colon Cancer	0.81	2	0.54	1	0.87	3	0.94	4	0.99	5
Decubitus Ulcers	2.13	4	1.98	3	1.85	2	1.68	1	3.12	5
Dementia	5.67	4	2.20	3	0.82	2	0.64	1	6.51	5
Depression	1.08	4	0.66	3	0.39	1	0.56	2	1.60	5
Diabetes	1.01	1	5.42	5	1.51	4	1.38	3	1.03	2
Hip Replacement	0.46	3	2.96	5	0.66	4	0.42	2	0.28	1
Ischemic Stroke	1.04	3	2.38	5	0.51	2	0.49	1	1.12	4
Knee Replacement	0.52	5	0.40	3	0.35	2	0.34	1	0.47	4
Lung Cancer	0.98	3	1.02	5	0.99	4	0.80	2	0.78	1
MRSA	5.99	4	2.97	3	1.55	1	1.93	2	6.72	5
PTCA	2.27	4	5.62	5	1.43	2	1.07	1	1.99	3
Peptic Ulcer	1.81	3	3.54	5	0.91	2	0.66	1	2.07	4
Pneumonia	1.03	3	1.15	5	0.95	2	0.83	1	1.06	4
Postop Infection	2.08	4	2.21	5	2.06	3	1.99	1	2.03	2
Prostate Cancer	2.34	1	2.78	5	2.38	2	2.38	3	2.74	4
Renal Failure	1.62	4	4.95	5	1.53	3	1.23	1	1.40	2
Septicemia	5.19	4	3.89	3	1.77	2	1.61	1	6.02	5
Spinal Fusion	2.61	3	0.80	1	2.59	2	2.91	4	2.93	5
PSI 11 - Postop	3.19	4	1.33	1	2.21	3	2.01	2	3.38	5
PSI 13 - Postop	3.67	2	4.39	3	5.56	5	4.94	4	2.52	1
PSI 15 - Acc	2.44	4	4.58	5	1.71	2	1.50	1	2.24	3
PSI 6 - Iatro	2.63	2	7.31	5	3.28	4	2.49	1	3.15	3
PSI 7 - Selected Inf	5.89	2	8.29	5	6.88	4	6.38	3	5.85	1
PSI 9 - Postop	4.15	3	7.60	5	2.97	1	3.39	2	4.39	4

This table summarizes and compared the accuracy of five models for all 33 tested categories.

Table 7: Projection Results for Discharge Count

Condition or Procedure	Projection Method									
	Early Five Projection		Baseline Projection		Early Four Projection		Imputed Four Projection		Imputed Five Projection	
	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank	MAPE	Rank
All Conds/Procs (mean)	5.01	3.28	5.62	3.94	3.27	2.75	2.84	2.03	4.85	3.00
AMI	0.99	3	2.90	5	1.03	4	0.79	2	0.69	1
Asthma	3.25	3	3.81	5	3.34	4	2.20	2	1.87	1
Bariatric	9.31	4	8.41	3	6.21	2	6.06	1	9.35	5
Breast Cancer	1.82	2	5.06	5	3.85	4	3.61	3	1.27	1
C-Section	1.64	2	2.01	3	2.81	5	2.68	4	1.52	1
CABG	1.58	1	5.11	5	3.18	3	4.03	4	2.34	2
Cellulitis	2.43	2	7.25	5	5.45	4	4.76	3	1.47	1
Clostridium Difficil	11.36	4	8.57	3	3.55	2	3.07	1	12.51	5
Colon Cancer	0.63	1	1.57	5	1.19	4	1.10	3	0.85	2
Decubitus Ulcers	2.52	1	5.10	5	4.87	4	4.71	3	3.67	2
Dementia	11.29	4	6.51	3	3.49	2	2.92	1	12.37	5
Depression	1.18	3	2.10	5	1.00	2	0.99	1	1.29	4
Diabetes	1.07	4	0.69	1	0.72	2	0.79	3	1.07	5
Hip Replacement	0.89	3	3.35	5	0.55	1	0.60	2	1.06	4
Ischemic Stroke	0.80	2	4.38	5	0.70	1	0.83	3	1.09	4
Knee Replacement	4.96	3	7.32	5	1.91	2	1.57	1	5.10	4
Lung Cancer	2.86	4	2.02	3	2.02	2	1.87	1	3.18	5
MRSA	9.98	4	15.33	5	3.78	2	2.78	1	8.90	3
PTCA	9.83	4	9.67	3	10.25	5	9.61	2	8.76	1
Peptic Ulcer	2.25	4	7.96	5	1.95	3	1.66	1	1.85	2
Pneumonia	5.87	3	6.10	5	6.07	4	3.90	2	3.24	1
Postop Infection	1.88	4	2.39	5	1.55	2	1.03	1	1.56	3
Prostate Cancer	7.94	3	13.14	5	3.59	2	2.97	1	8.29	4
Renal Failure	8.76	4	17.87	5	6.36	2	5.77	1	8.54	3
Septicemia	4.89	5	1.79	1	2.65	3	1.88	2	4.30	4
Spinal Fusion	1.88	3	2.75	5	0.59	2	0.39	1	1.95	4
PSI 11 - Postop	6.02	5	3.59	1	3.66	2	3.75	3	5.98	4
PSI 13 - Postop	7.67	4	6.72	3	8.69	5	5.99	2	5.12	1
PSI 15 - Acc	1.35	3	1.22	1	1.34	2	1.45	5	1.44	4
PSI 6 - Iatro	26.45	4	8.54	3	2.62	1	2.70	2	29.12	5
PSI 7 - Selected Inf	4.43	4	4.80	5	4.41	3	3.15	2	3.09	1
PSI 9 - Postop	2.42	5	1.78	3	1.43	2	1.37	1	2.39	4

This table summarizes and compared the accuracy of five models for all 33 tested categories.

Recommendations

Next Steps

To generate national projections during 2010, we recommend the following sequence of steps:

1. Create production versions of the SAS programs used in this study. A statistician created several of the programs used in this study. An advanced SAS programmer should work with the statistician to create a set of programs and documentation suitable for repeated use in a production environment.
2. Decide on outcomes, conditions, and procedures to project. This demonstration focused on diagnostic and procedure categories, but the techniques can also be applied to demographic groups or hospital characteristics or other criteria.

Note: many of the following processes can be performed well in advance of the scheduled August 2010 projections.

3. Check the quality and completeness of the early quarterly data. Decide on the usability of each quarter of data from each state.
4. Replicate the simulations described in this report, using 2001-2006 as the baseline period and using 2007-2008 as the projection period.
    a. From SID data, calculate quarterly outcome statistics for each state, NIS stratum, and projection group over the 2001-2008 time period.
    b. Identify the states for which we received early quarterly data during Q1-Q4 2009 and Q1 2010.
    c. Calculate discharge weights for early states over the entire period 2001-2008.
    d. Calculate discharge weights for all SID states over the entire period 2001-2008.
    e. Calculate discharge-weighted quarterly estimates for early states over the entire period 2001-2008.
    f. Calculate discharge-weighted quarterly estimates for all SID states over the entire period 2001-2008.
    g. Calculate the average ratio of the all-state estimate calculated in step 4.f to the early-state estimate calculated in step 4.e over the baseline period 2001-2006.
    h. Impute full-SID estimates for the five “early” quarters Q1-Q4 2007 and Q1 2008.
    i. Generate projections using the five projection methods in this report.
    j. Identify the best of the five projection methods for use with each outcome and condition. For example, if the results in Table 4 held for ALOS, we would select the “baseline” projection method for AMI and the “imputed four” projection method for asthma, assuming that these projections proved reasonable on inspection of the graphs showing all five projection methods.
5. Apply the projection method selected in step 4.j to the 2001-2010 data period.
    a. Calculate discharge-weighted quarterly estimates for early states for the five early quarters Q1-Q4 2009 and Q1 2010.

b. Calculate the average ratio of the all-state estimate calculated in step 4.f to the early-state estimate calculated in step 4.e over the new baseline period 2001-2008.

c. Impute the full-SID estimates for the five early quarters Q1-Q4 2009 and Q1 2010.

d. Generate quarterly projections for 2009 and 2010 according to the projection model selected in step 4.j.

e. Inflation-adjust the projections for average charges.

State-Level Projections

At AHRQ's request, these models and methods can be modified slightly to generate state-level projections. The process would be simpler and more straightforward than the methods for national projections, utilizing all quarterly data available from a given state – already summarized for the national projections – as input to the SAS Time Series Forecasting system. For each outcome, condition, and procedure, the system would select the best time series model for each state and it would generate state-level quarterly projections along with standard errors for those projections.

Frequency

We anticipate that early quarterly data will be available for only five states in 2010. Consequently, it is likely the above process will often select the "baseline" projection method—which involves no early data—as the best method. To the extent that additional quarterly data will be available by the close of 2010, we recommend updating the projections in January or February of 2011. With quarterly data from more states, the best projection method could change because of better imputations for the early quarters. This update would not be too burdensome because the computer programs would be in place and it would only be necessary to update the early quarterly data.

Dissemination

The audience and mode of dissemination will be decided in collaboration with AHRQ staff, although we anticipate the results will be of interest to a wide variety of people. The next step in this process is to select both the categories for projections and the audience for those projections. We will address both questions together as the latter will influence the former, and visa versa.

After identifying the audience, we will focus on the dissemination methods best suited to that group. Consideration will be given to all relevant possibilities from raw data tables to short and focused summaries similar to HCUP Statistical Briefs.

Early Trend Change Warnings

Once we generate the projections, we could alert AHRQ staff to potentially radical changes in trends in two ways. First, we could base alerts on visual discrepancies shown in the graph between the projections and the imputed values for early quarters. Second, we could base alerts on annual swings by more than 10 percent (or some other suitable threshold) between projections for 2008 and 2009 and between projections for 2009 and 2010.

Available Data

AHRQ has tasked the HCUP team with creating same-year projections by August of 2010. At that time, data resources available will include Nationwide Inpatient Sample (NIS), State Inpatient Data (SID), as well as quarterly data from up to five states.

Nationwide Inpatient Sample

NIS files are created annually for the calendar year two years prior. The NIS is generally available before the end of the second quarter. For example, the 2007 calendar year NIS were released in June of 2009. We expect the 2008 NIS to be available two months prior to delivery of the 2010 Rapid Cycle estimates.

State Inpatient Data

Availability of annual state data spans approximately 10 months (although longer interludes are not uncommon). The first state data are supplied to HCUP beginning in May following the calendar year's end. We will use all available 2009 SID files. In practical terms, this means that only state data received by HCUP before July 1, 2009 can be used. The 2008 HCUP data acquisition experience saw eight states supply their 2008 data before July 1, 2009.

Quarterly State Inpatient Data

Same-year projections can also use quarterly data acquired and processed for the Rapid Cycle estimates task (Task C.25). For 2010, we will have quarterly data from up to only five states.

The initial states have not been selected, although we will target states that report availability of quarterly data within four or five months after the quarter's end. These are states that tend to also supply annual data before July 1st, so we expect a great deal of overlap between the quarterly data states and the states with 2009 SID data.

Based on the "State Quarterly Data Evaluation Report" quarterly data is available from most states. Hypothetically, by July of 2010, some quarterly data will be available from 34 states. By quarter,

- Q1 2009: 34 States
- Q2 2009: 33 States
- Q3 2009: 31 States
- Q4 2009: 25 States
- Q1 2010: 8 States

Table 8 summarizes data availability by state and quarter.

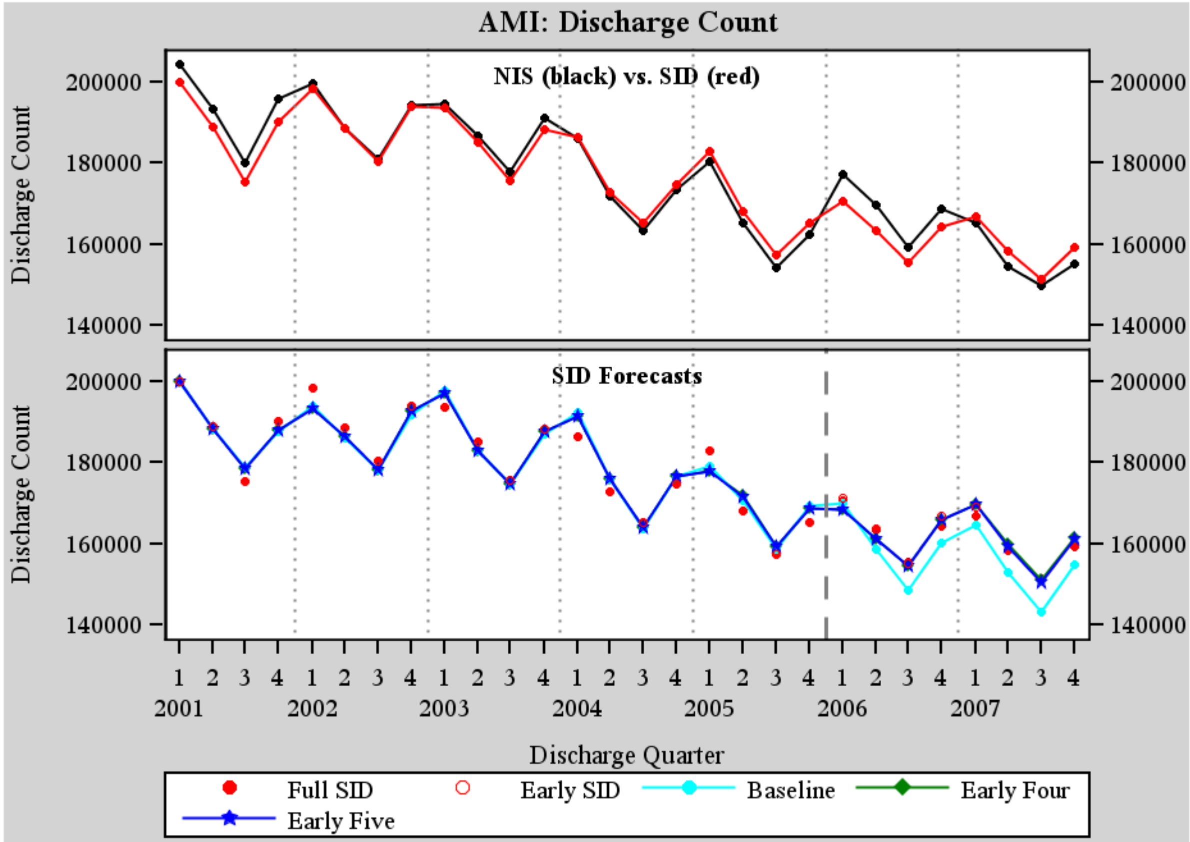
Because of the limited range of quarterly data, it is unlikely that same-year projections in 2010 will utilize quarterly data. Where annual data for 2008 and quarterly 2009 data are available, state-level projections are possible. However, to the extent that quarterly data are required to adjust projections, implementing same-year projections may need to wait until sufficient quarterly data is available.

Table 8: Availability of Quarterly Data in July of 2010

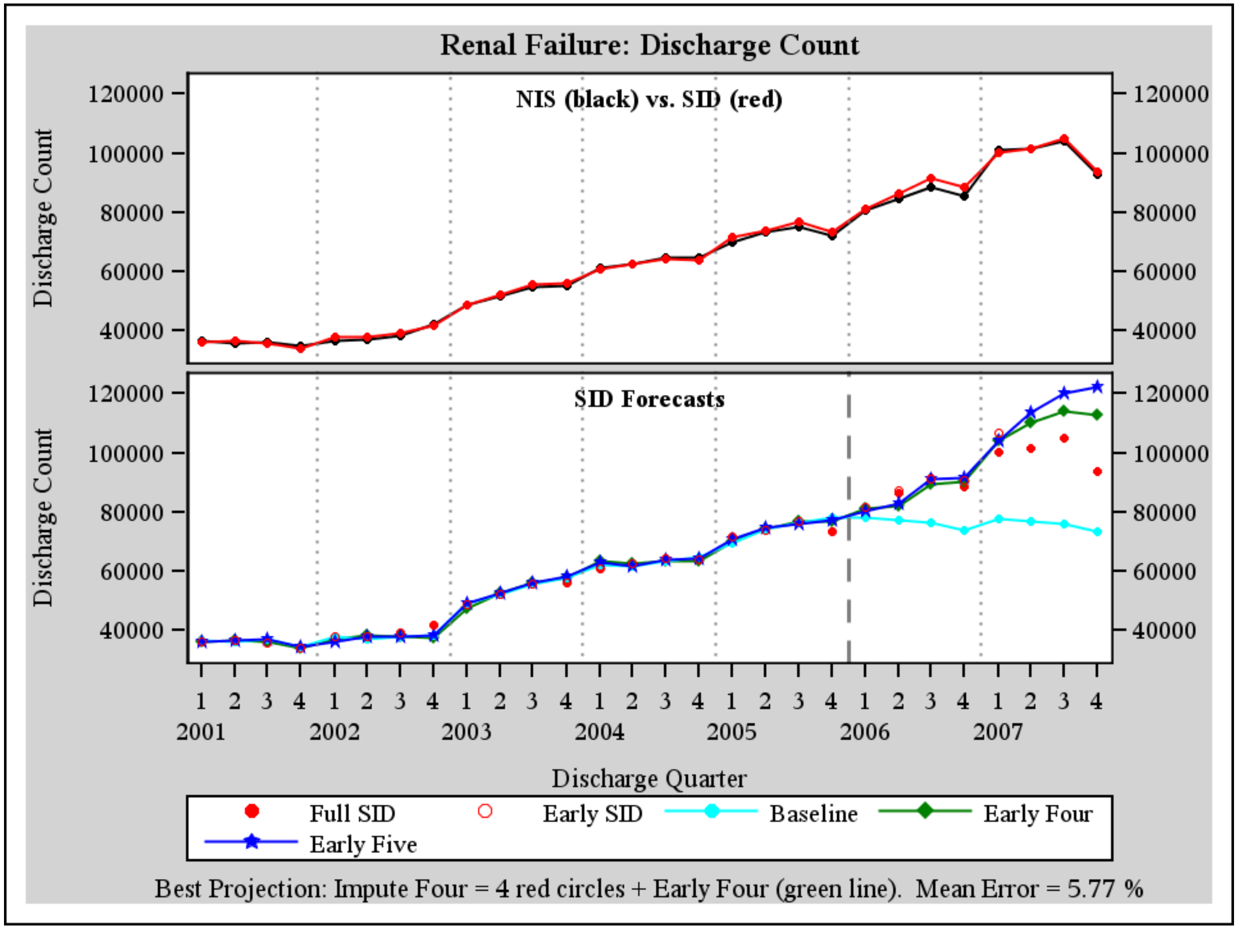
	2009 Q1	2009 Q2	2009 Q3	2009 Q4	2010 Q1
AZ	1	1	1	1	
AR	1	1	1		
CA	1	1			
CT	1	1	1	1	
FL	1	1	1		
GA	1	1	1	1	1
HI	1	1	1	1	1
IL	1	1	1	1	
IN	1	1	1	1	
IA	1	1	1	1	1
KS	1	1	1		
KY	1	1	1		
ME	1	1	1	1	
MD	1	1	1	1	
MA	1				
MI	1	1	1	1	
MN	1	1	1	1	1
MO	1	1	1	1	1
NE	1	1	1	1	
NV	1	1	1	1	1
NJ	1	1	1	1	
NY	1	1	1	1	
OH	1	1	1	1	
OR	1	1	1	1	
RI	1	1	1	1	1
SC	1	1	1	1	
SD	1	1	1		
TN	1	1	1	1	
TX	1	1			
UT	1	1	1		
VT	1	1	1	1	
WV	1	1	1	1	
WI	1	1	1	1	
WY	1	1	1	1	1
Total	*34*	*33*	*31*	*25*	*8*

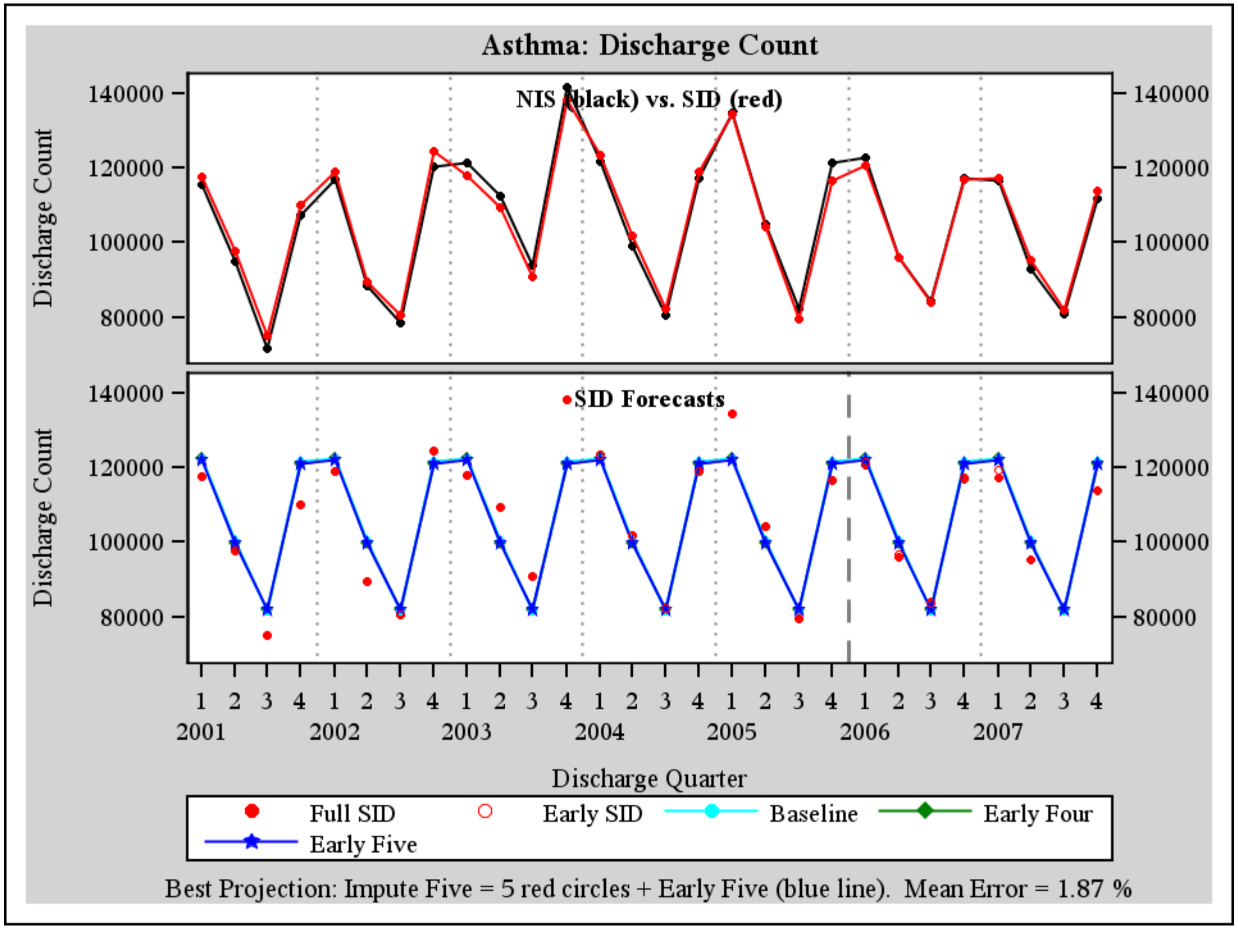
Processing of quarterly data will be more limited than processing of annual data. For quarterly data, the focus will be those variables required for generating same-year projections along with data elements necessary for assessing the quality and completeness of the quarterly data.

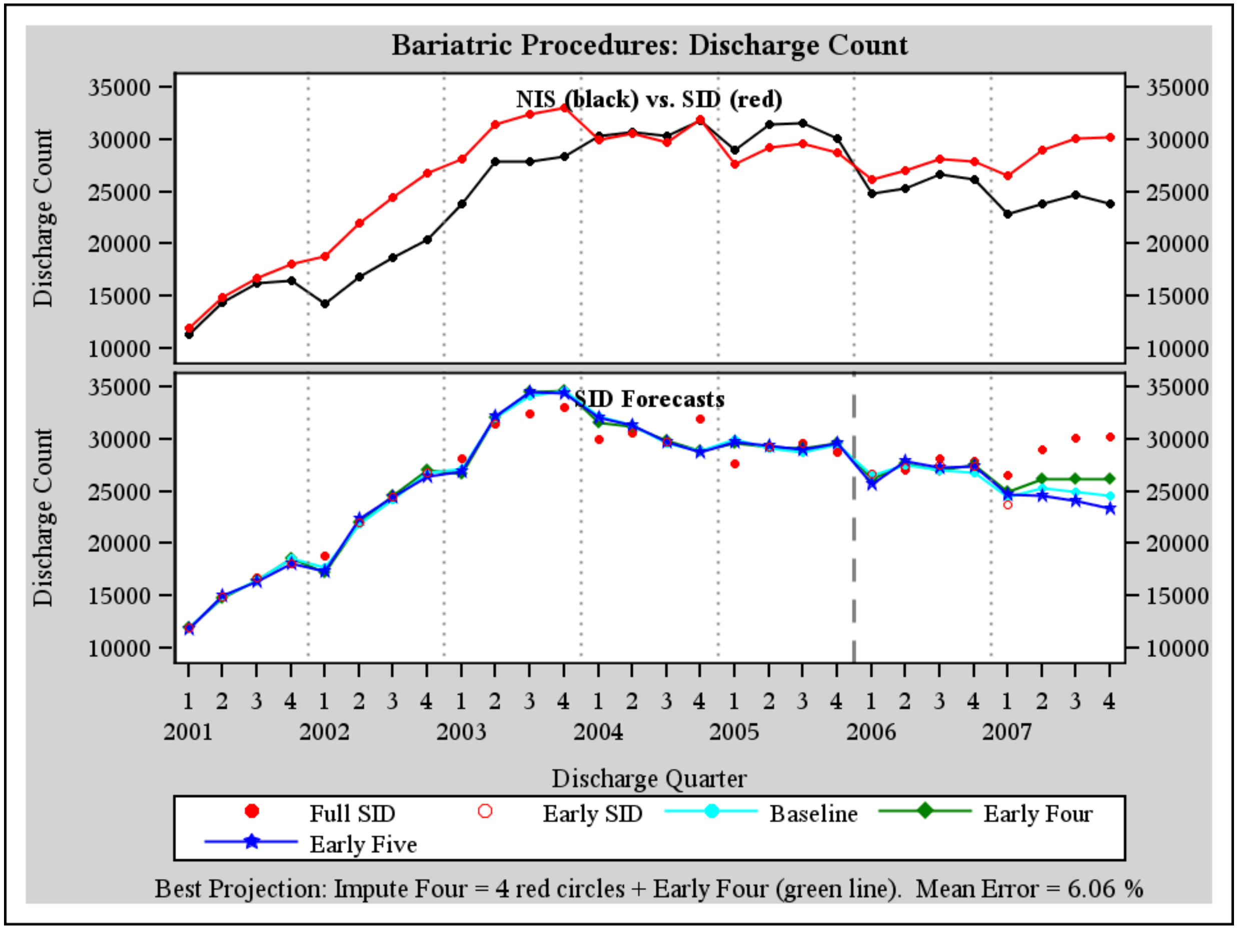
APPENDIX A: SID DISCHARGE PROJECTIONS

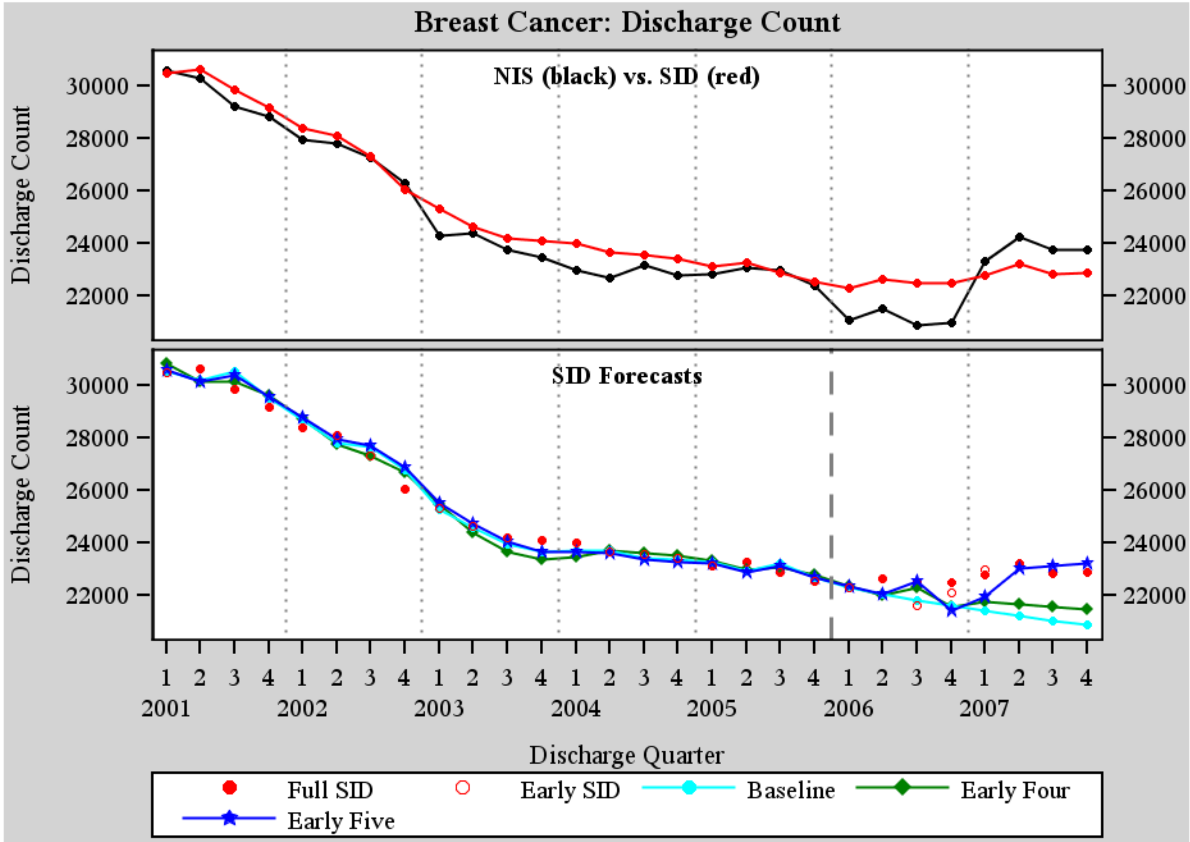


Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.69 %

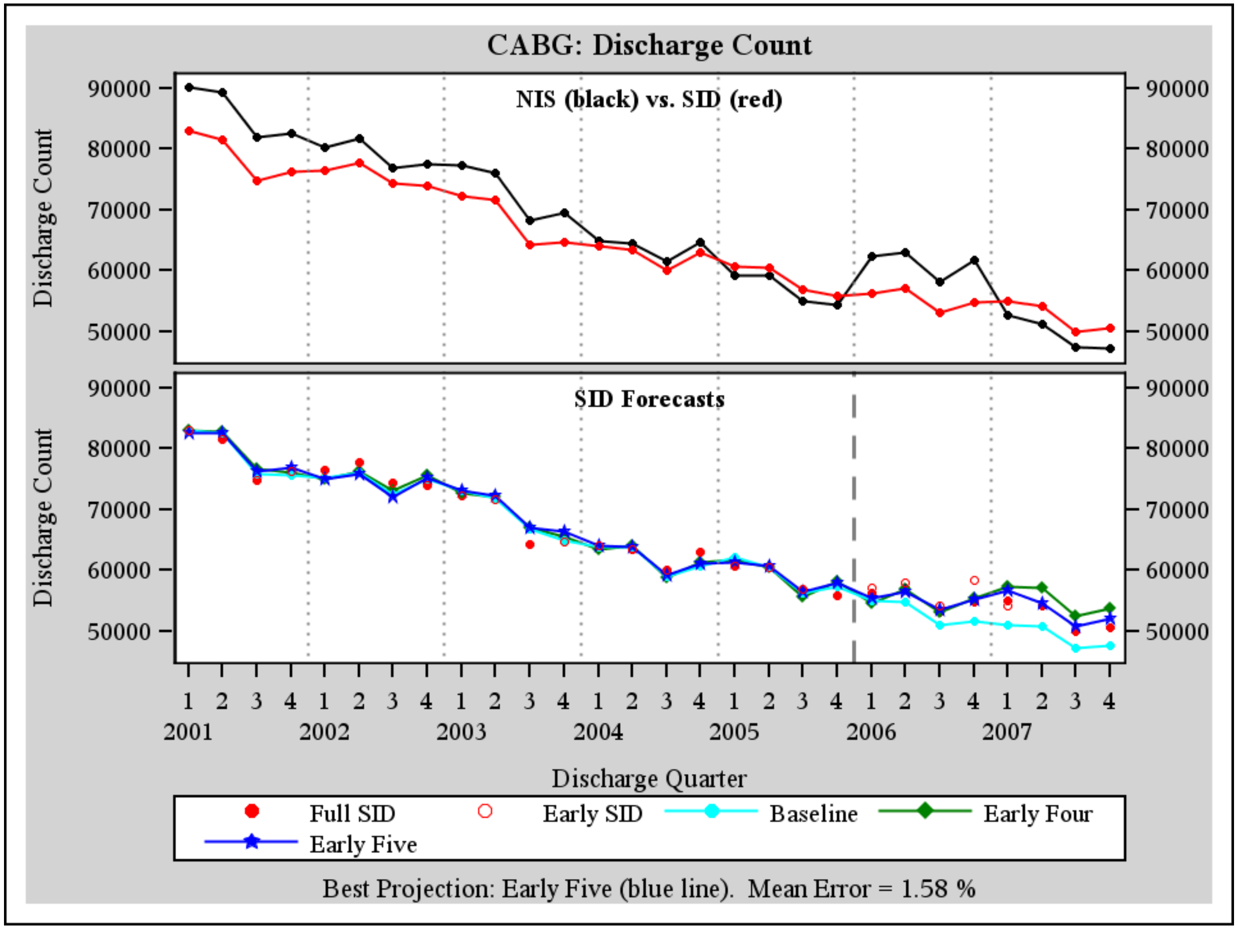

Renal Failure: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
120000
100000
80000
60000
40000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 5.77 %

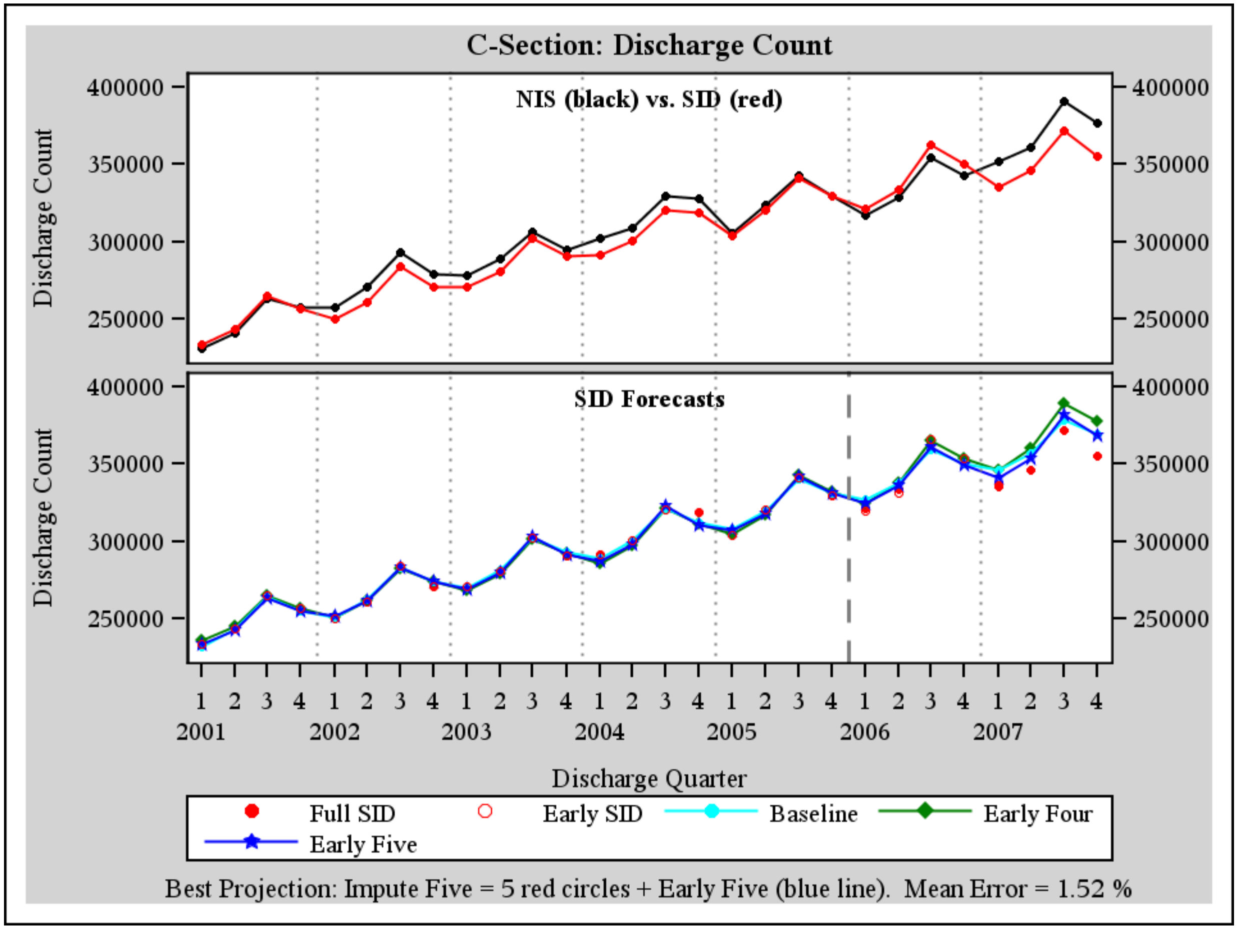

Asthma: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
140000
120000
100000
80000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.87 %

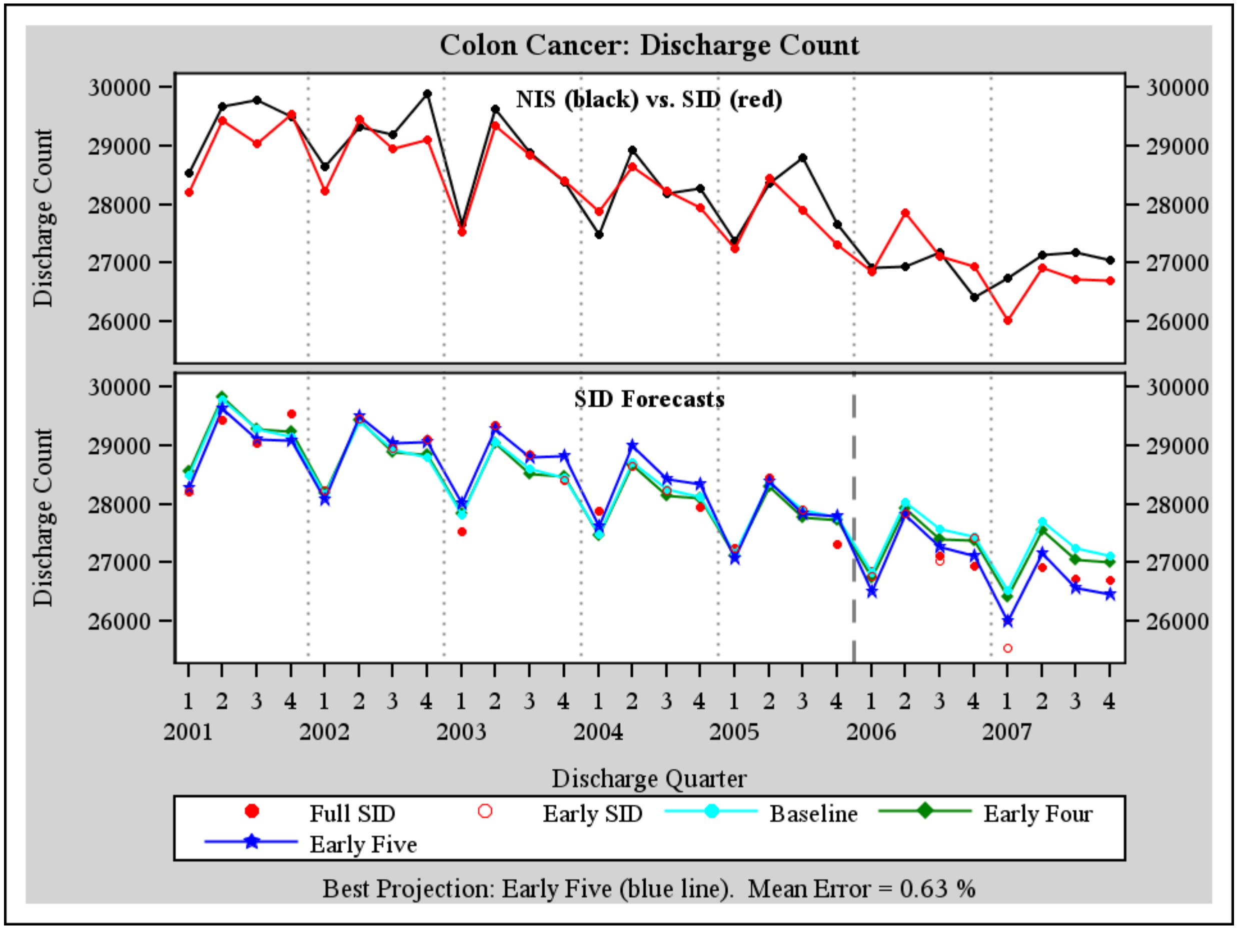

Bariatric Procedures: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
35000
30000
25000
20000
15000
10000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 6.06 %

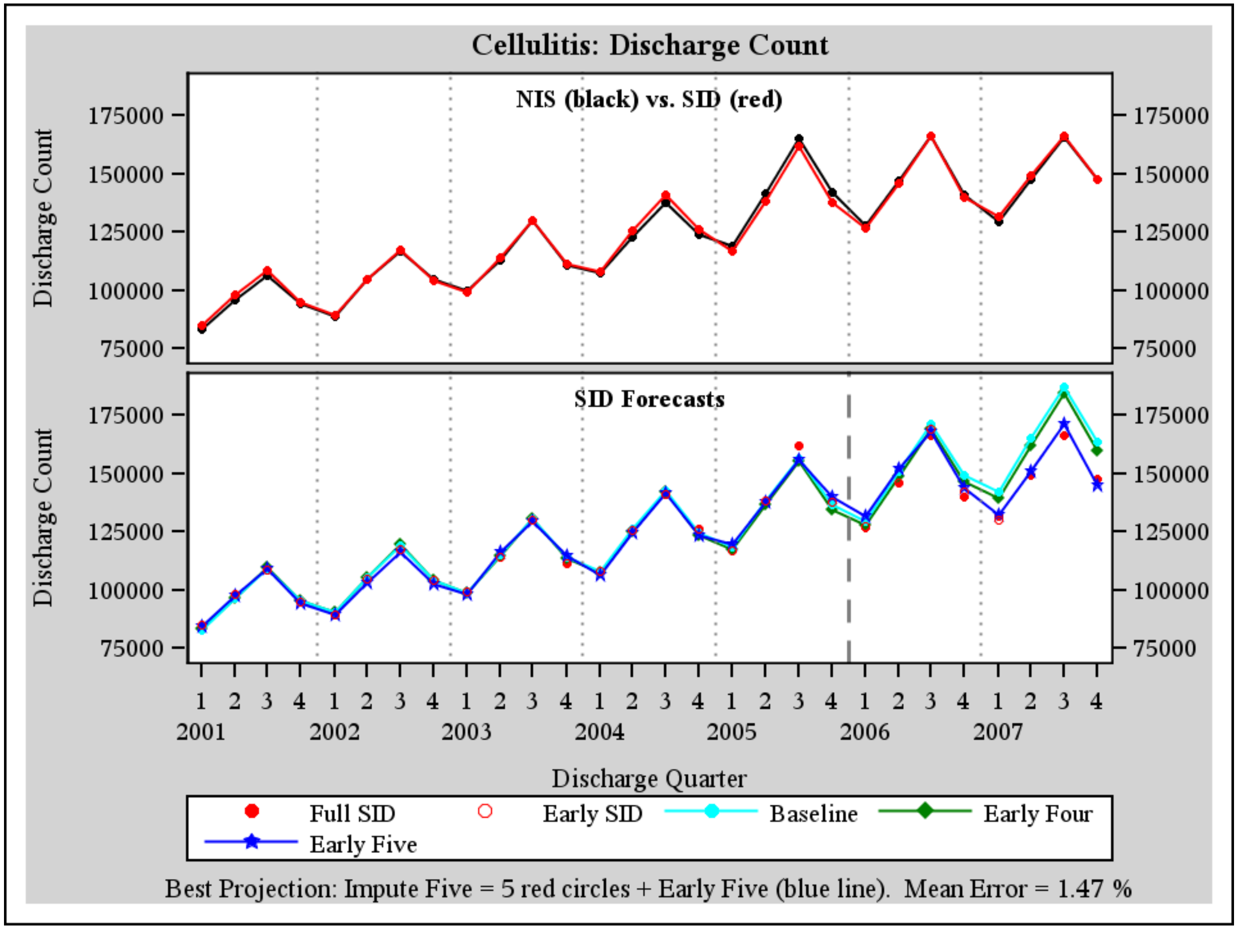


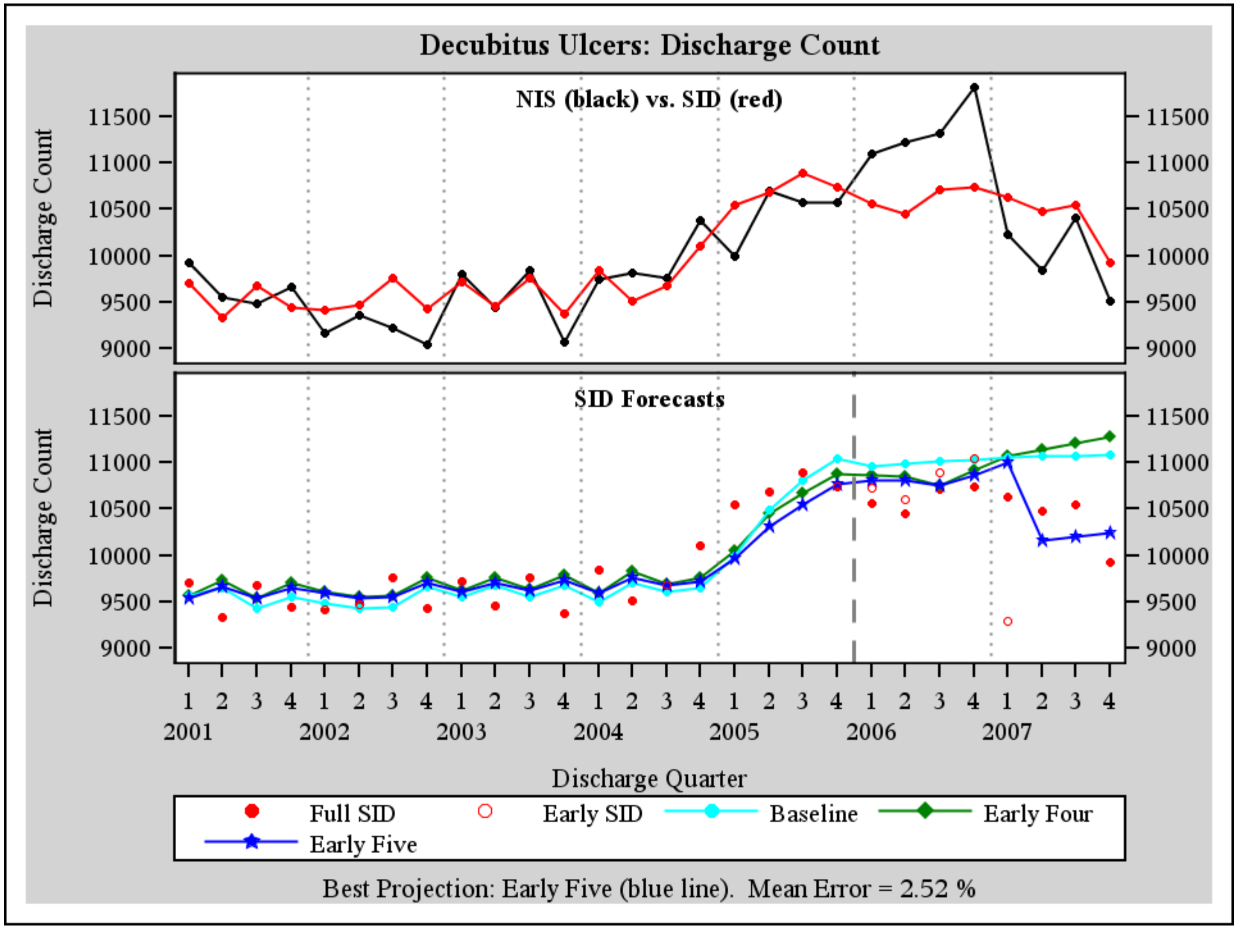
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.27 %

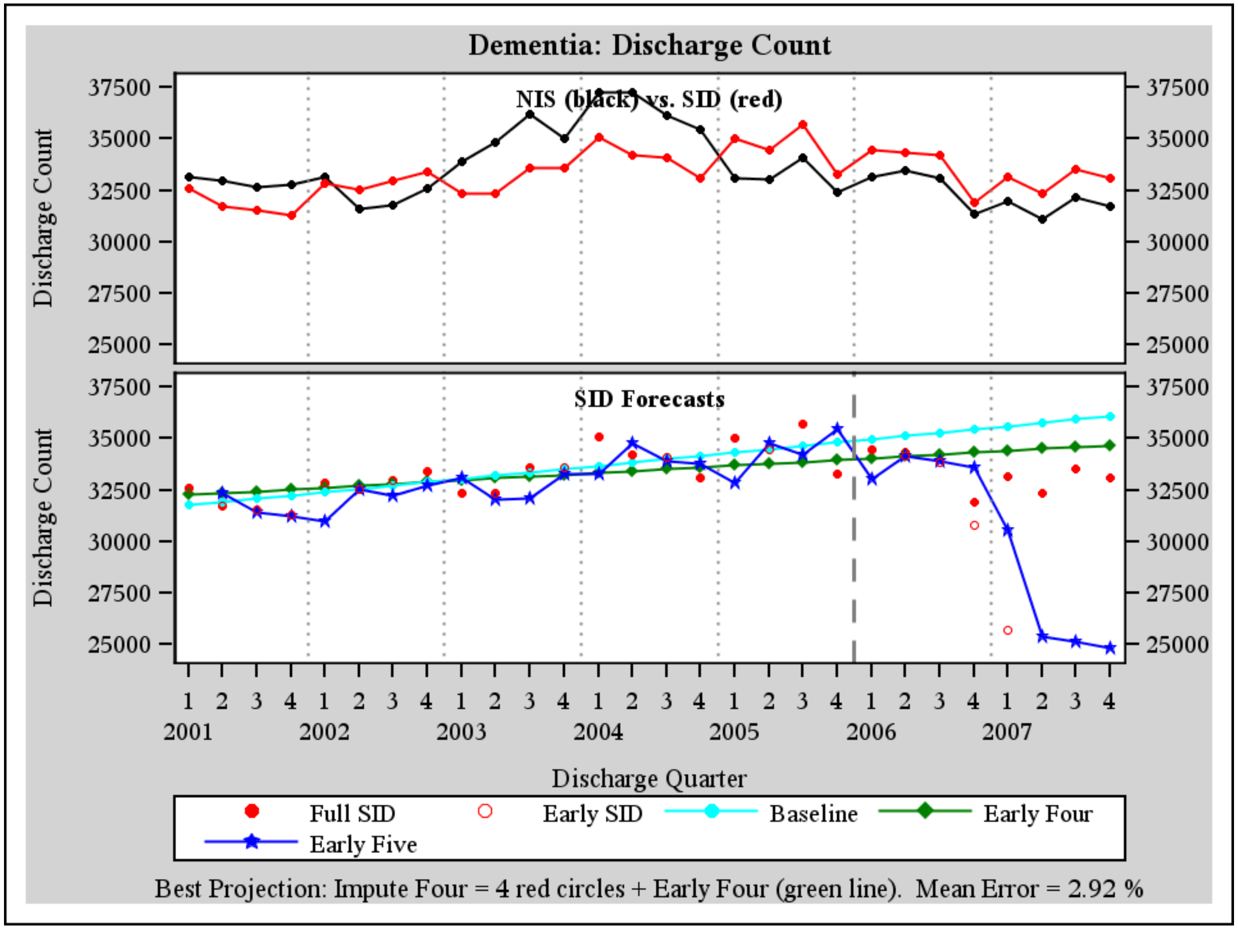

CABG: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
Discharge Quarter
2001
2002
2003
2004
2005
2006
2007
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 1.58 %

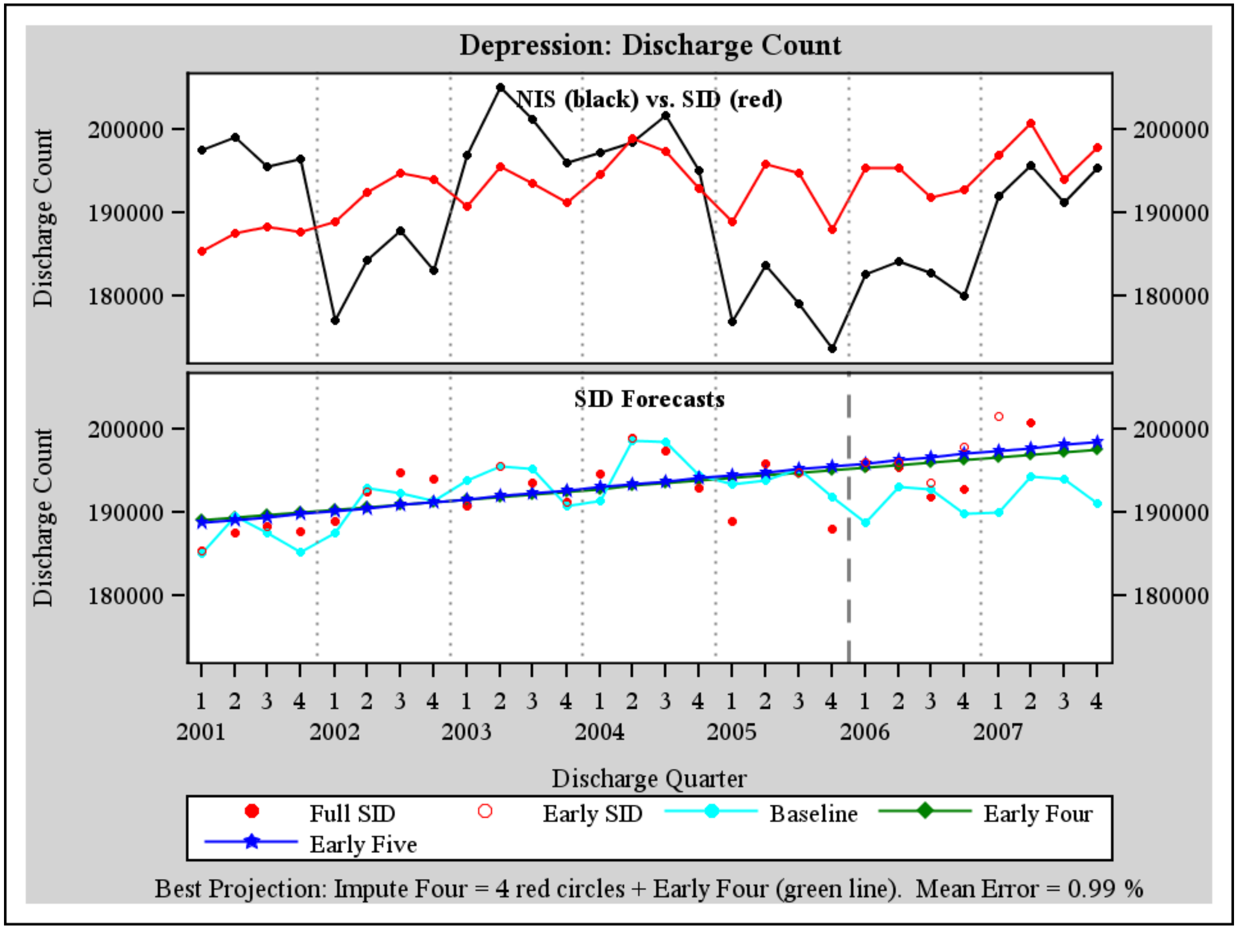

C-Section: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
400000
350000
300000
250000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.52 %

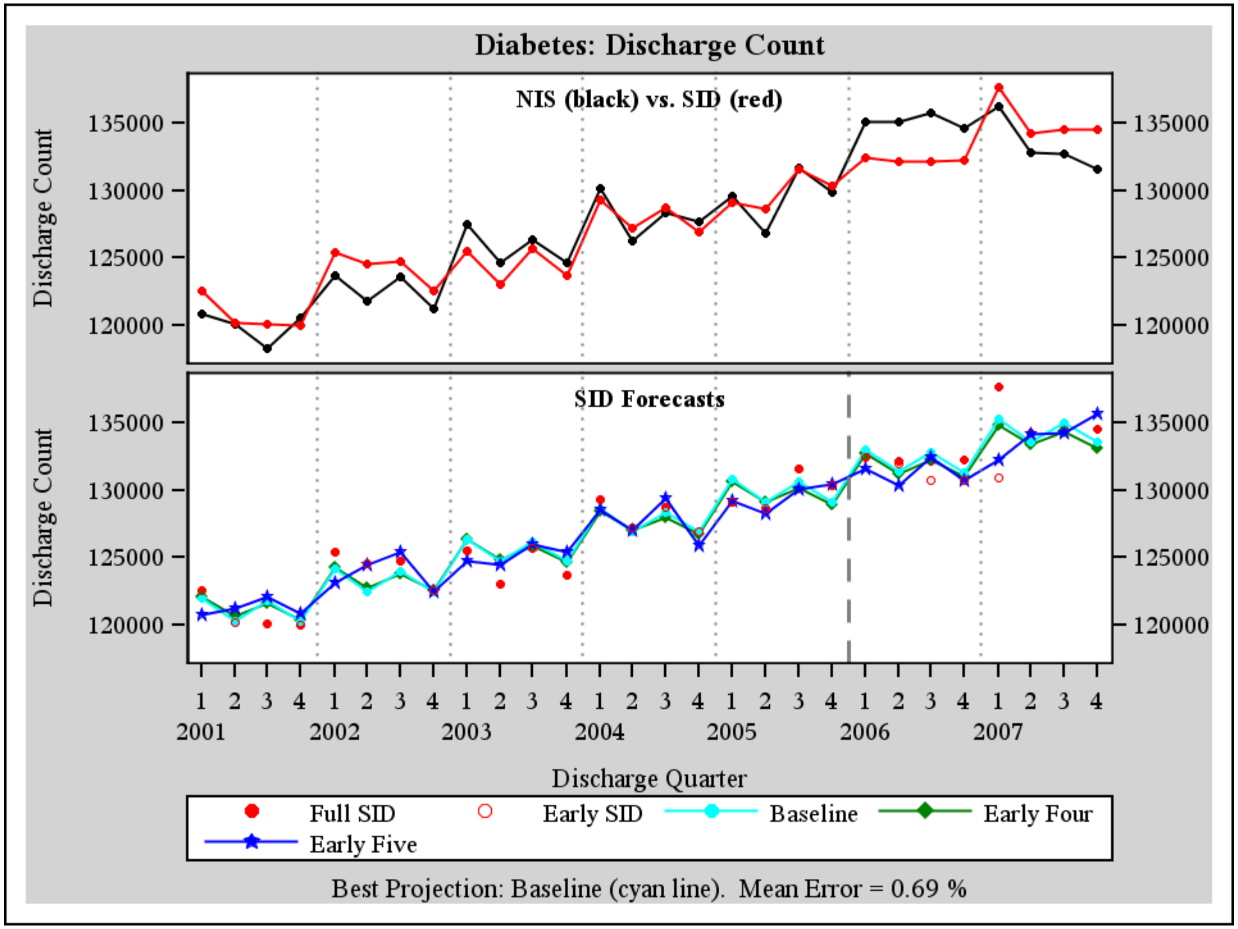

Colon Cancer: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
30000
29000
28000
27000
26000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 0.63 %

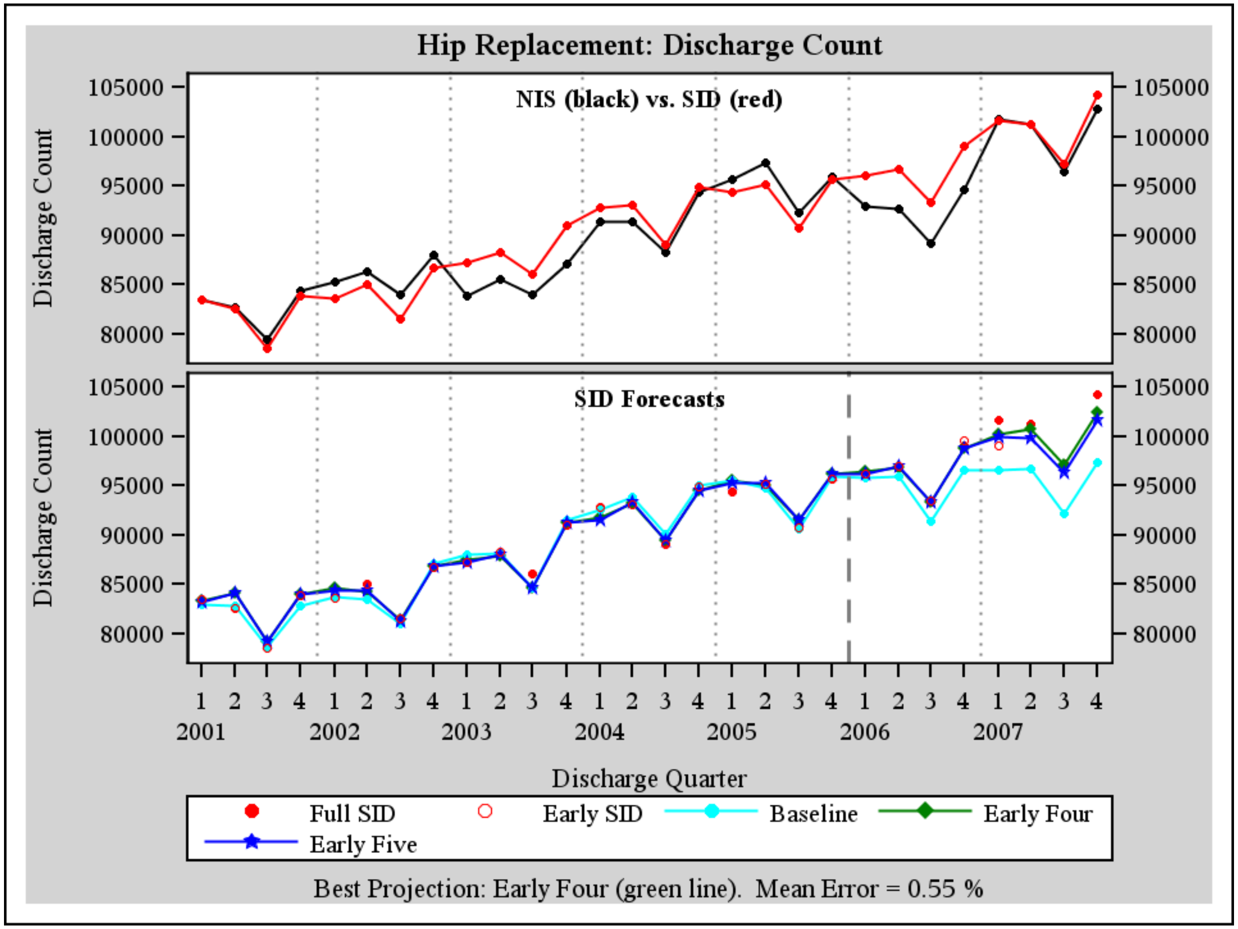

Cellulitis: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
175000
150000
125000
100000
75000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.47 %

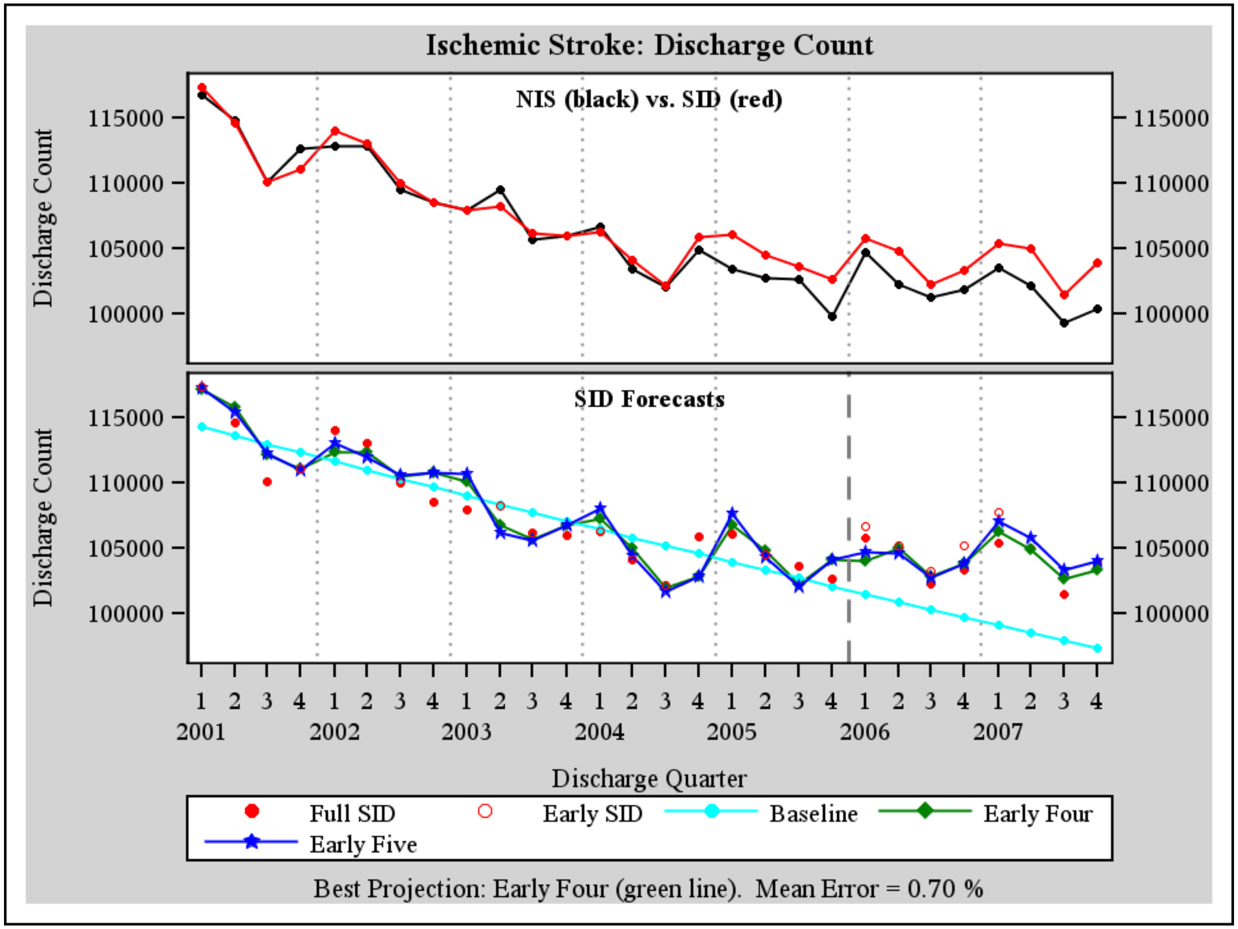

Decubitus Ulcers: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
11500
11000
10500
10000
9500
9000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 2.52 %

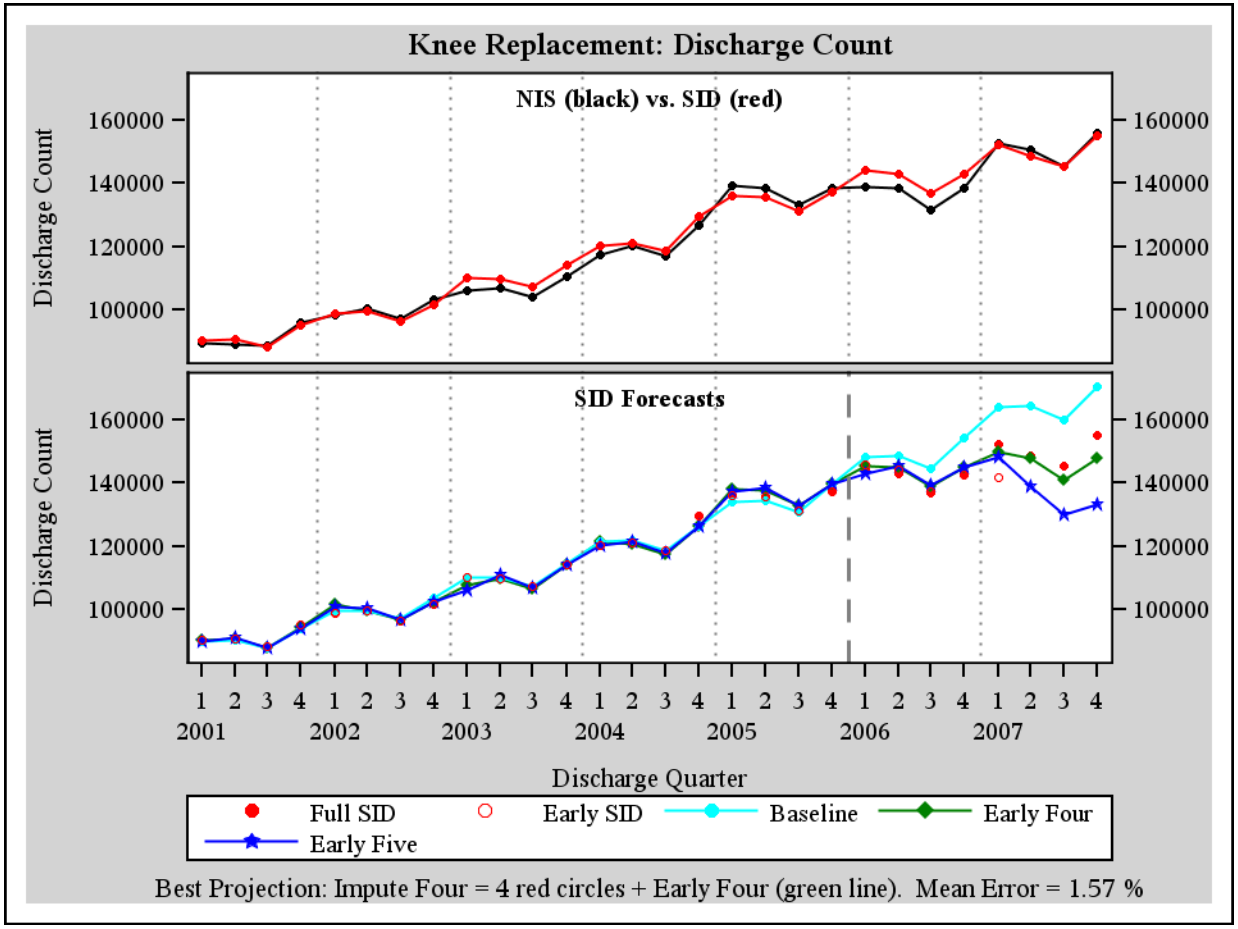

Dementia: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
37500
35000
32500
30000
27500
25000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.92 %

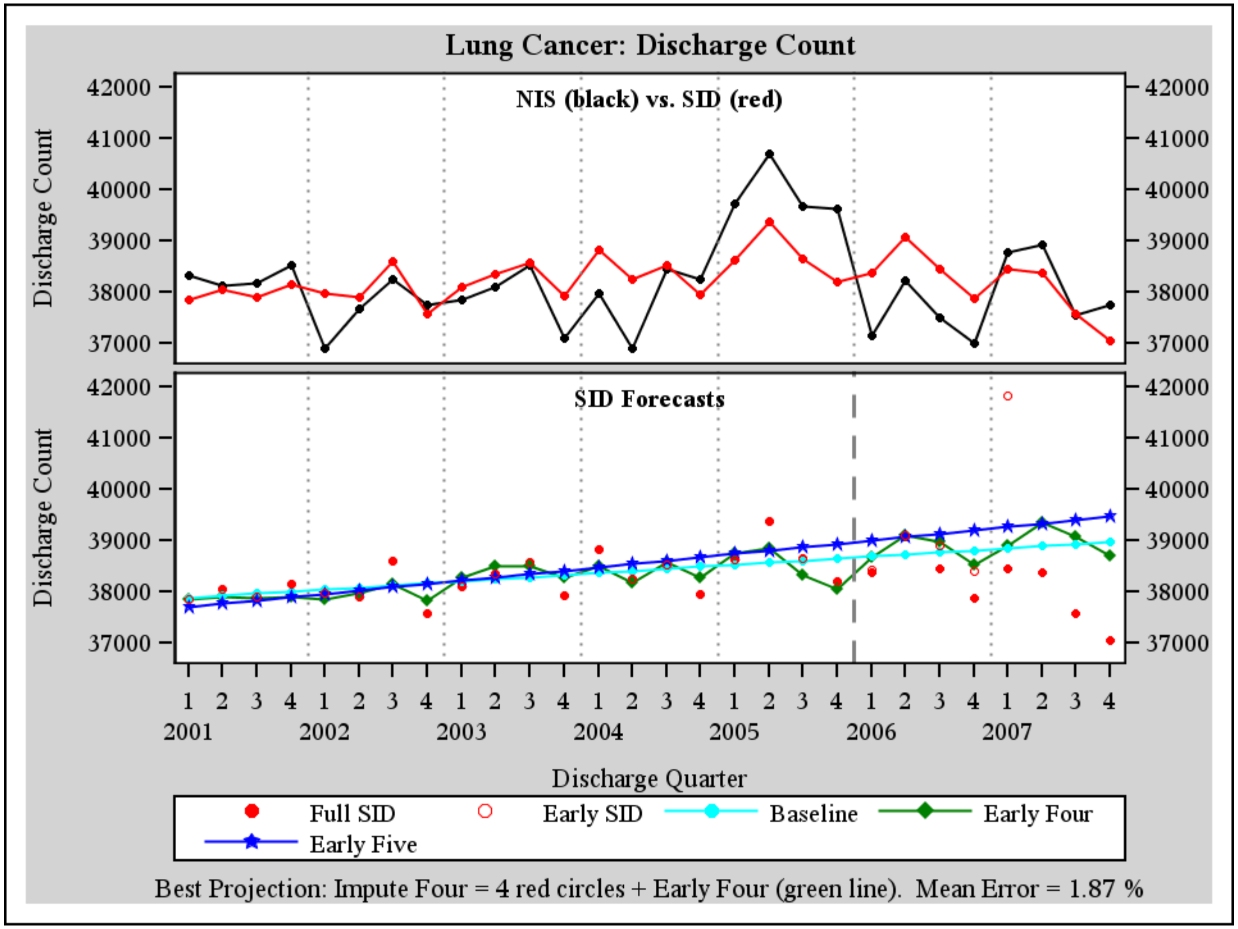

Depression: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
200000
190000
180000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.99 %

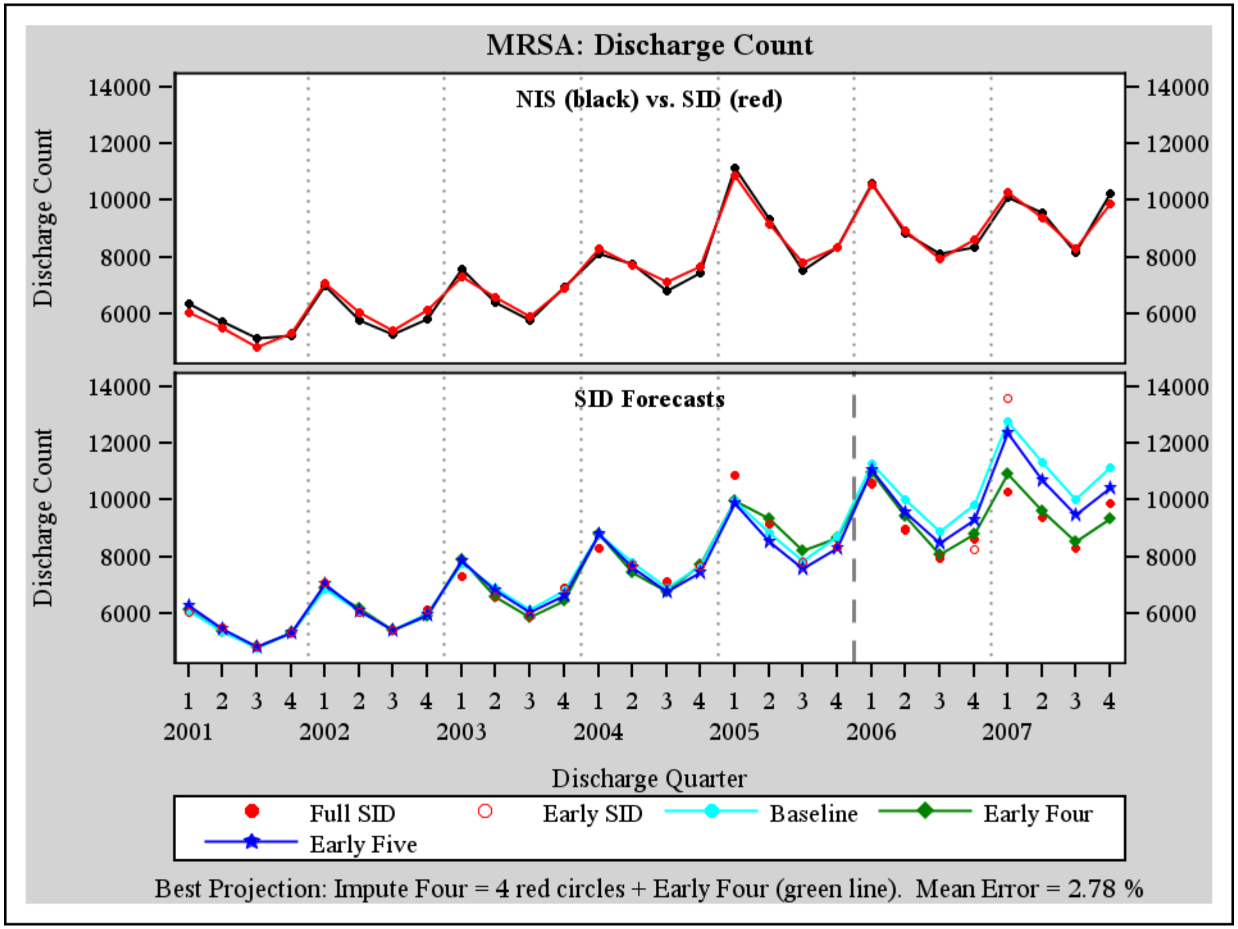

Diabetes: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
135000
130000
125000
120000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.69 %

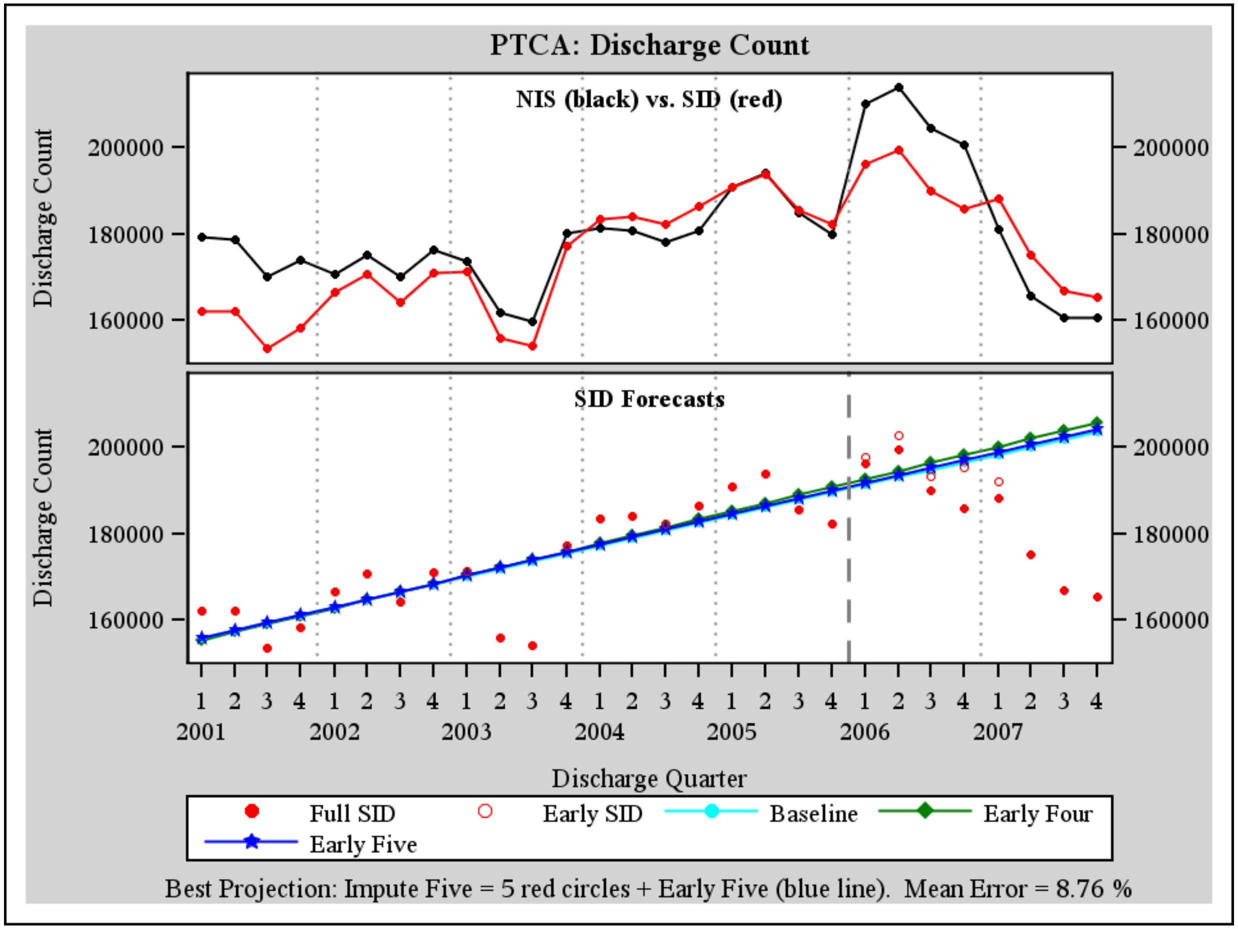

Hip Replacement: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
105000
100000
95000
90000
85000
80000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.55 %

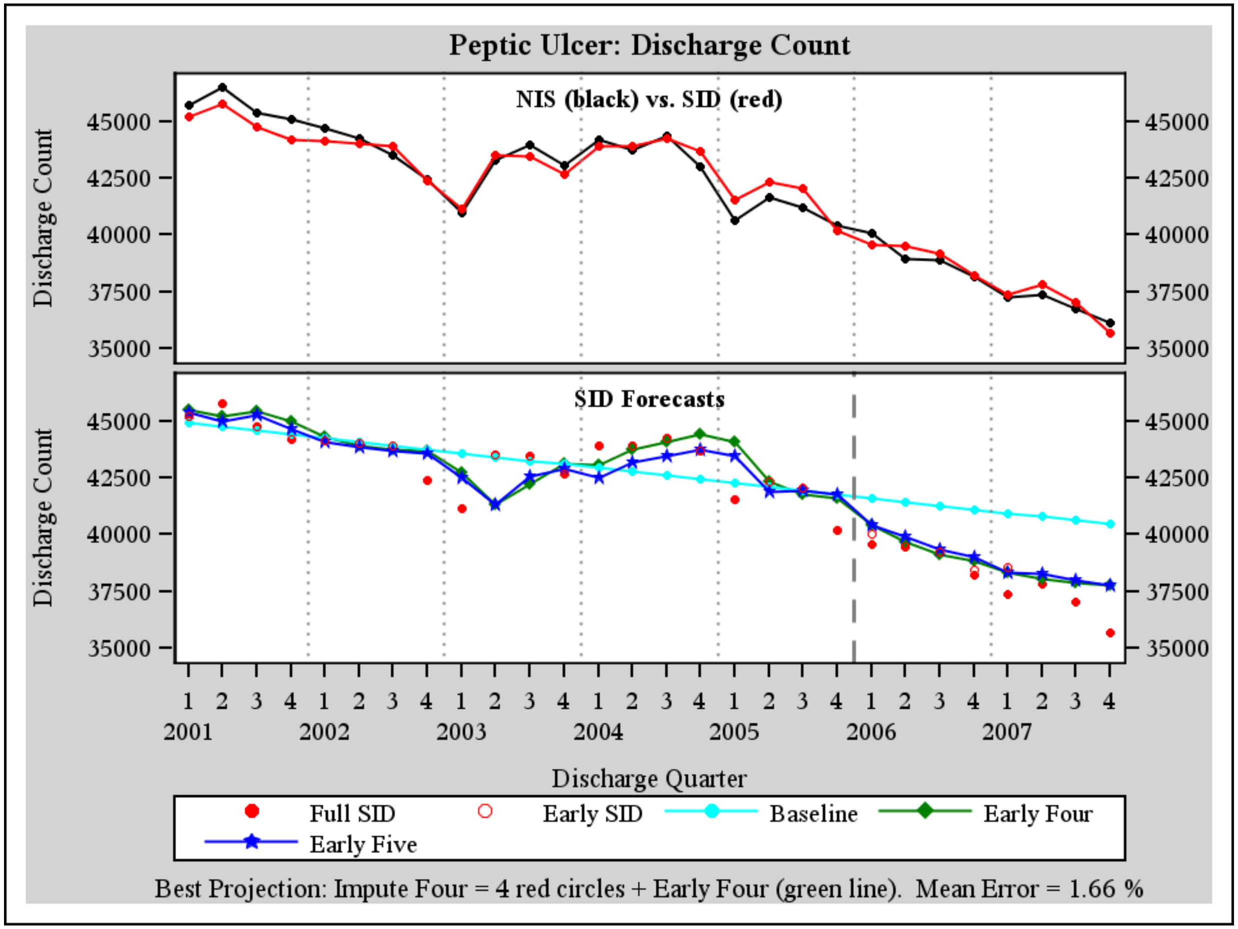

Ischemic Stroke: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
115000
110000
105000
100000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.70 %

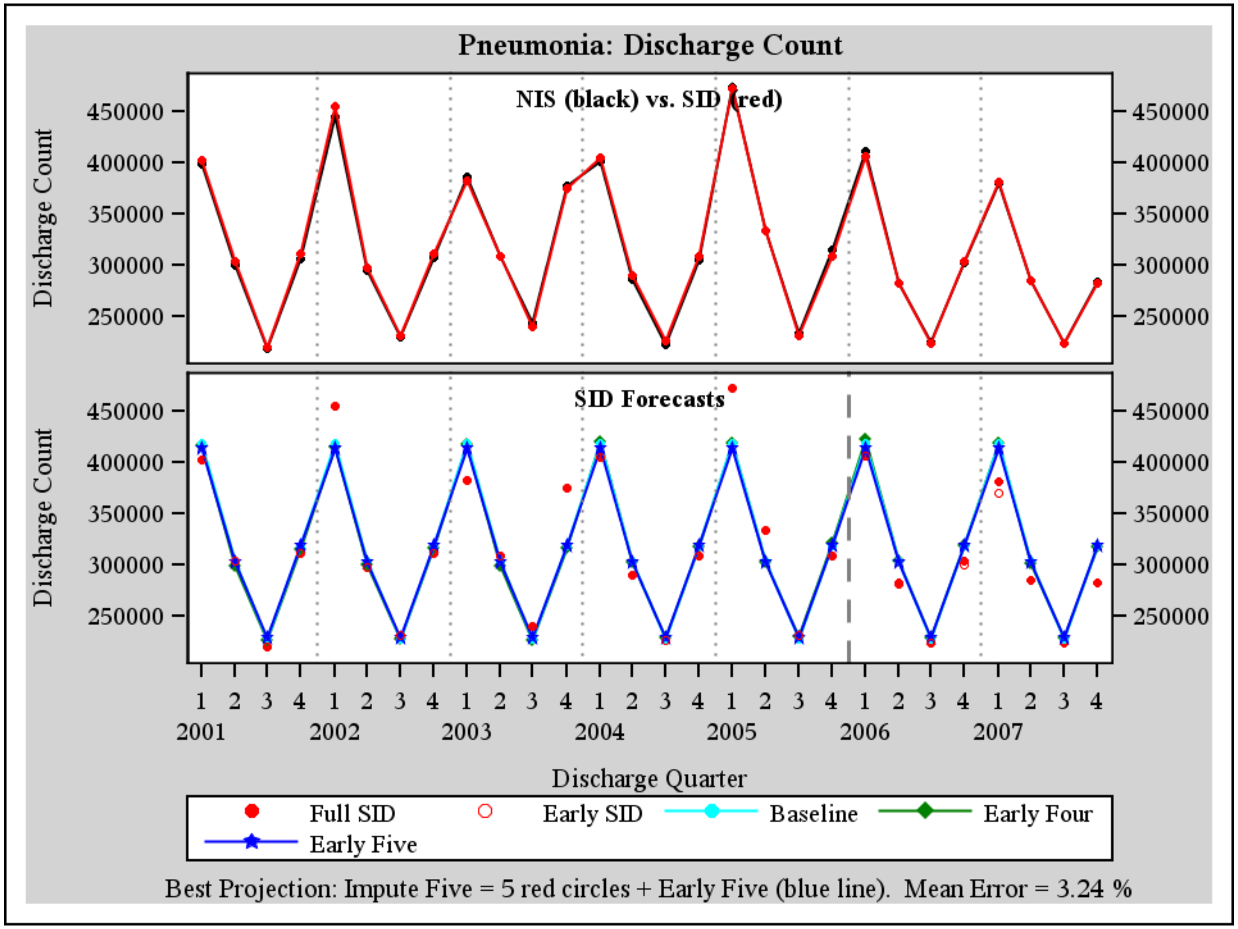

Knee Replacement: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
160000
140000
120000
100000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.57 %

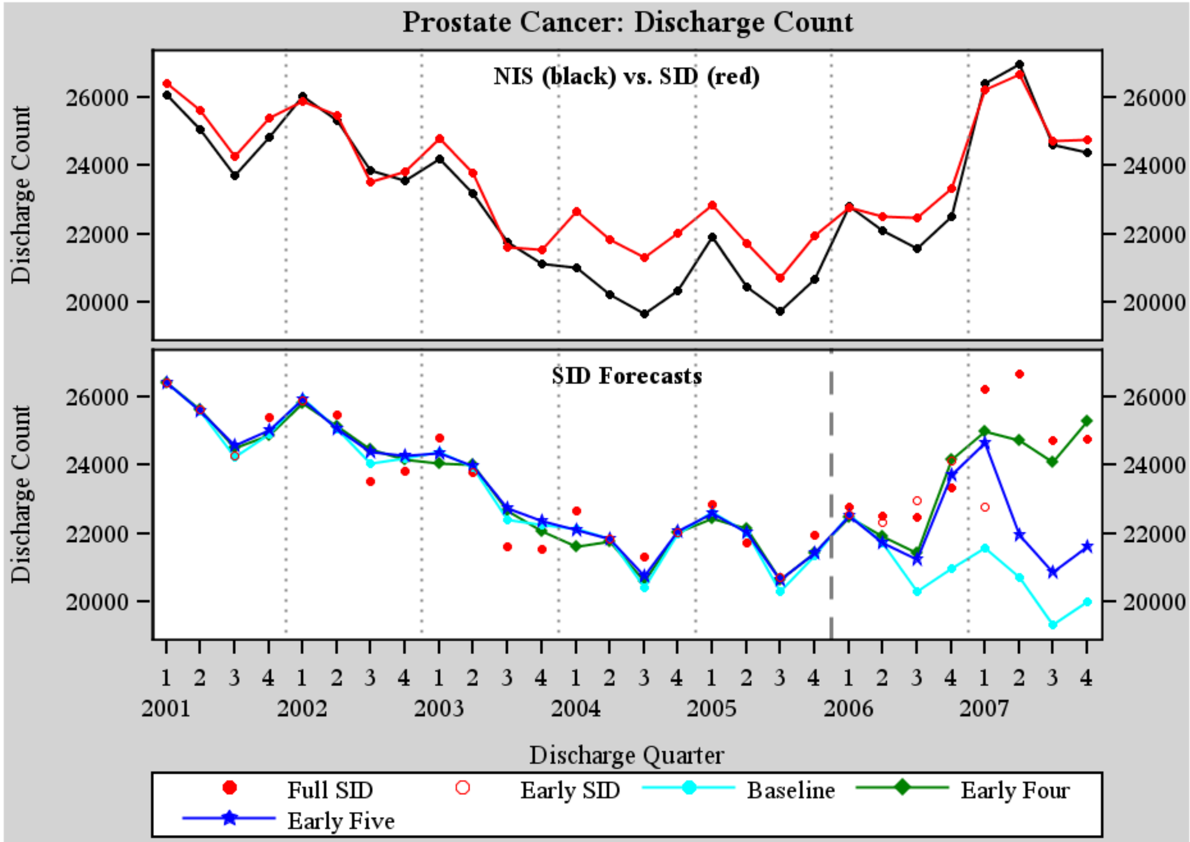

Lung Cancer: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
42000
41000
40000
39000
38000
37000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.87 %


MRSA: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
14000
12000
10000
8000
6000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.78 %

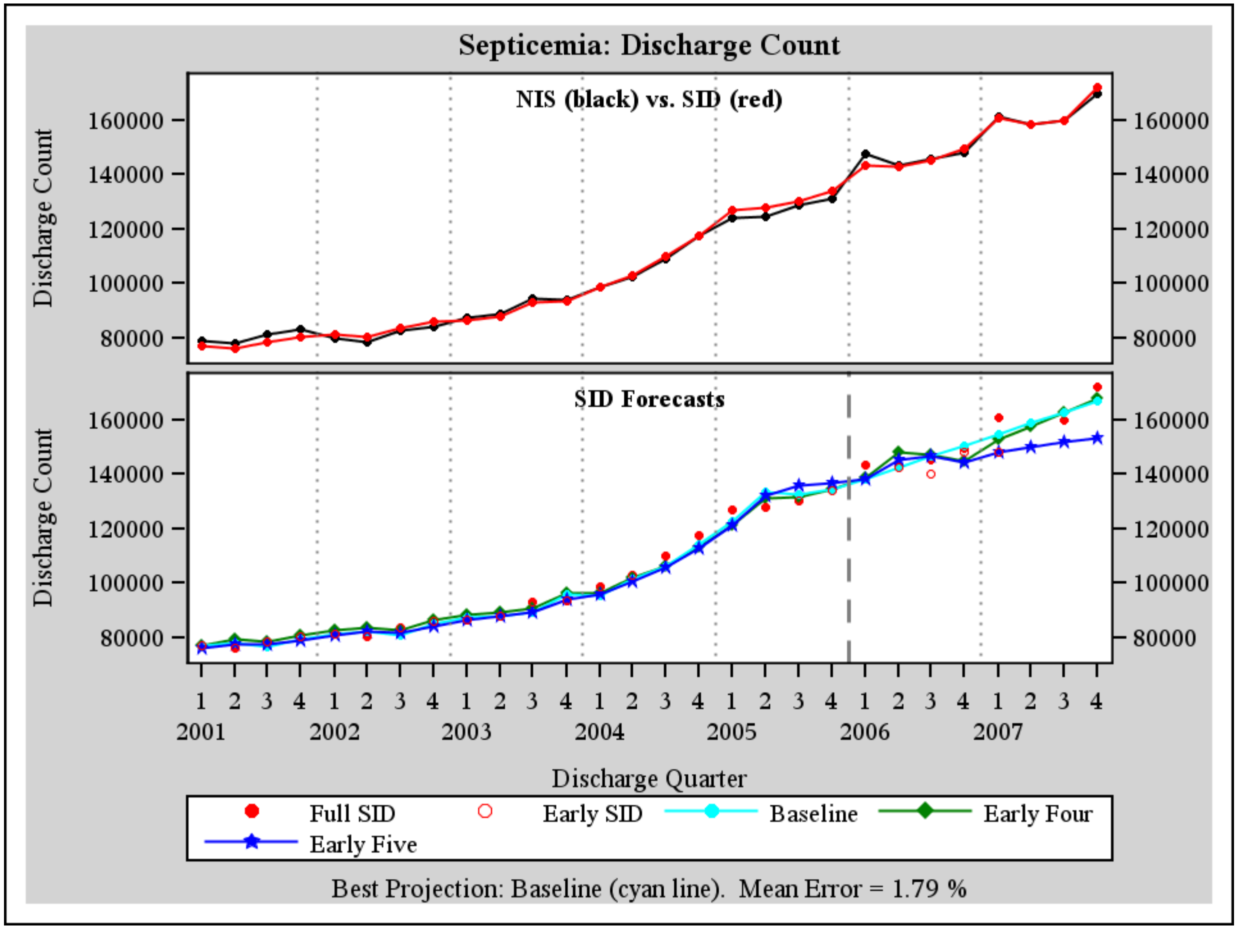

PTCA: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
200000
180000
160000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 8.76 %


Peptic Ulcer: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
45000
42500
40000
37500
35000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.66 %

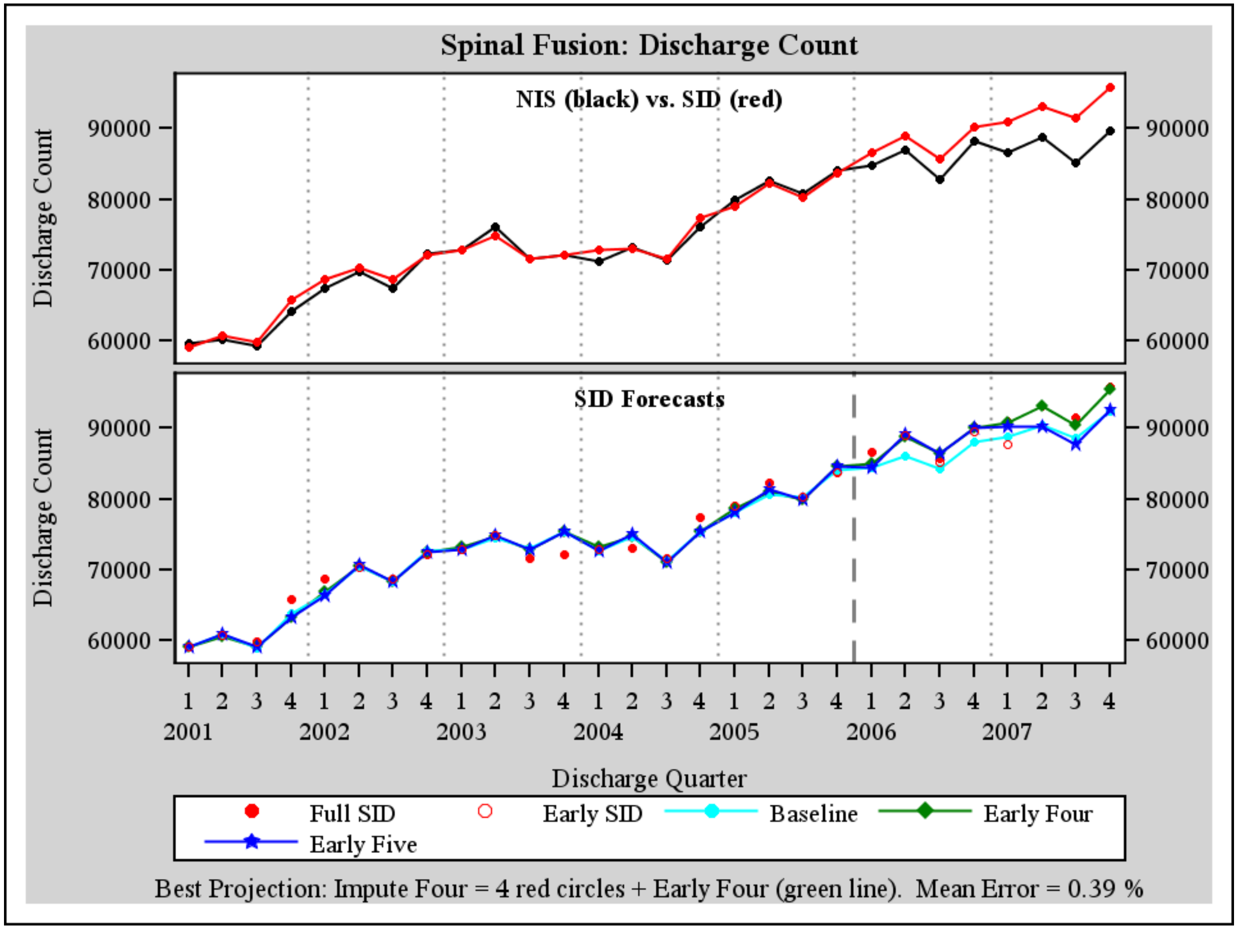

Pneumonia: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
450000
400000
350000
300000
250000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 3.24 %

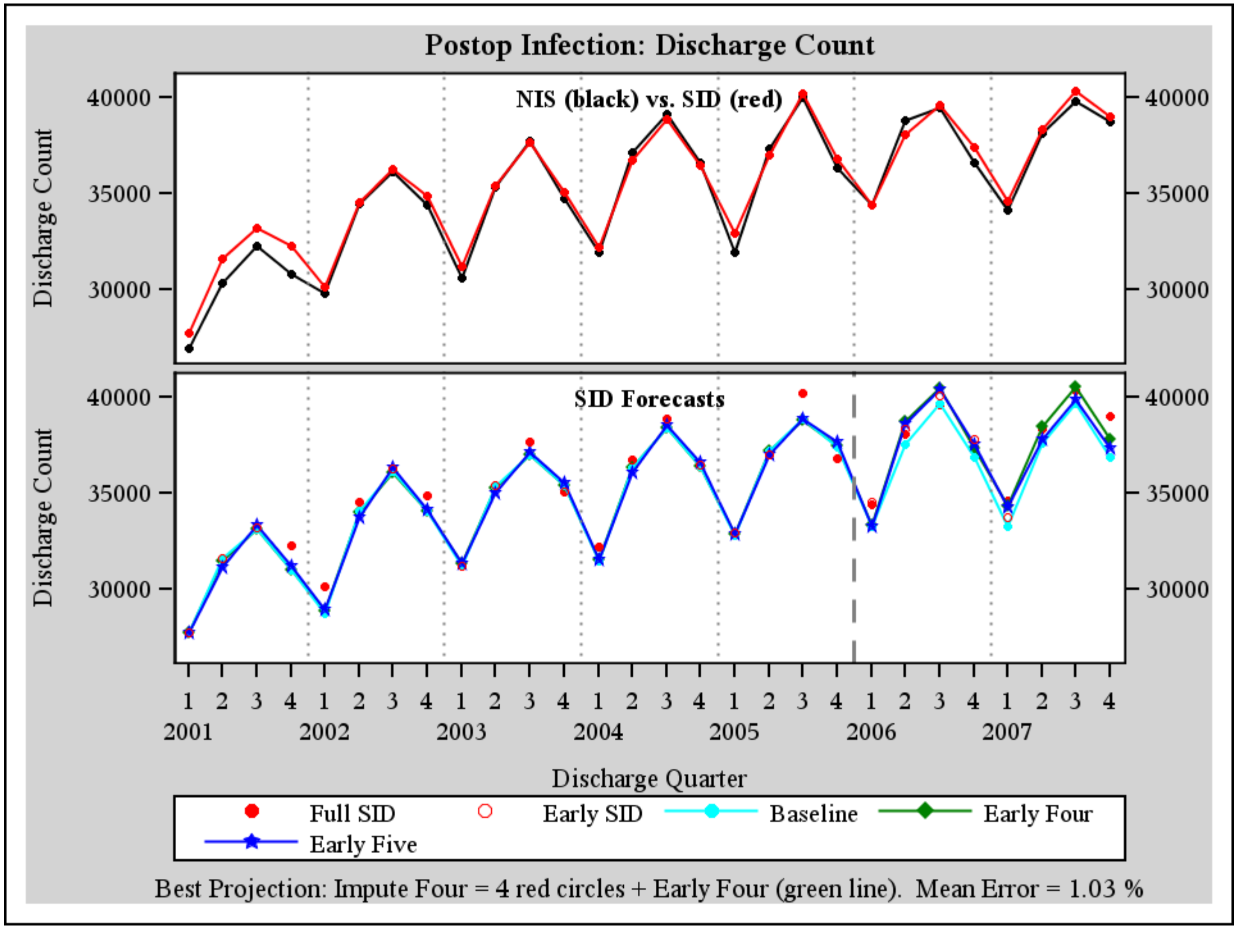


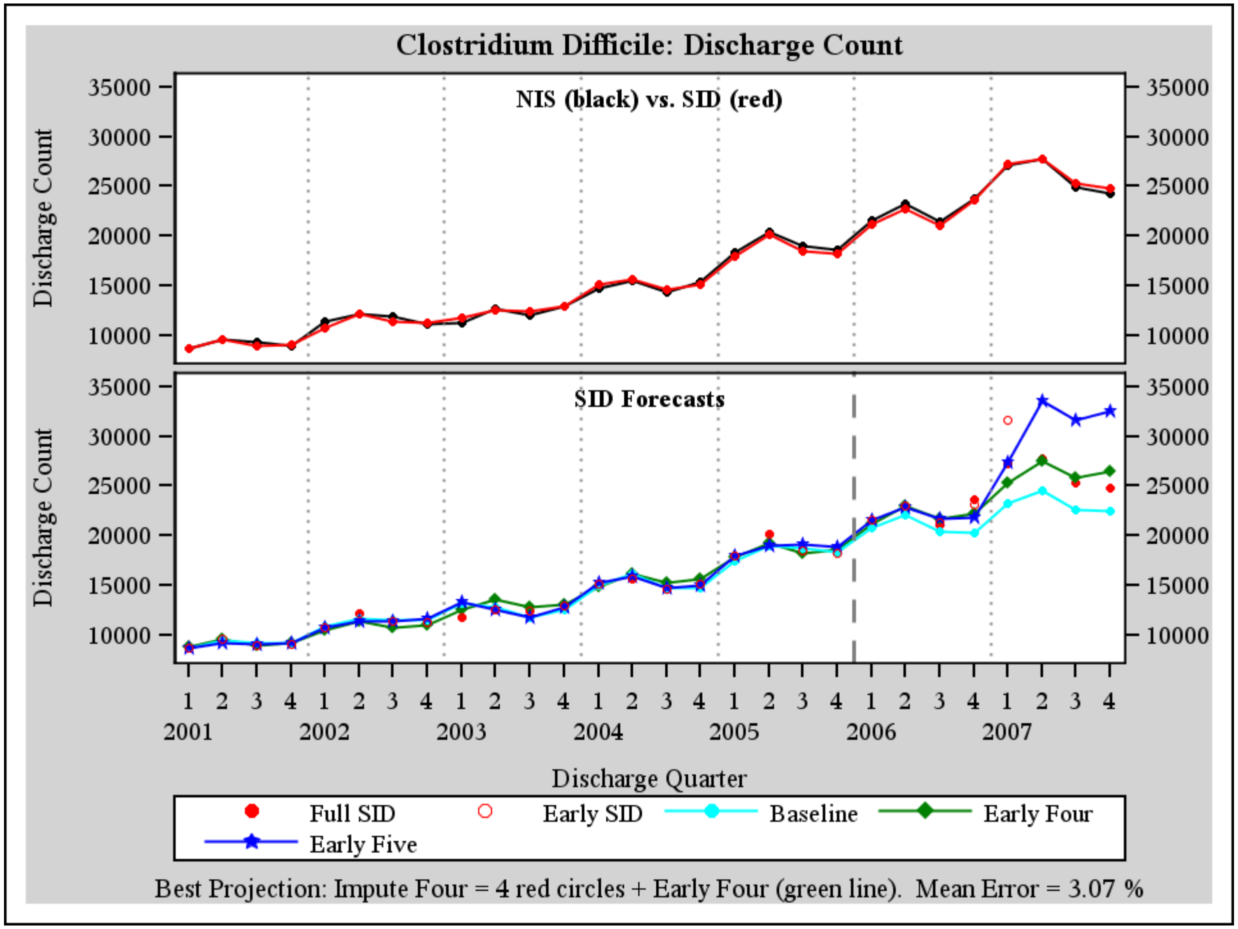
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.97 %



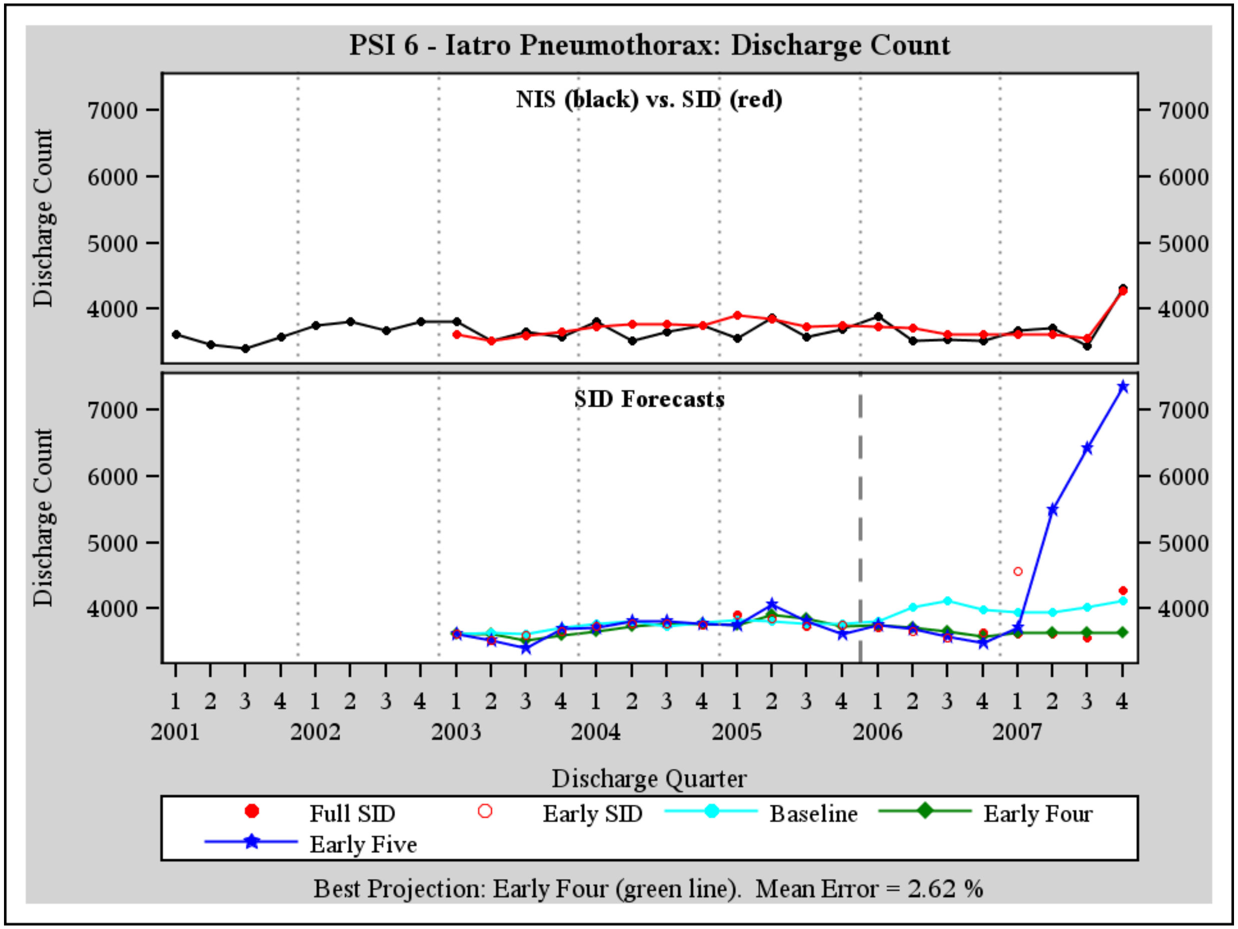
Septicemia: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
160000
140000
120000
100000
80000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.79 %

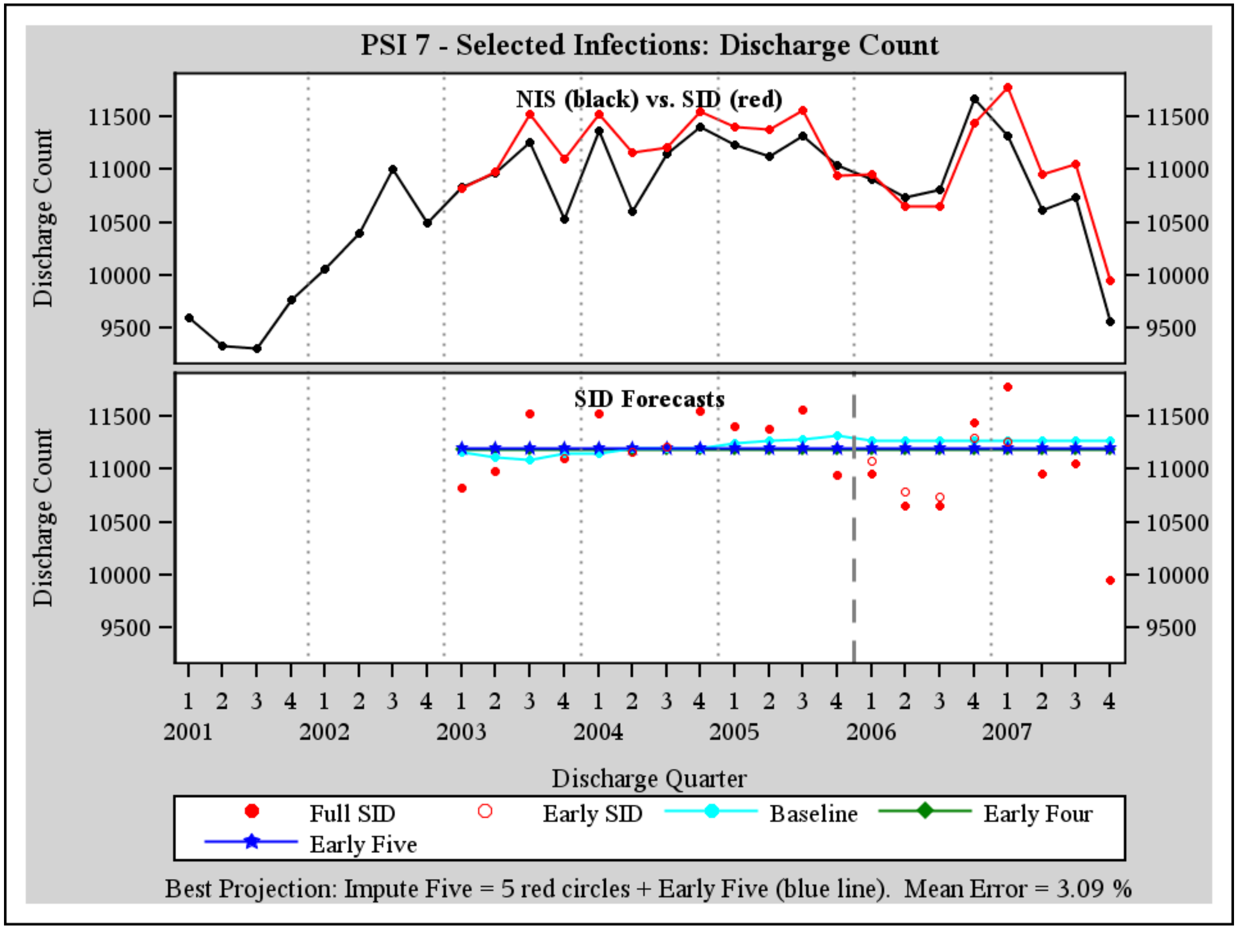

Spinal Fusion: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
90000
80000
70000
60000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.39 %

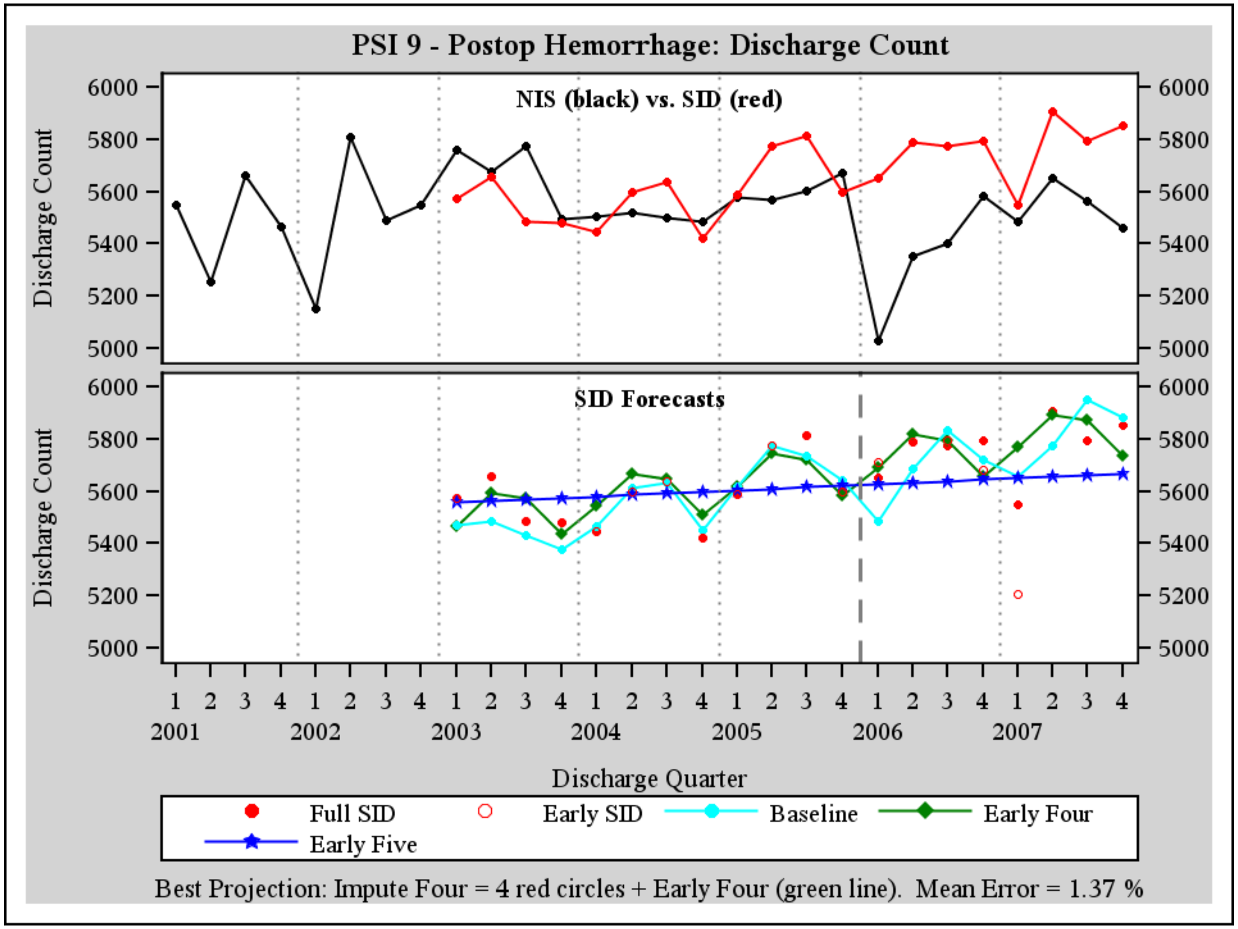

Postop Infection: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.03 %

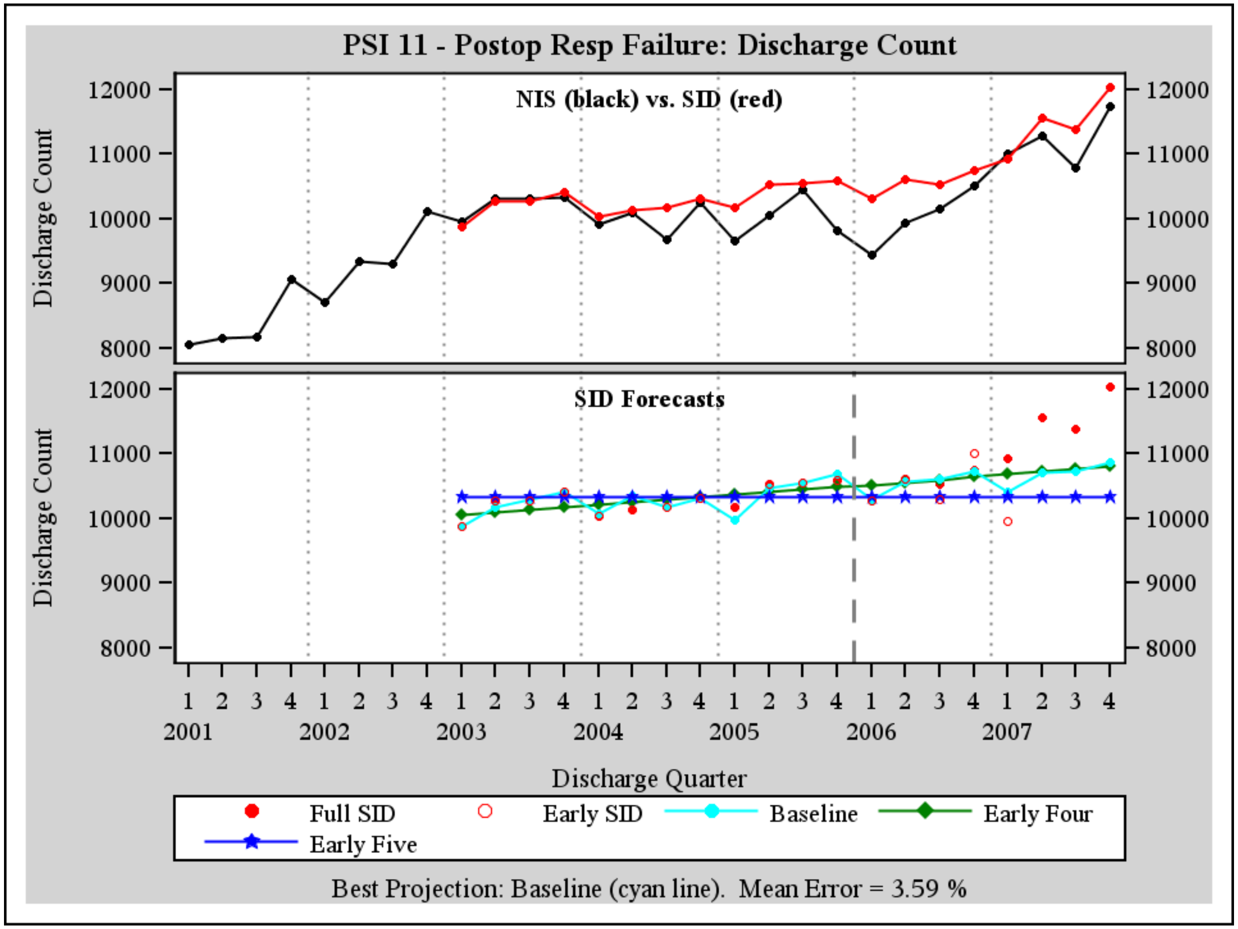


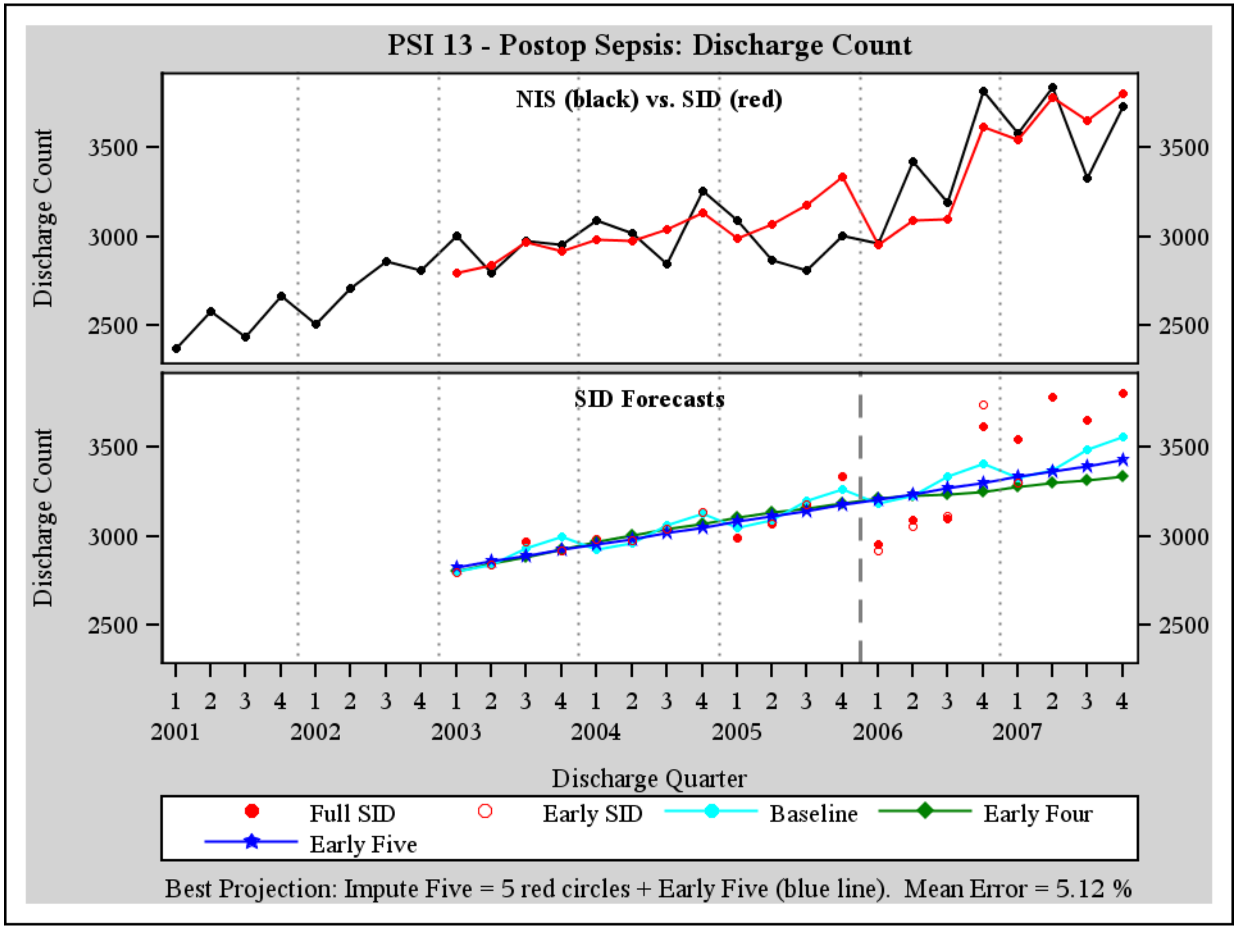
Clostridium Difficile: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
35000
30000
25000
20000
15000
10000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 3.07 %

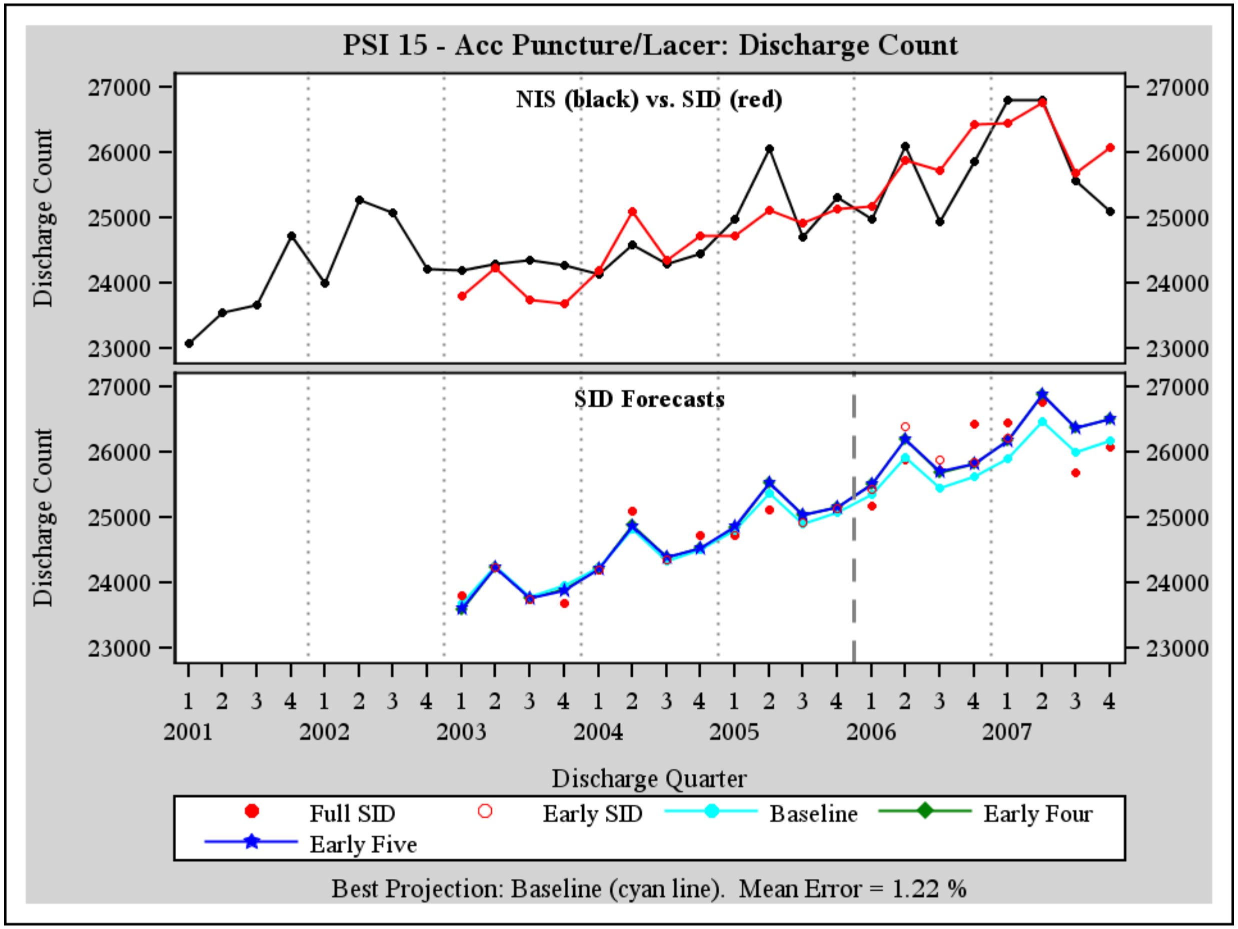

PSI 6 - Iatro Pneumothorax: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
7000
6000
5000
4000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 2.62 %


PSI 7 - Selected Infections: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
11500
11000
10500
10000
9500
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 3.09 %


PSI 9 - Postop Hemorrhage: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
6000
5800
5600
5400
5200
5000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.37 %

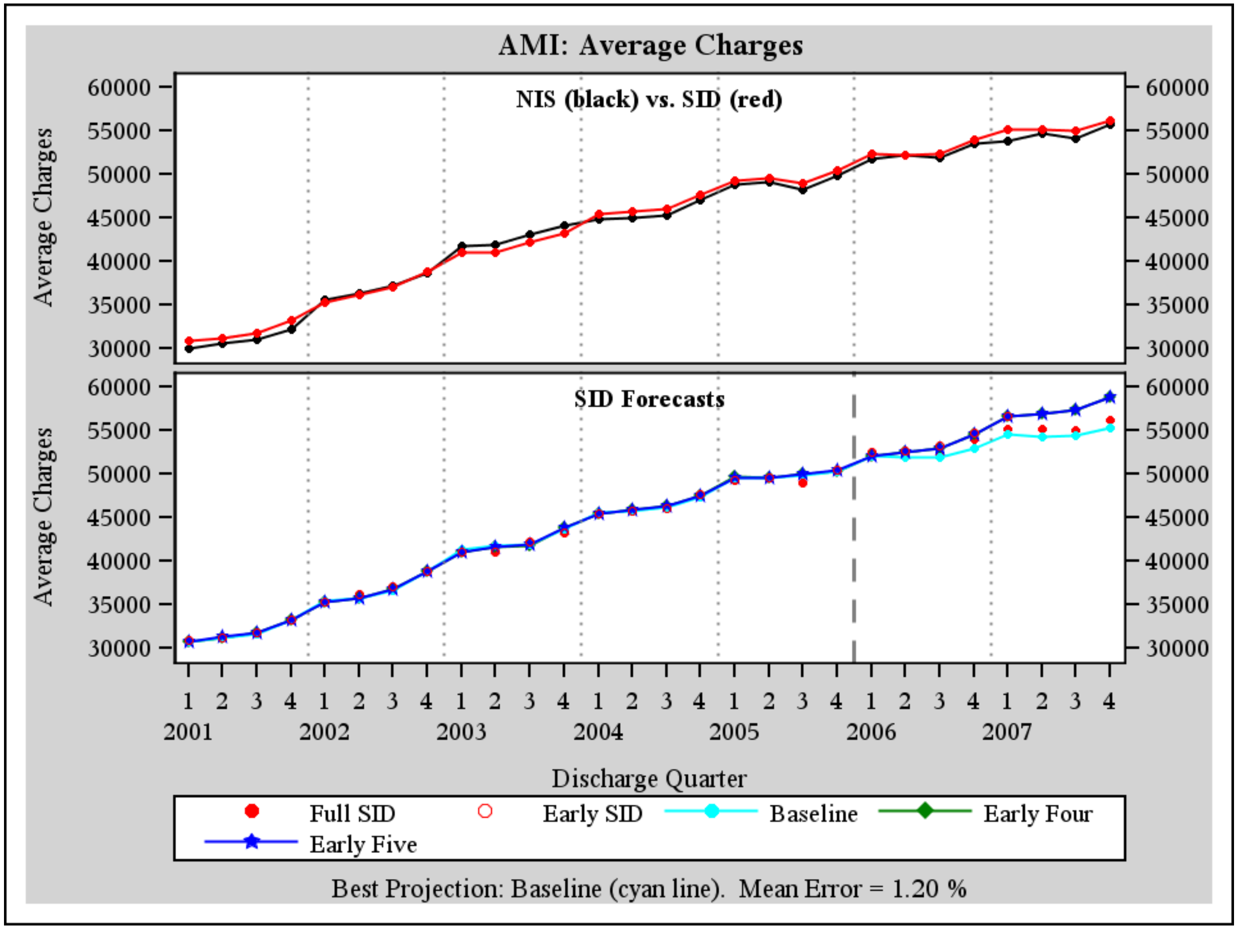

PSI 11 - Postop Resp Failure: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
12000
11000
10000
9000
8000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 3.59 %

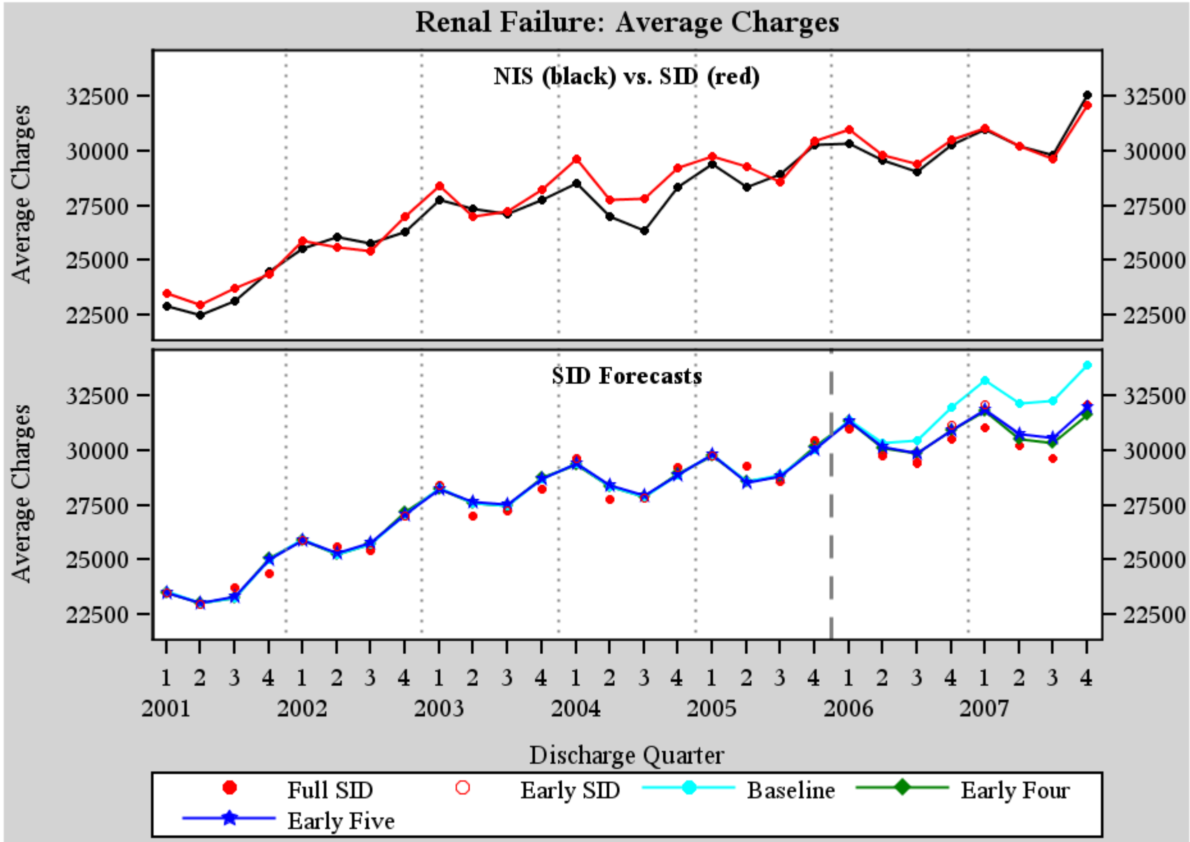

PSI 13 - Postop Sepsis: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
3500
3000
2500
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 5.12 %



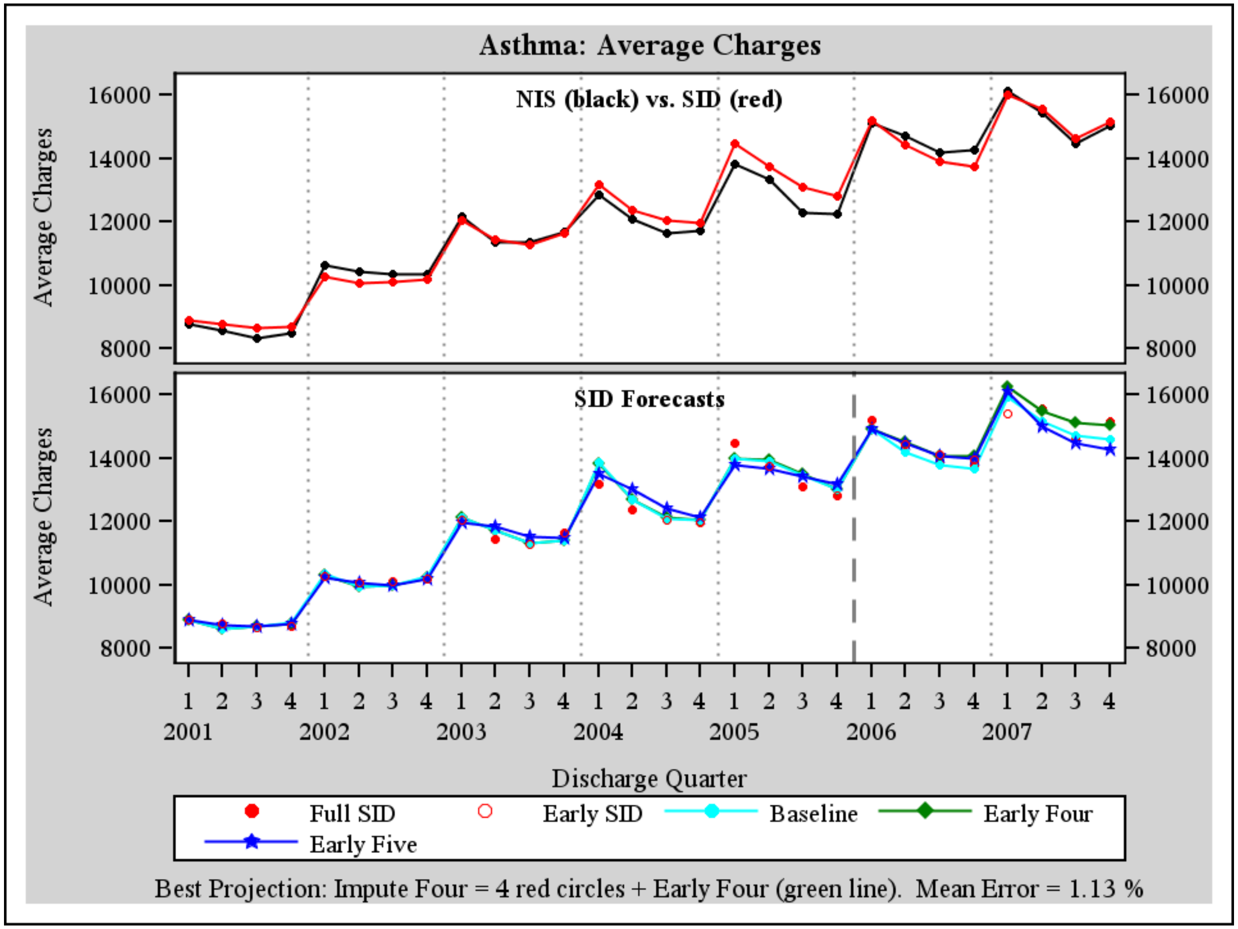
PSI 15 - Acc Puncture/Lacer: Discharge Count
NIS (black) vs. SID (red)
SID Forecasts
Discharge Count
27000
26000
25000
24000
23000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.22 %

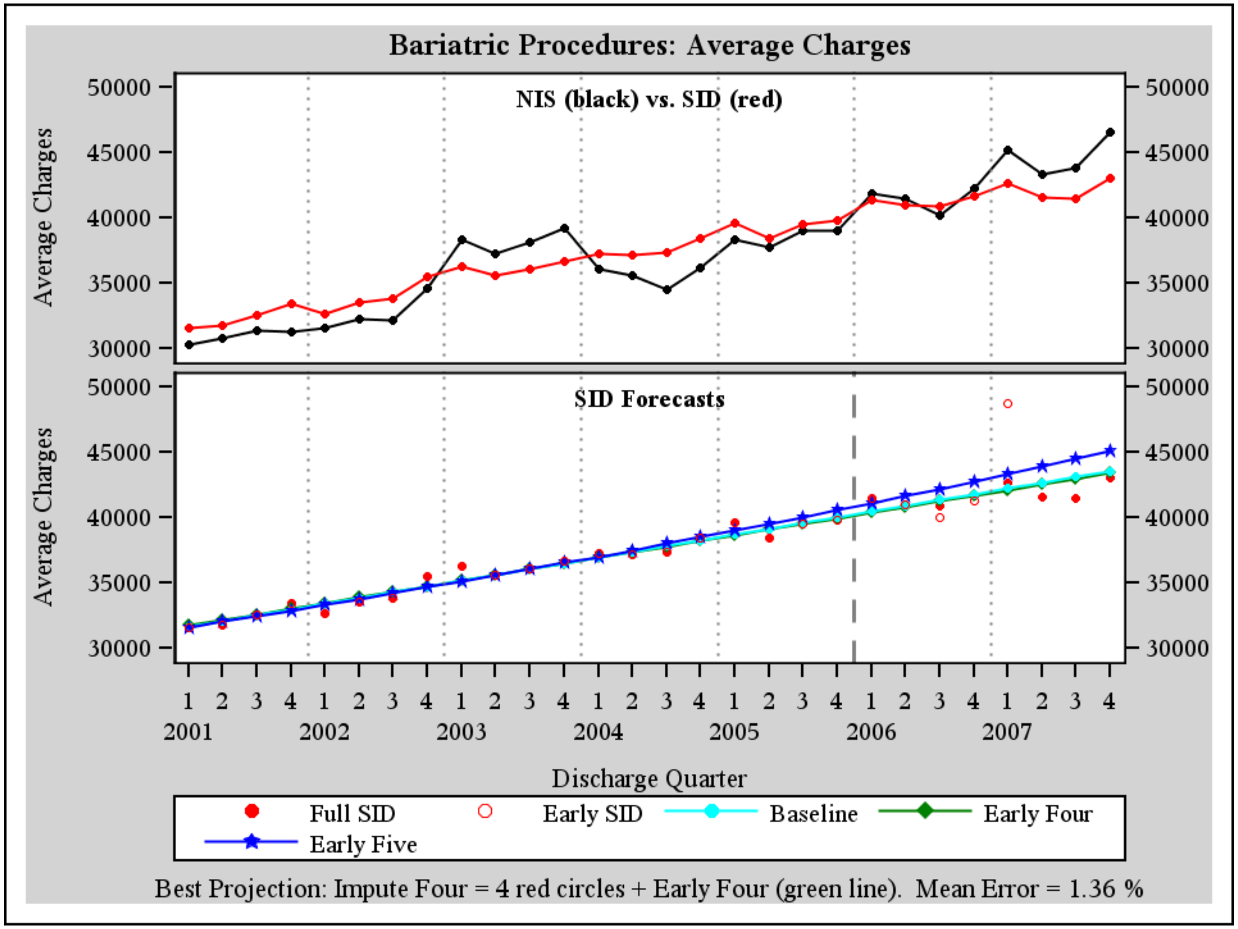
APPENDIX B: SID AVERAGE TOTAL CHARGE PROJECTIONS

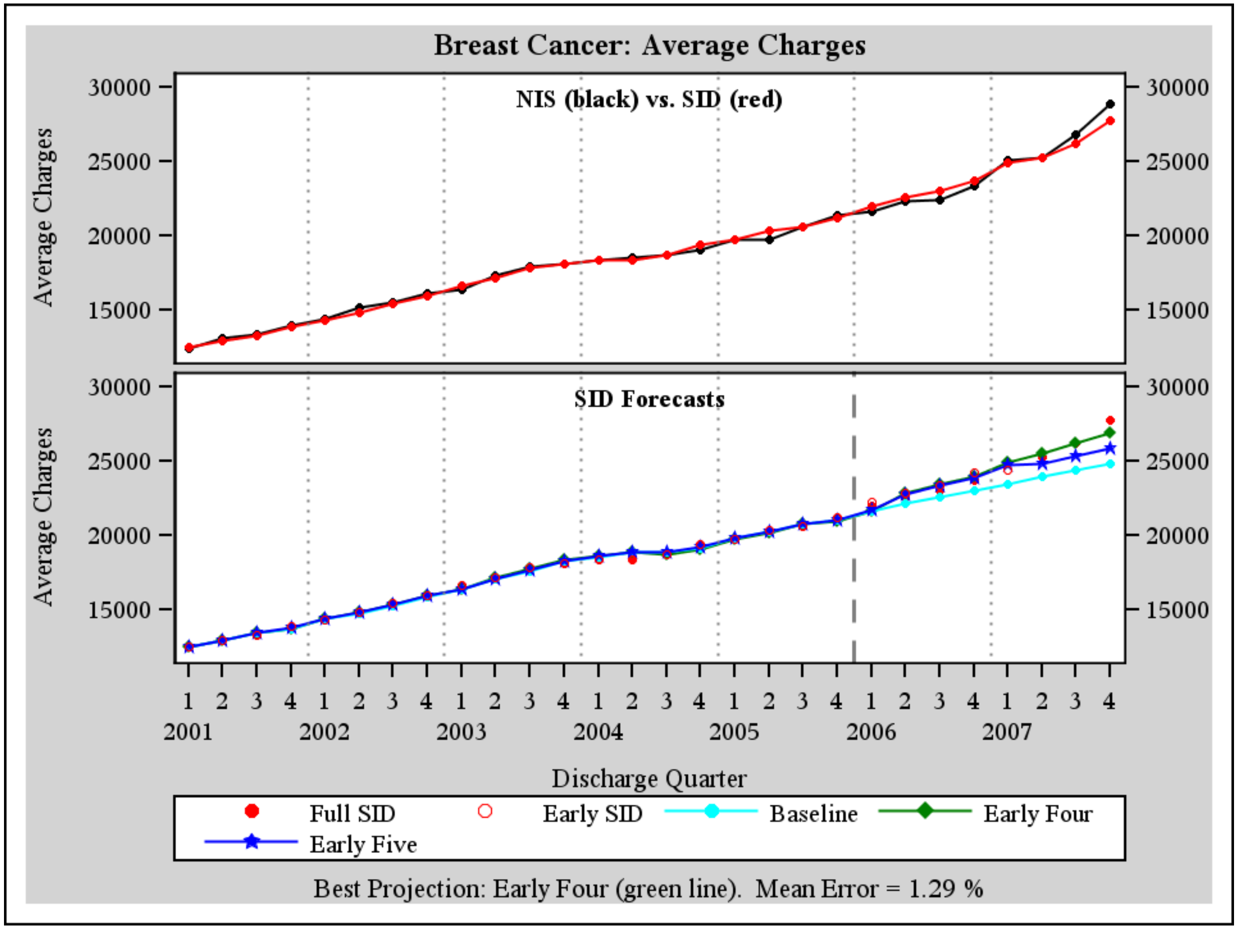

AMI: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
60000
55000
50000
45000
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.20 %



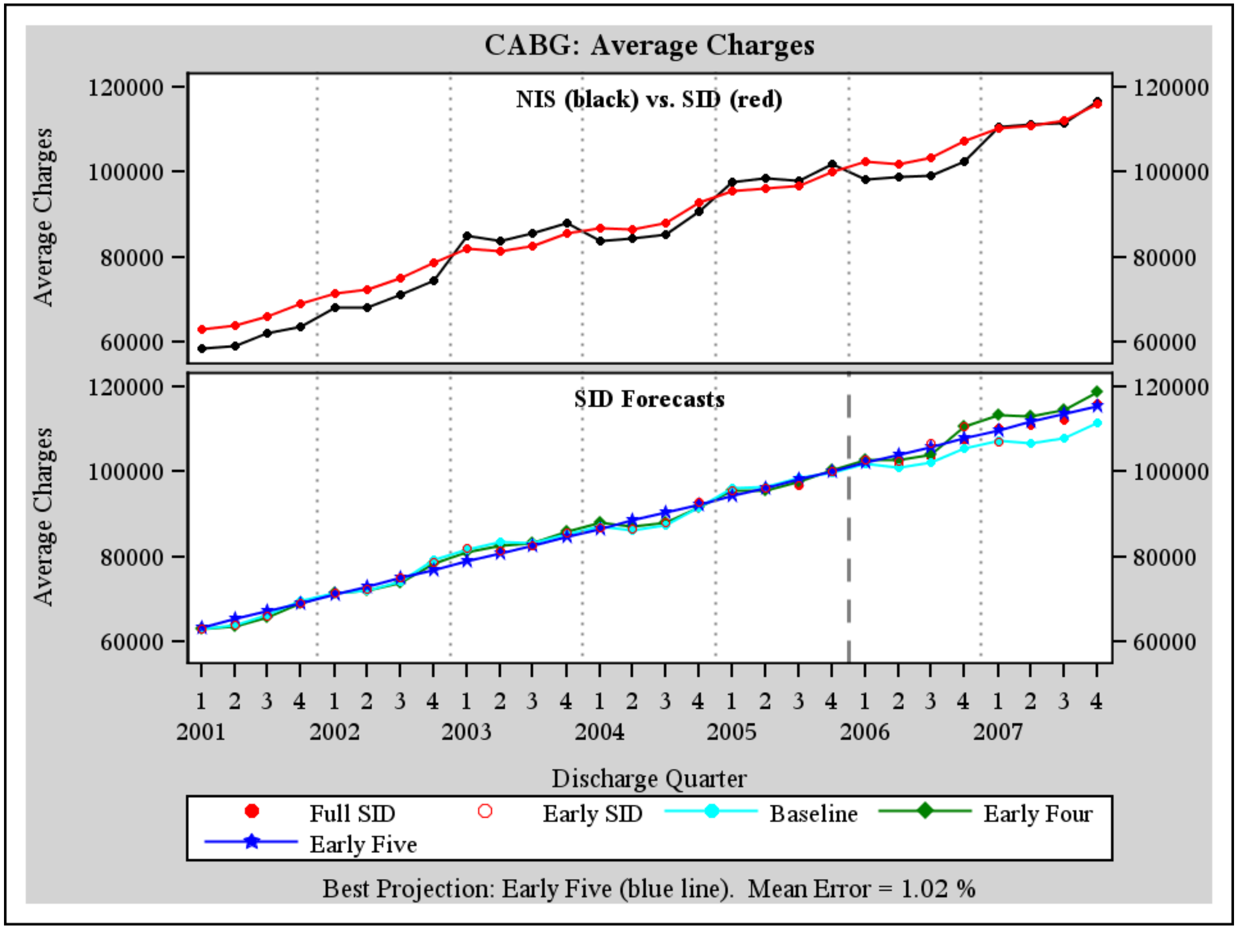
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.23 %

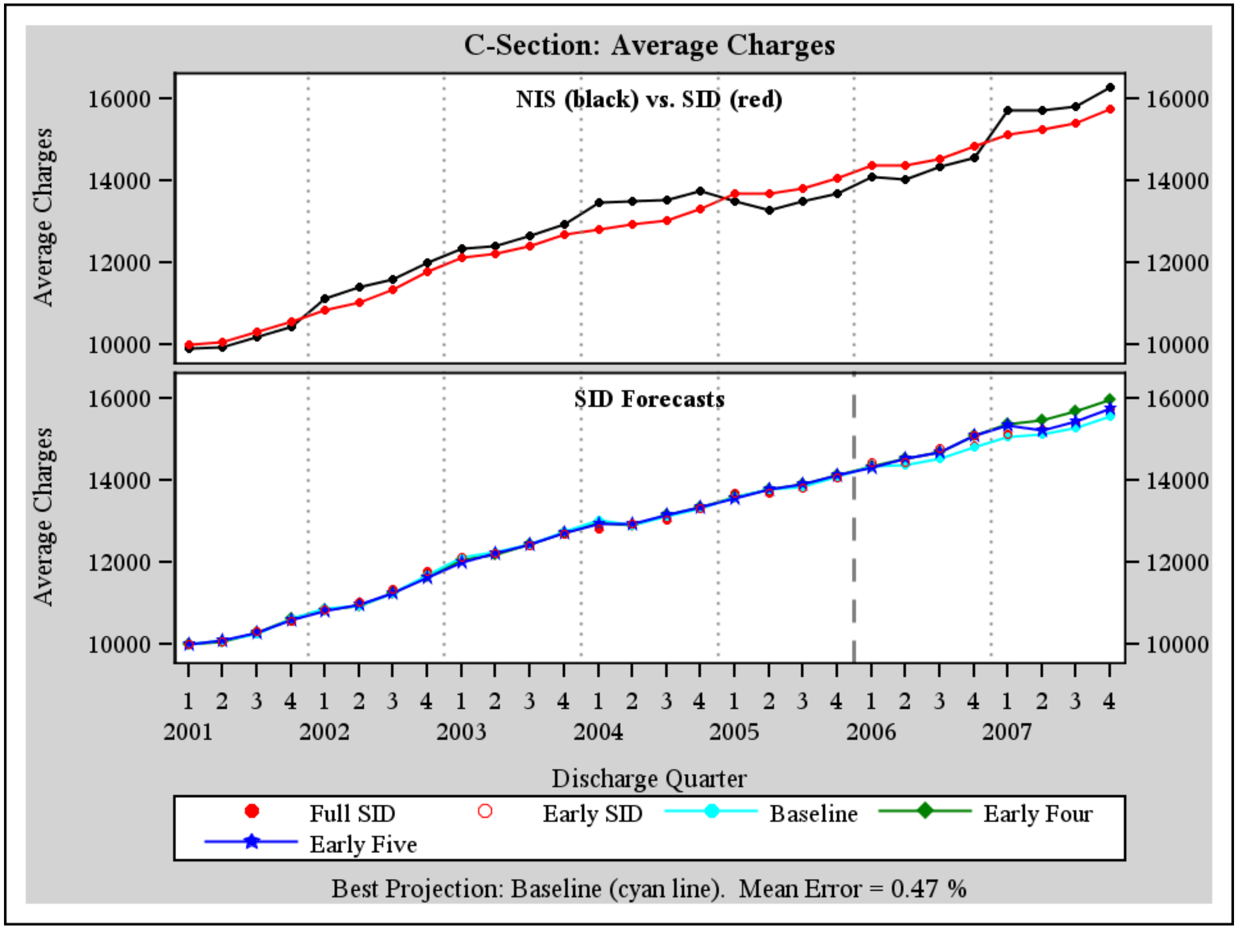

Asthma: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
16000
14000
12000
10000
8000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.13 %

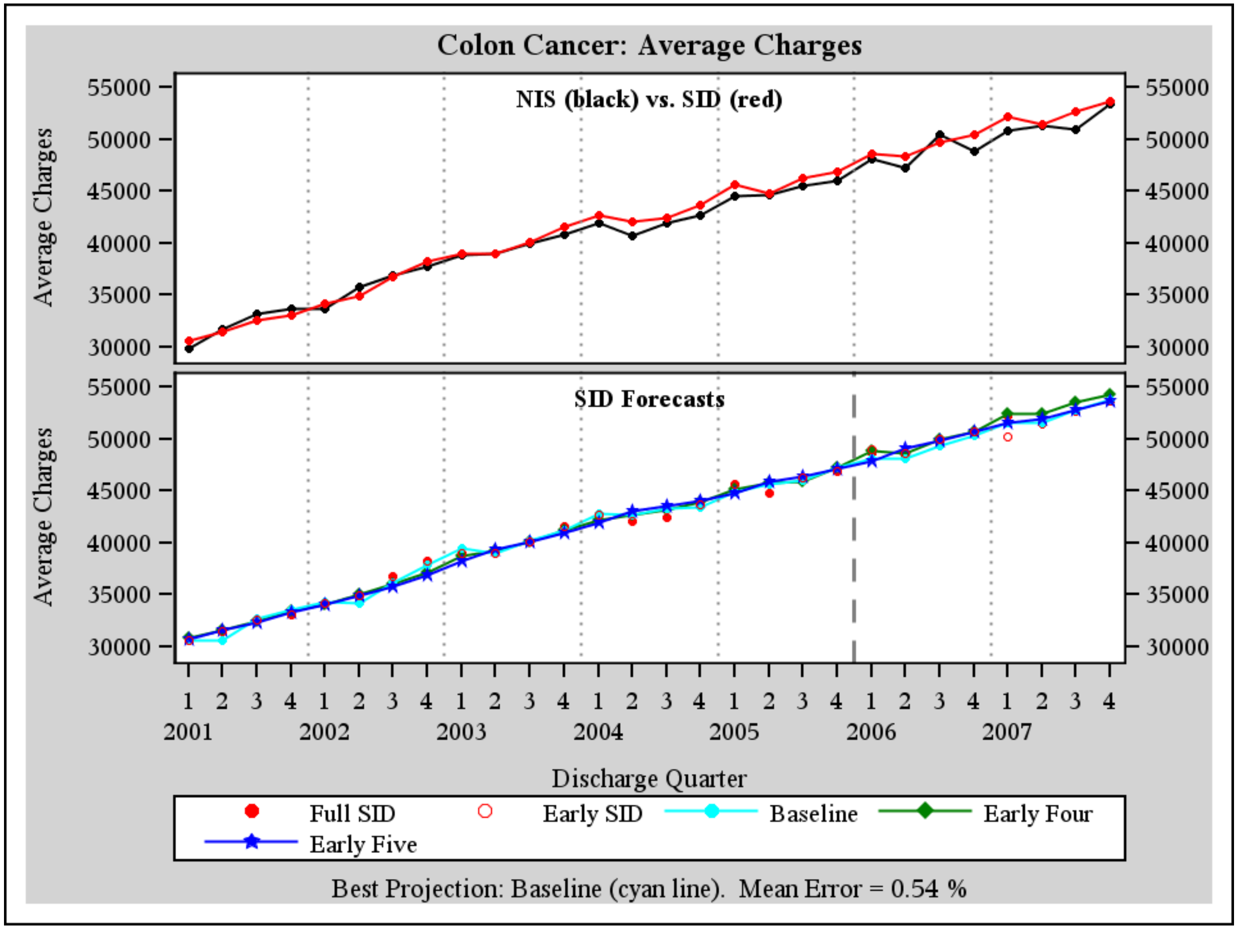

Bariatric Procedures: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
50000
45000
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.36 %

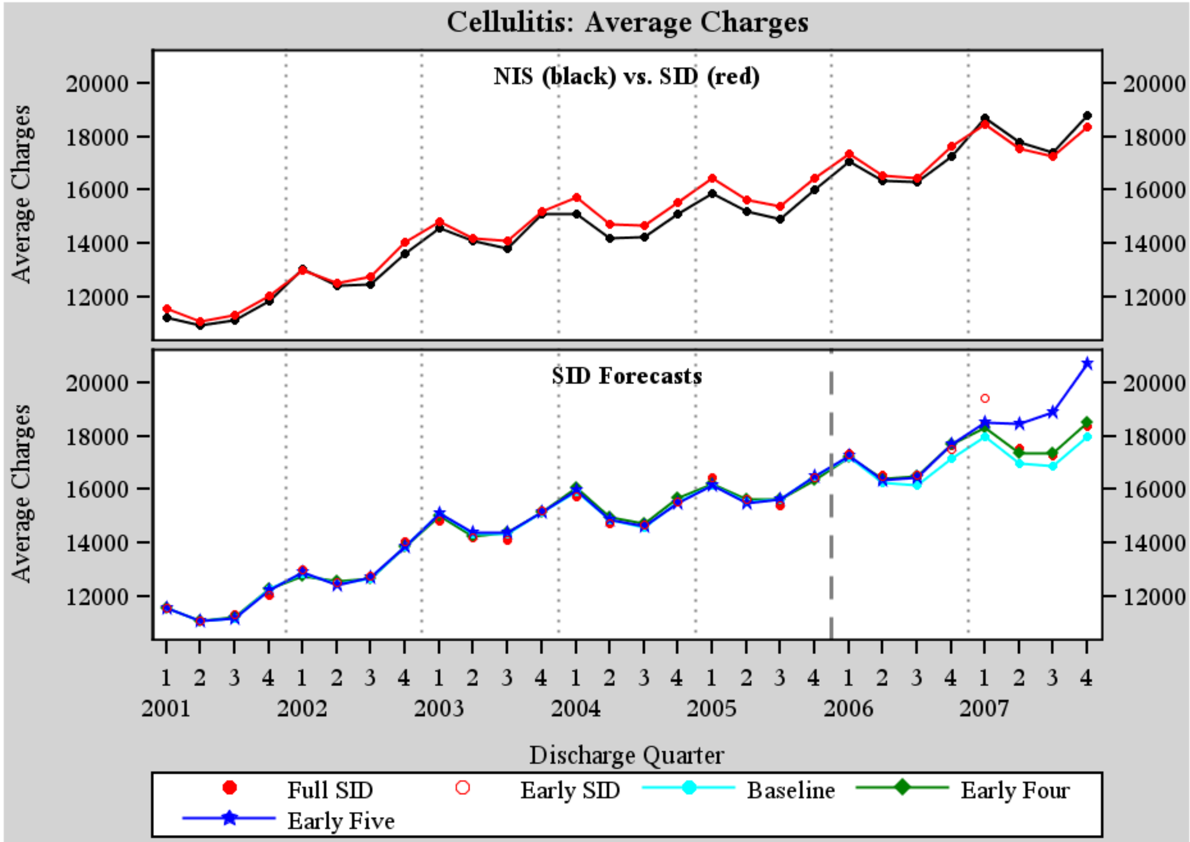


Breast Cancer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
30000
25000
20000
15000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 1.29 %

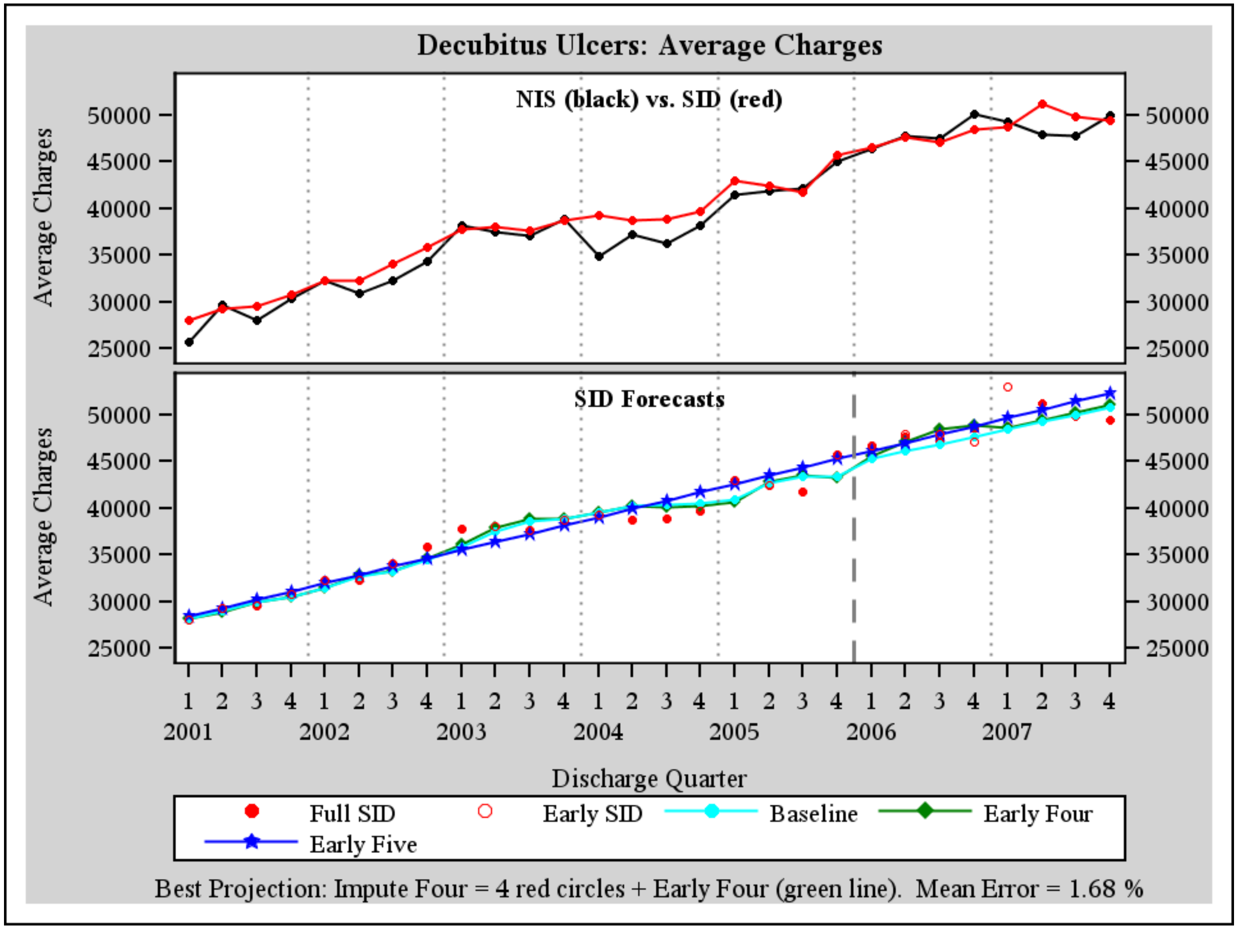

CABG: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
120000
100000
80000
60000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 1.02 %


C-Section: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
16000
14000
12000
10000
1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.47 %

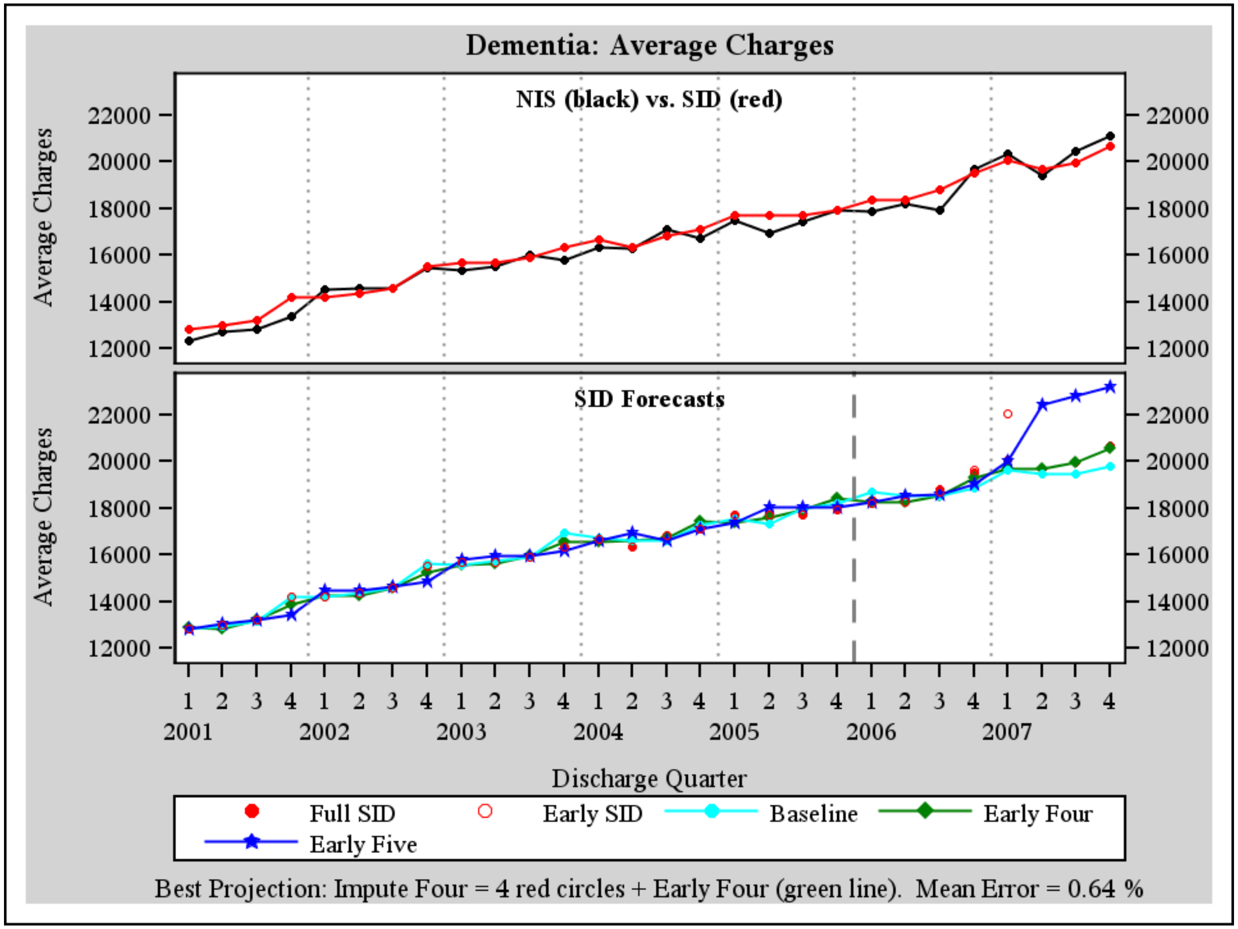

Colon Cancer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
55000
50000
45000
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.54 %

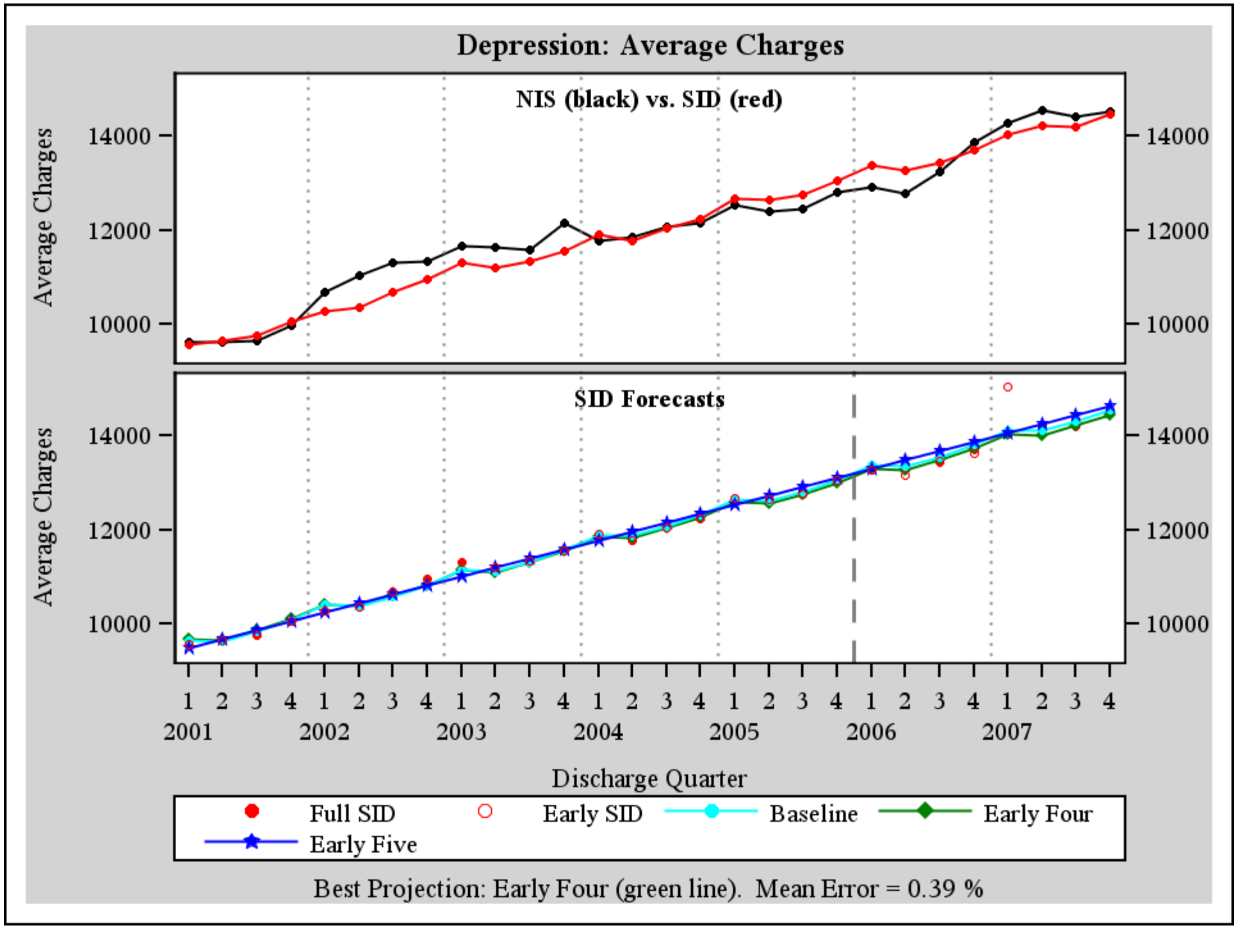


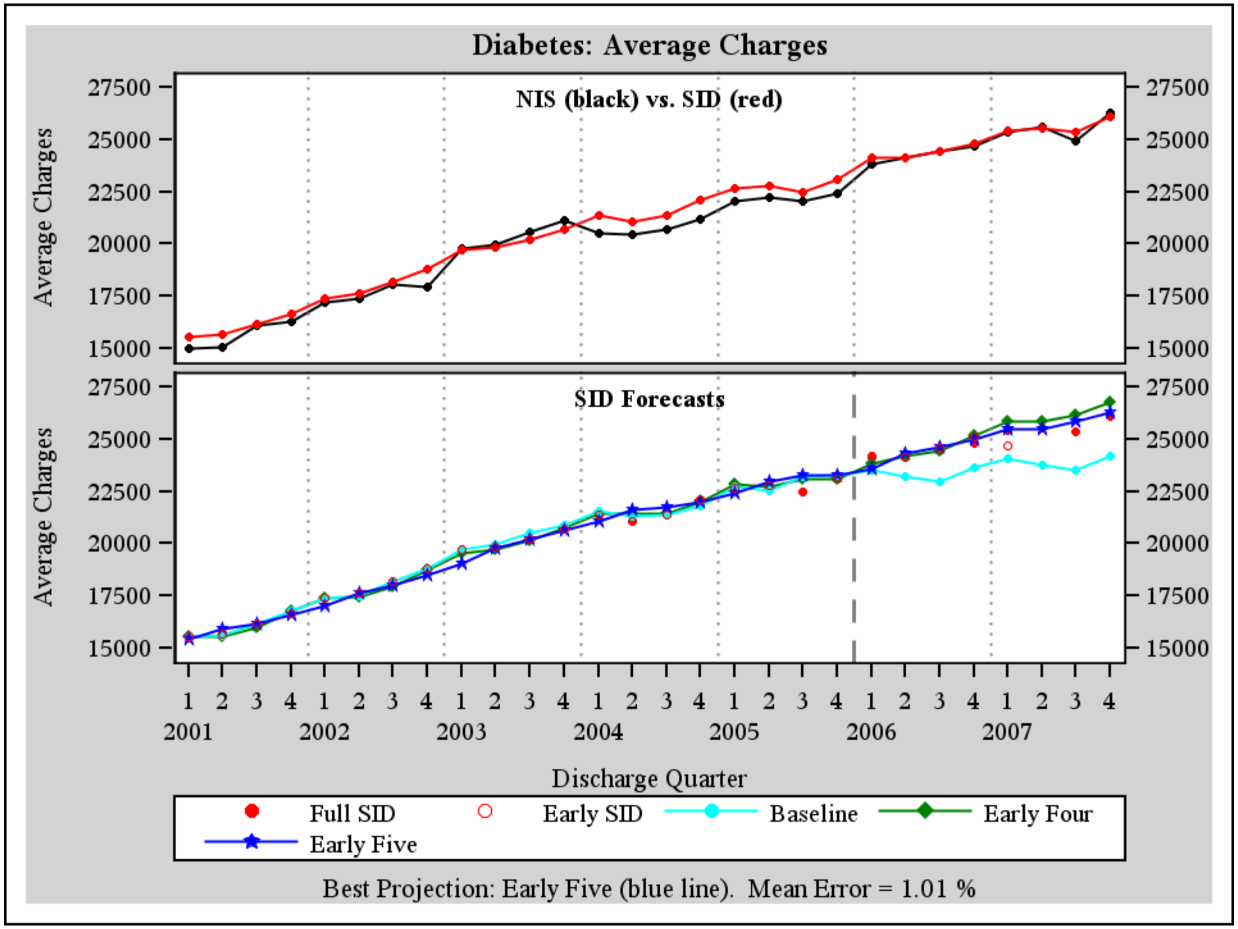
Best Projection: Early Four (green line). Mean Error = 0.61 %

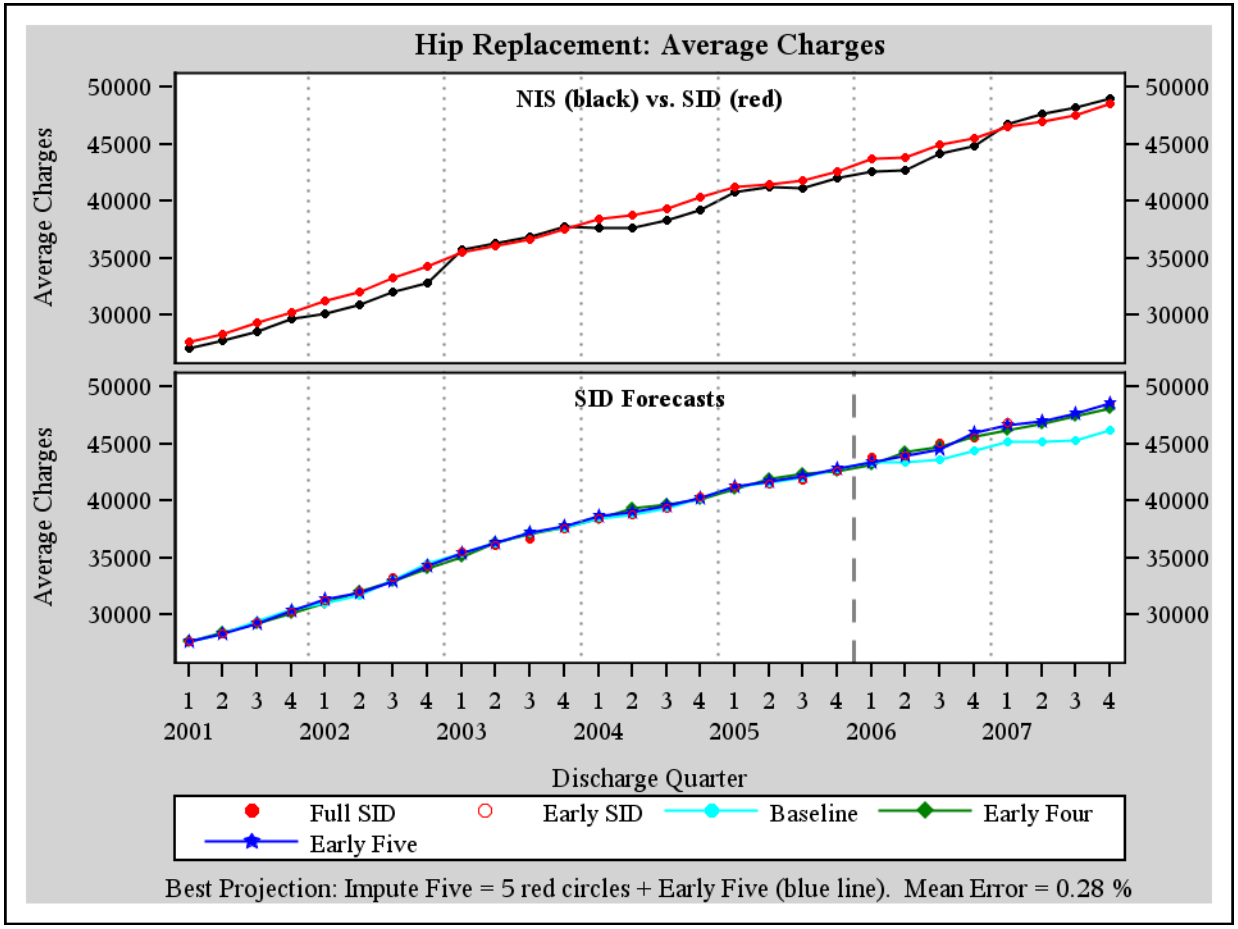


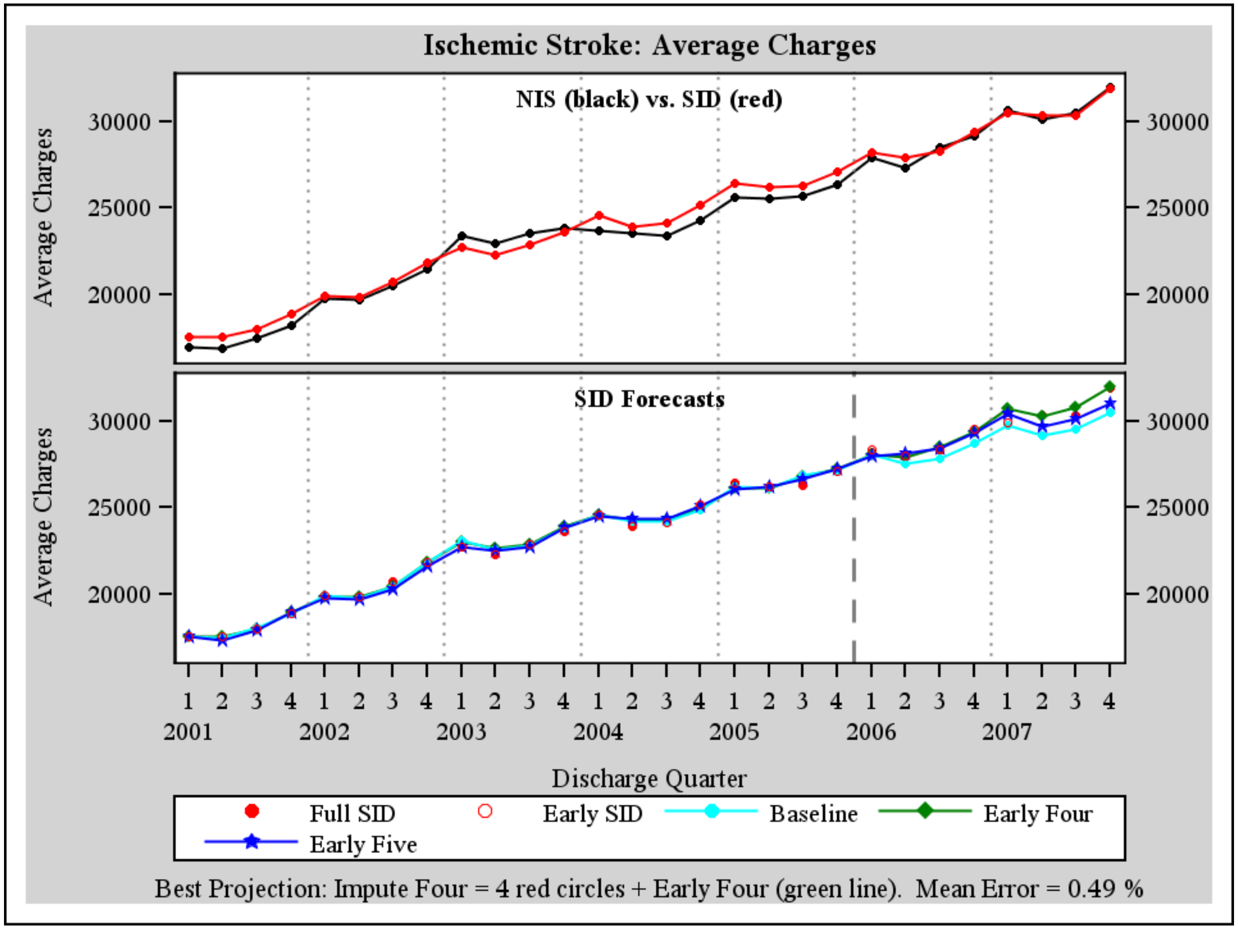
Decubitus Ulcers: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
50000
45000
40000
35000
30000
25000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.68 %

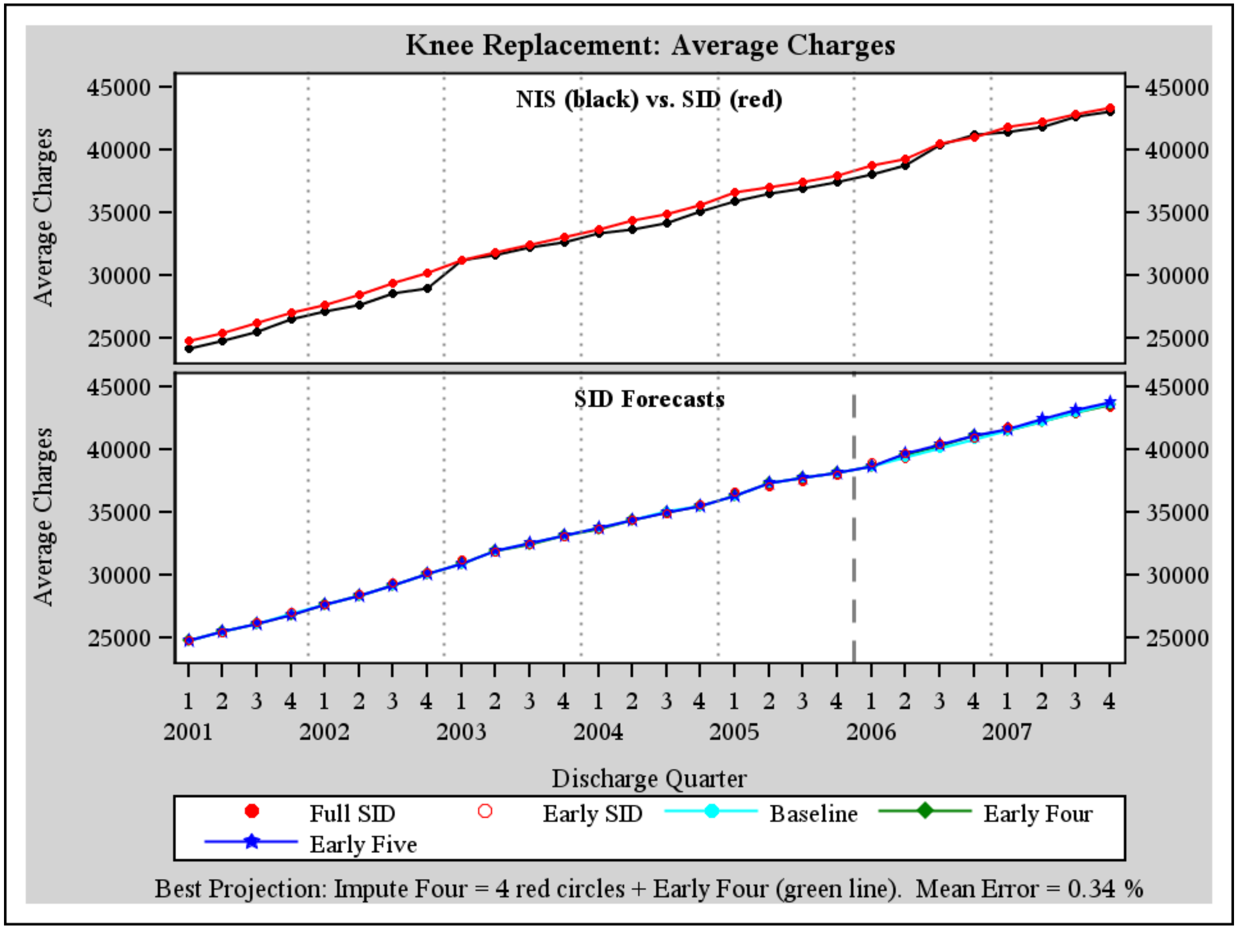

Dementia: Average Charges
NIS (black) vs. SID (red)
Average Charges
22000
20000
18000
16000
14000
12000
SID Forecasts
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.64 %

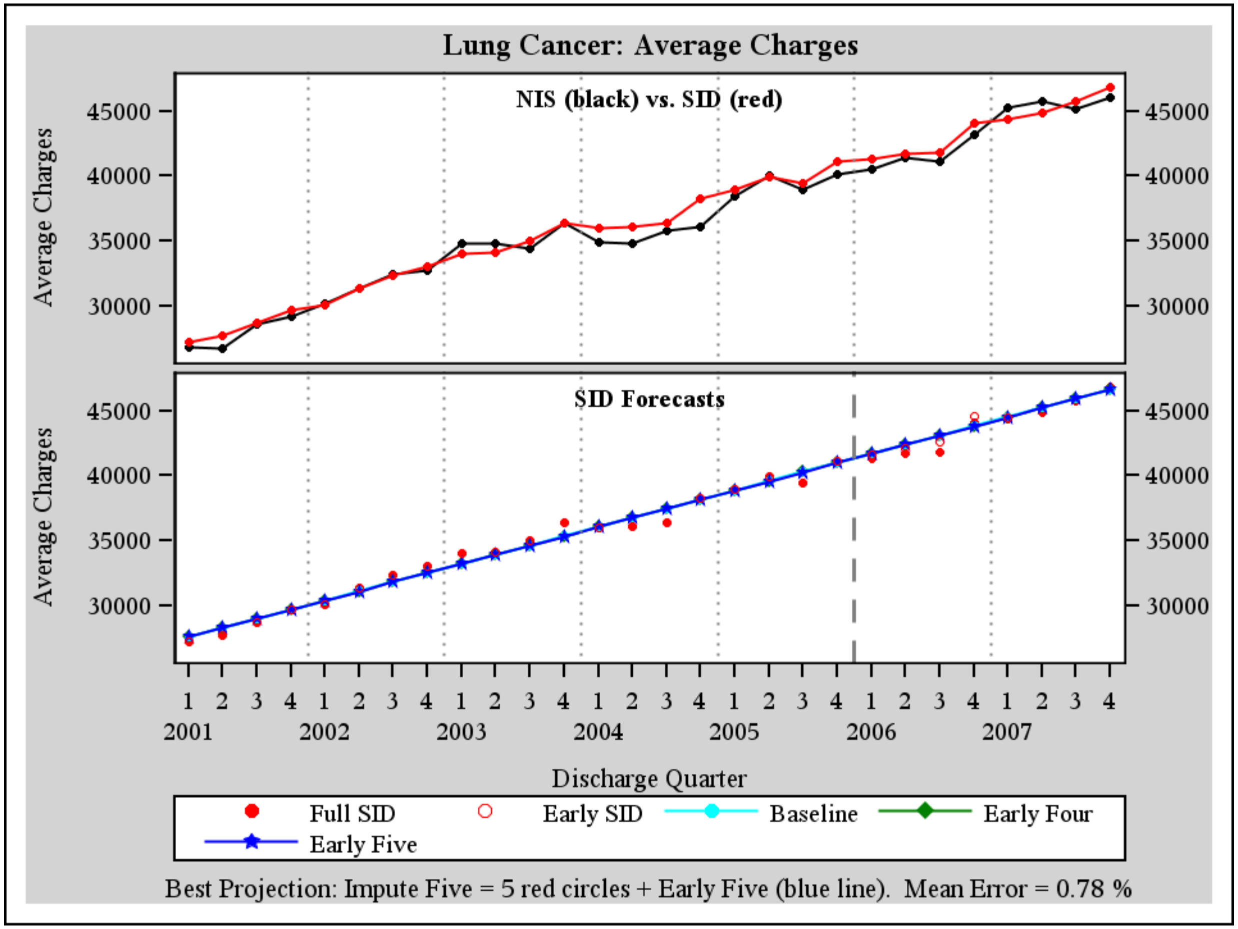

Depression: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
14000
12000
10000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.39 %

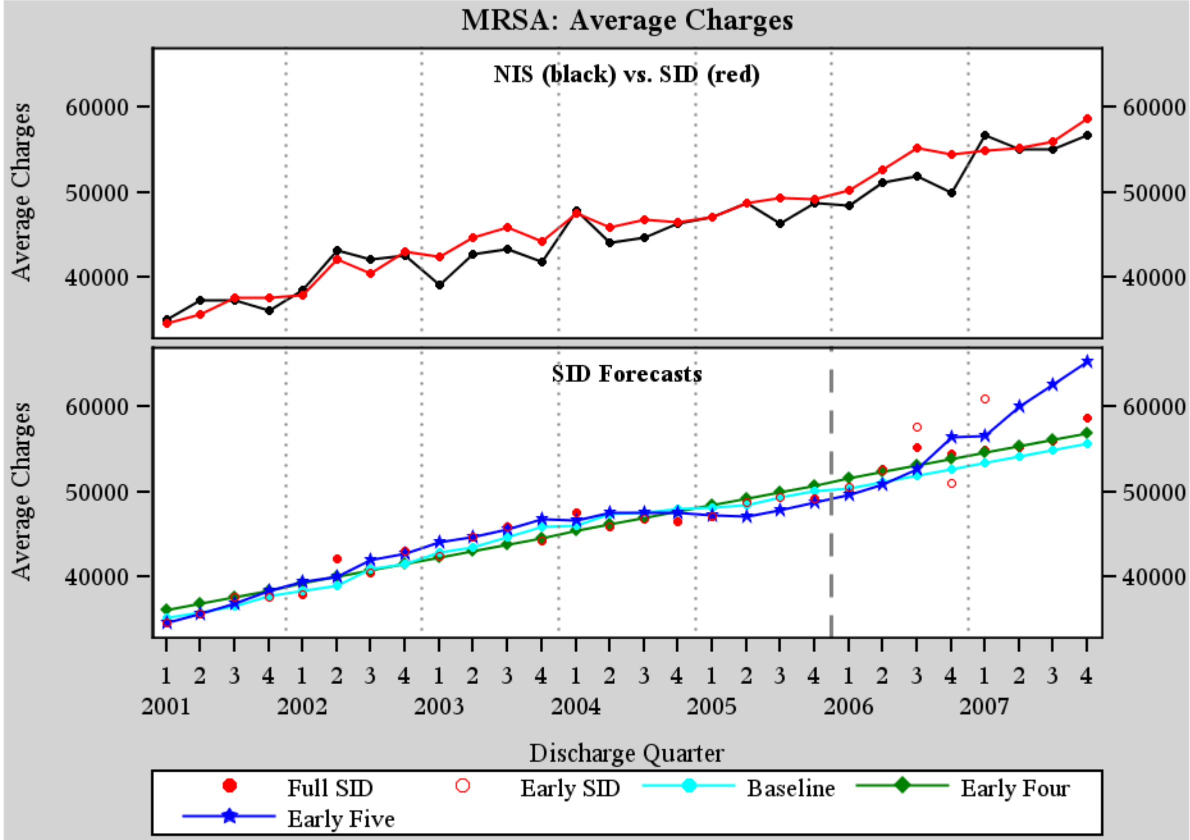

Diabetes: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
27500
25000
22500
20000
17500
15000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 1.01 %


Hip Replacement: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
50000
45000
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.28 %

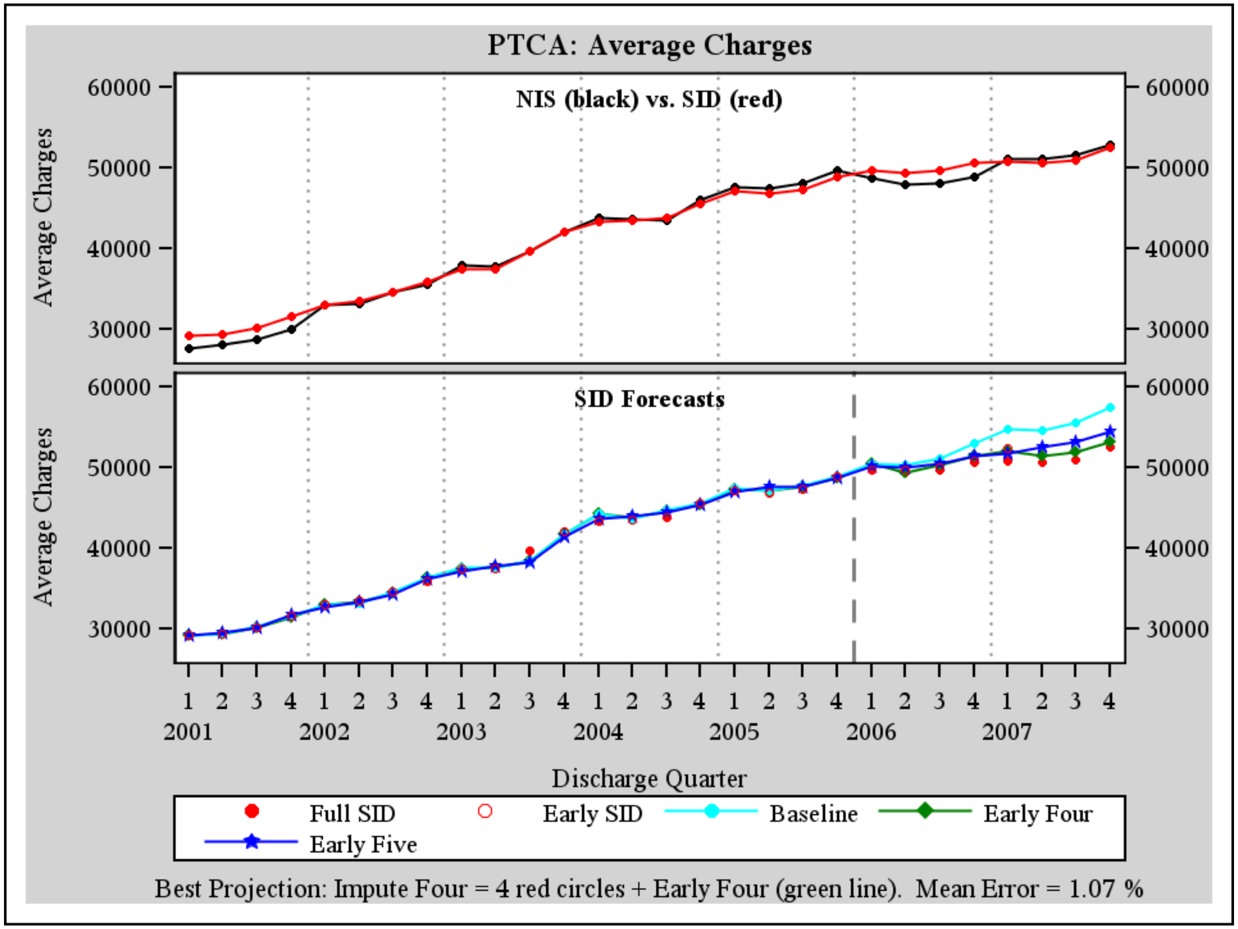

Ischemic Stroke: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
Average Charges
30000
25000
20000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.49 %

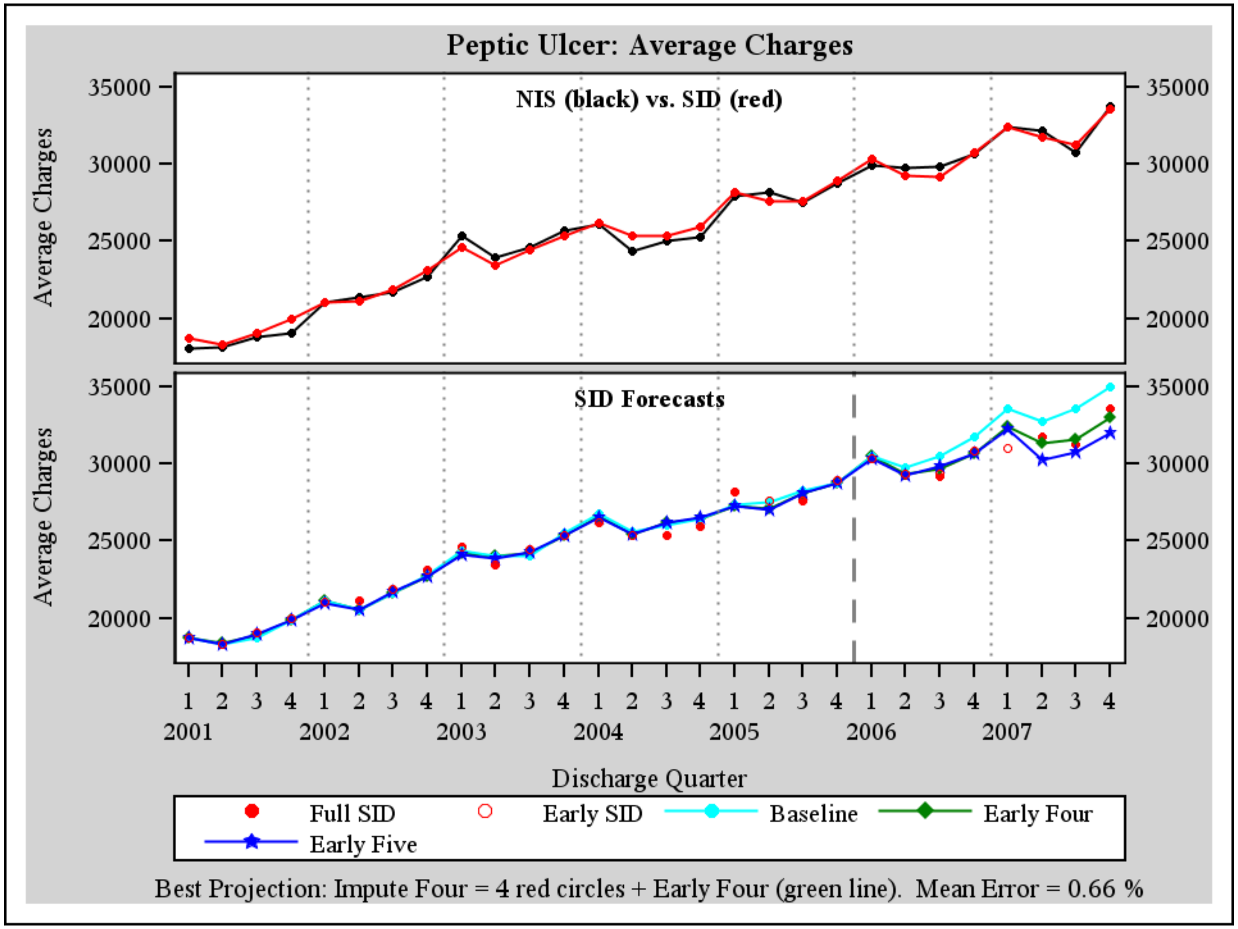

Knee Replacement: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
45000
40000
35000
30000
25000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.34 %


Lung Cancer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
45000
40000
35000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.78 %

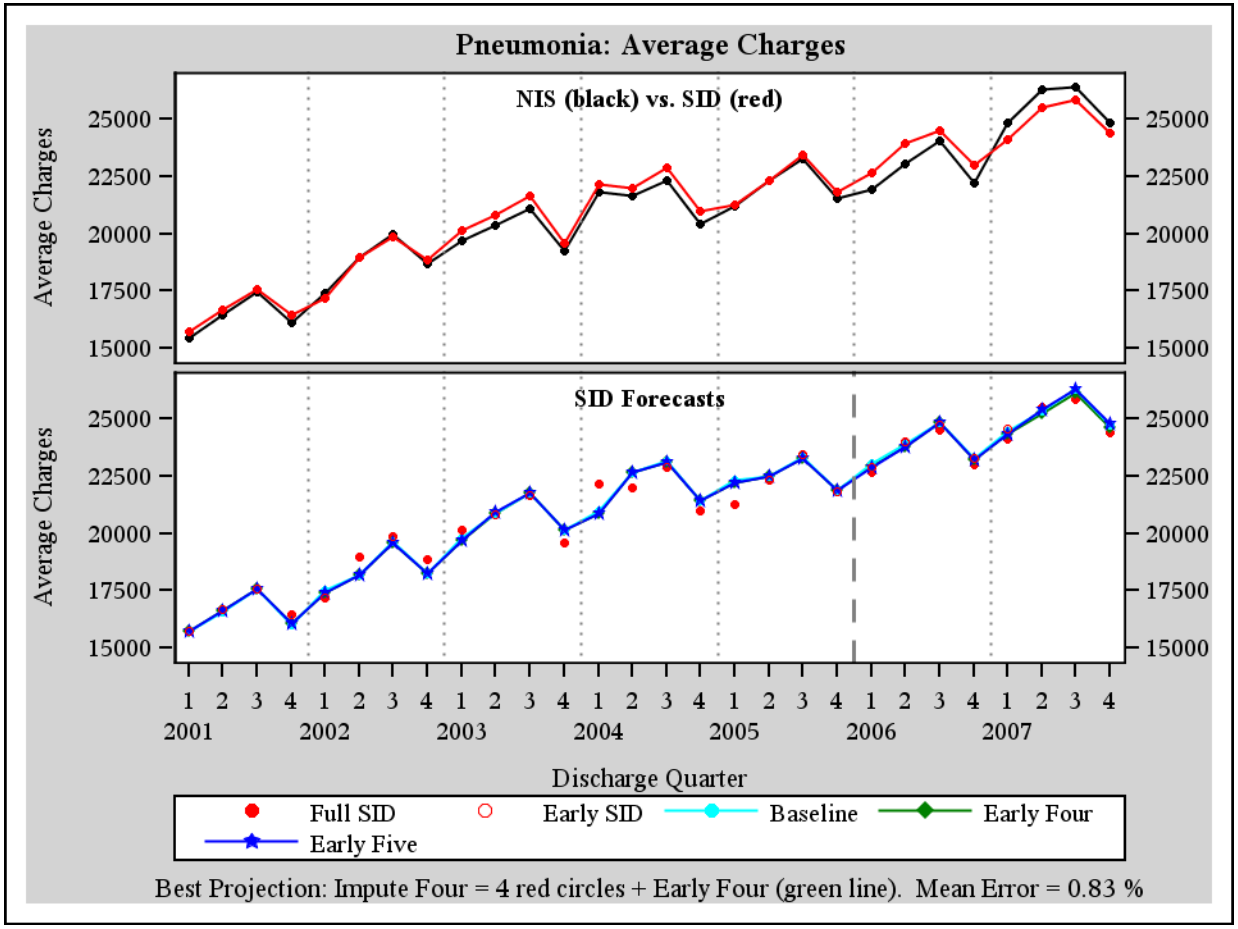


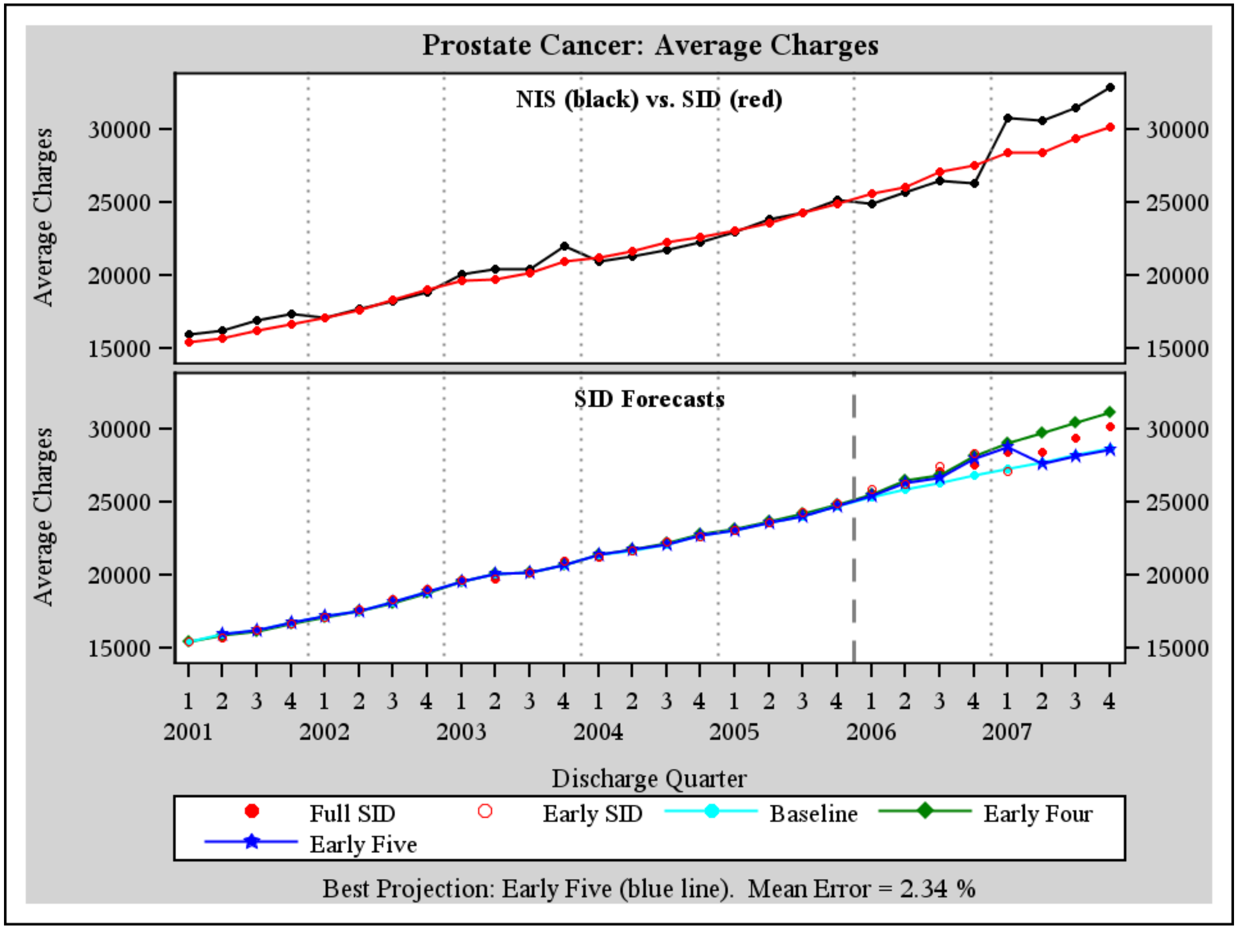
Best Projection: Early Four (green line). Mean Error = 1.55 %

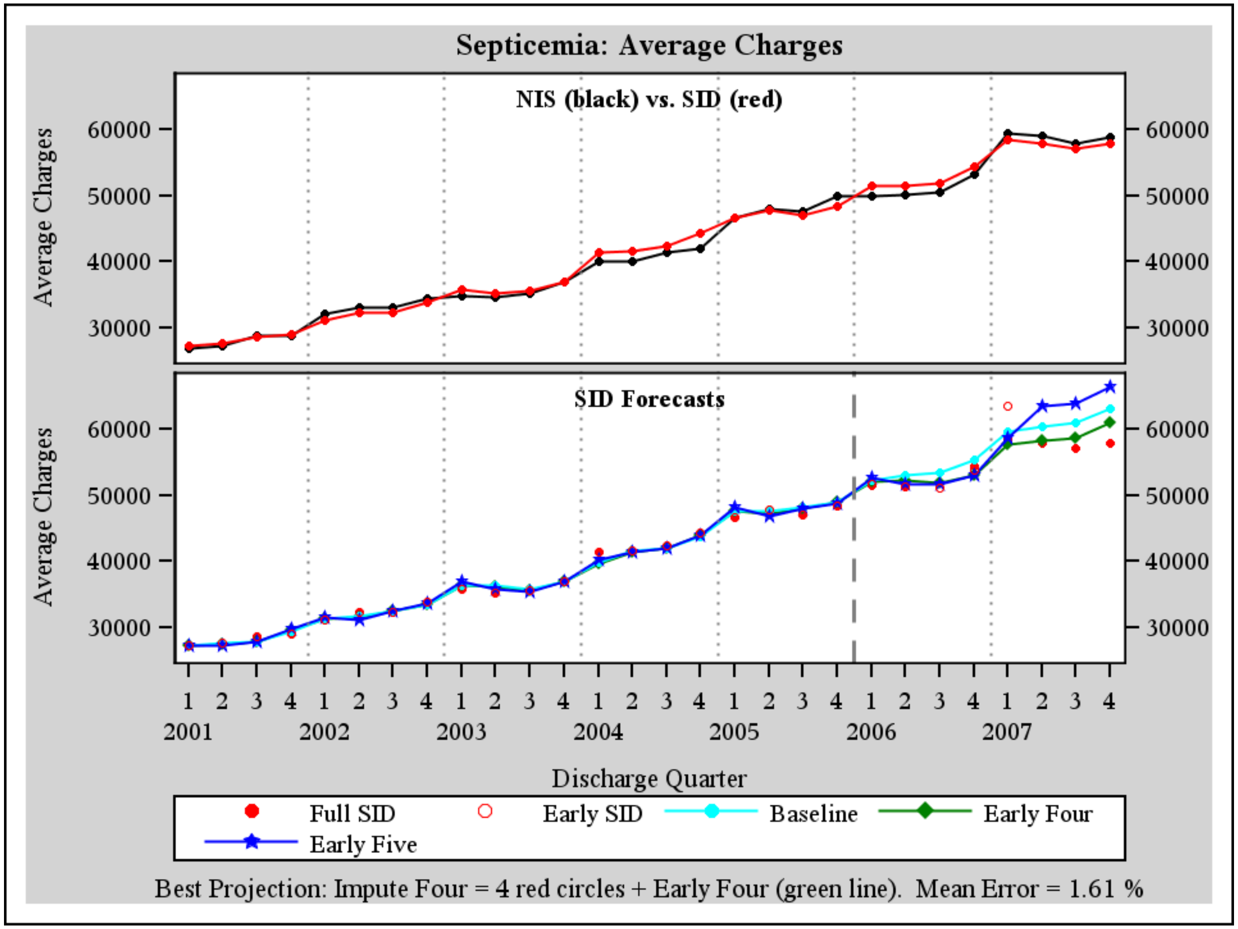

PTCA: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
60000
50000
40000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.07 %

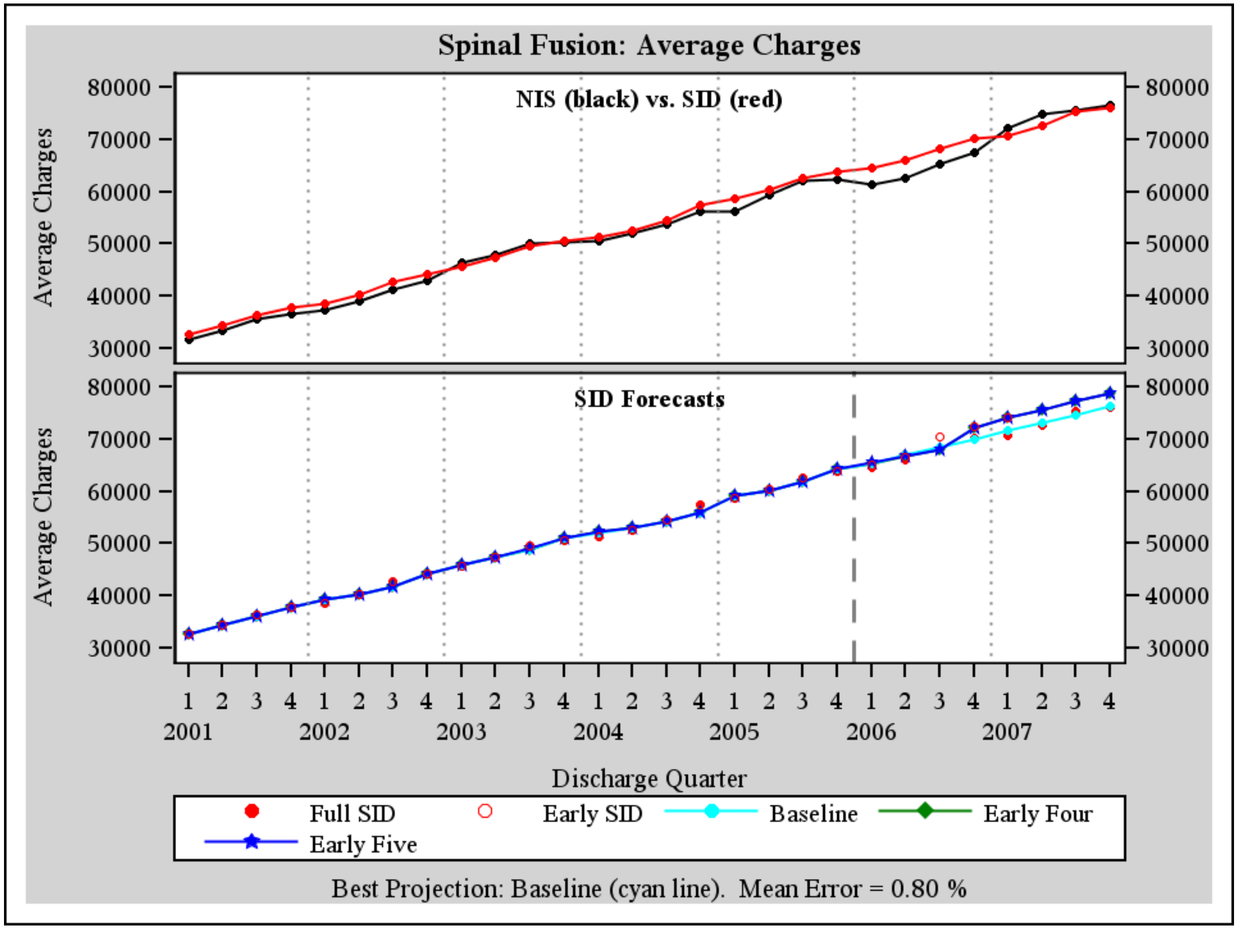


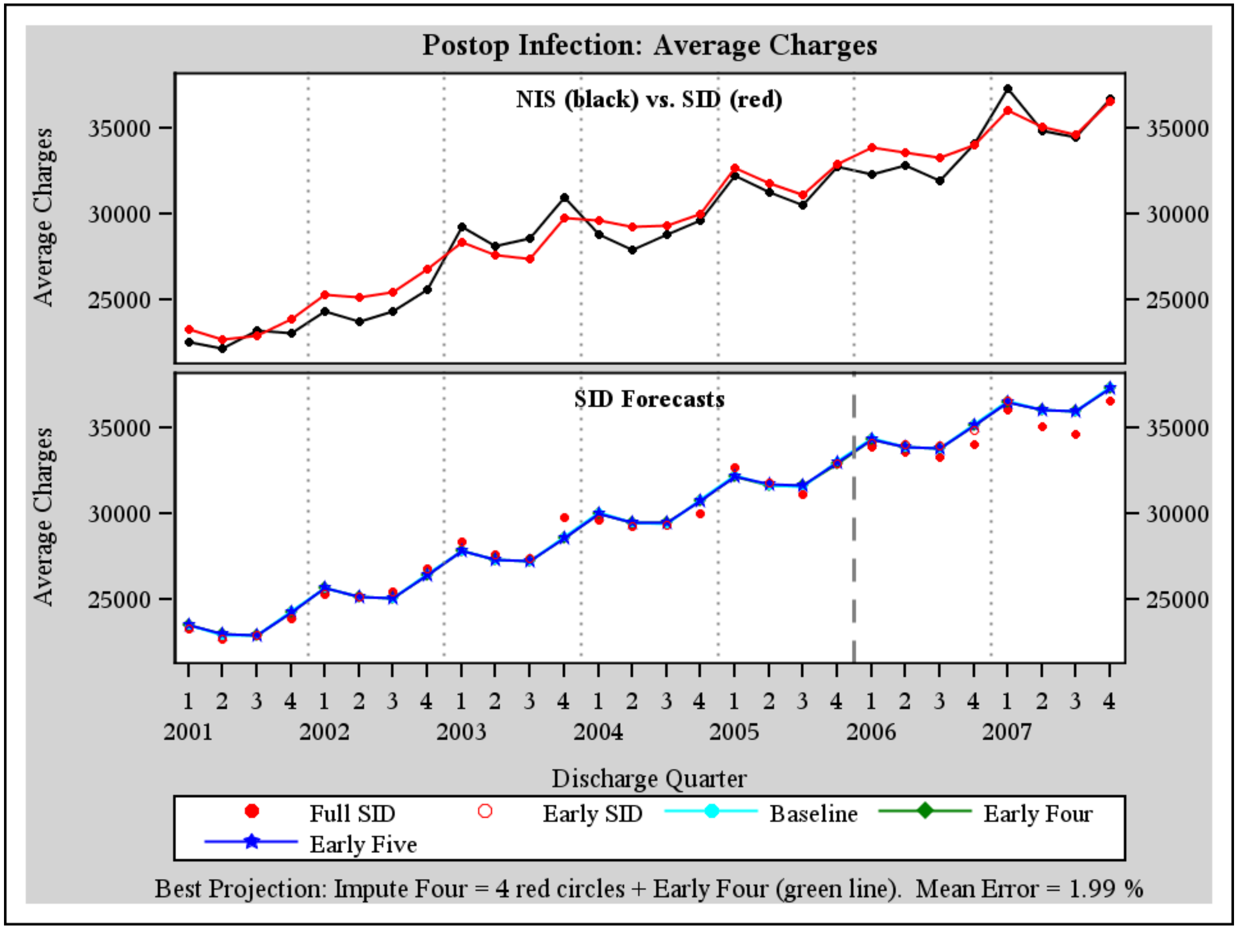
Peptic Ulcer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
35000
30000
25000
20000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.66 %

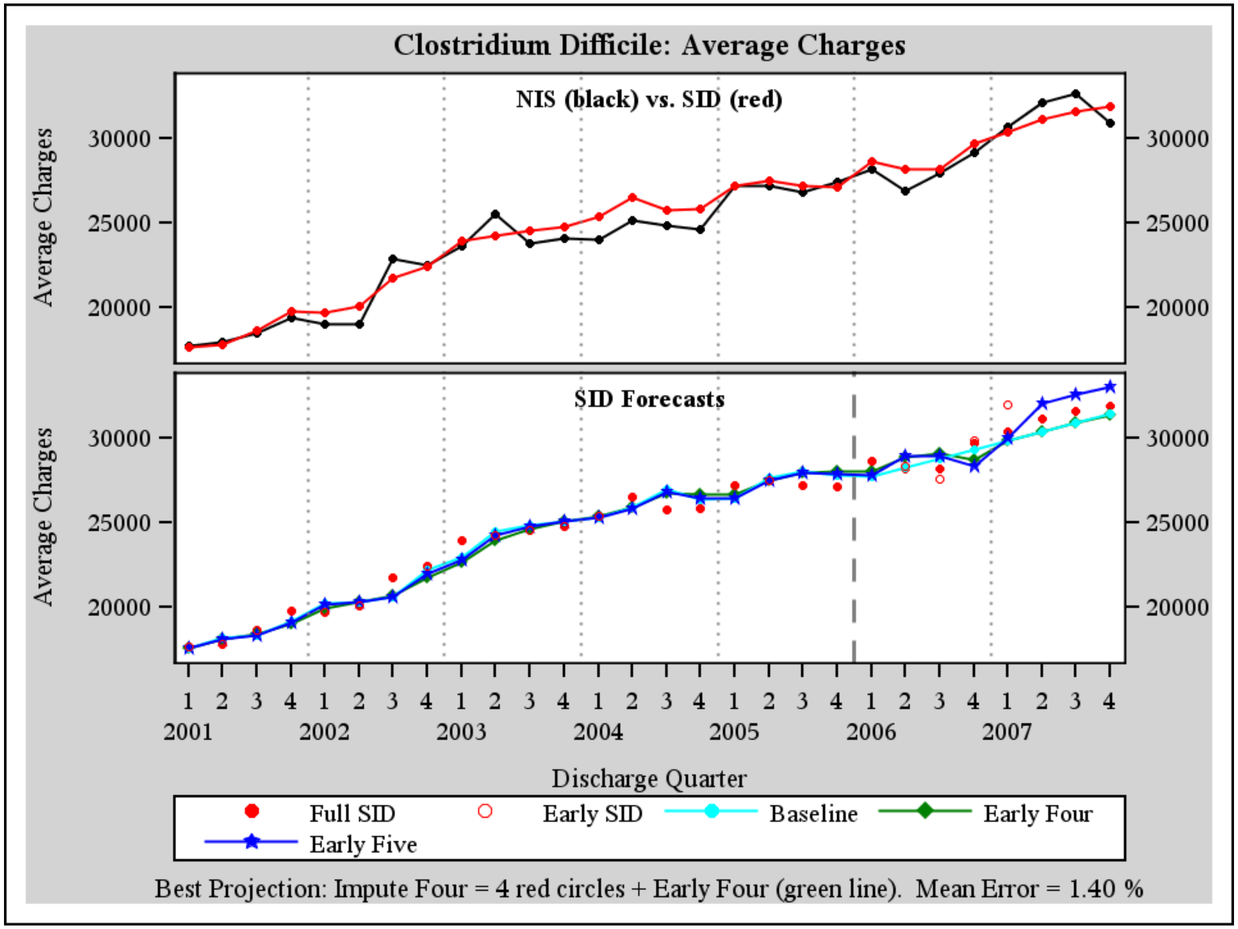

Pneumonia: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
25000
22500
20000
17500
15000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.83 %

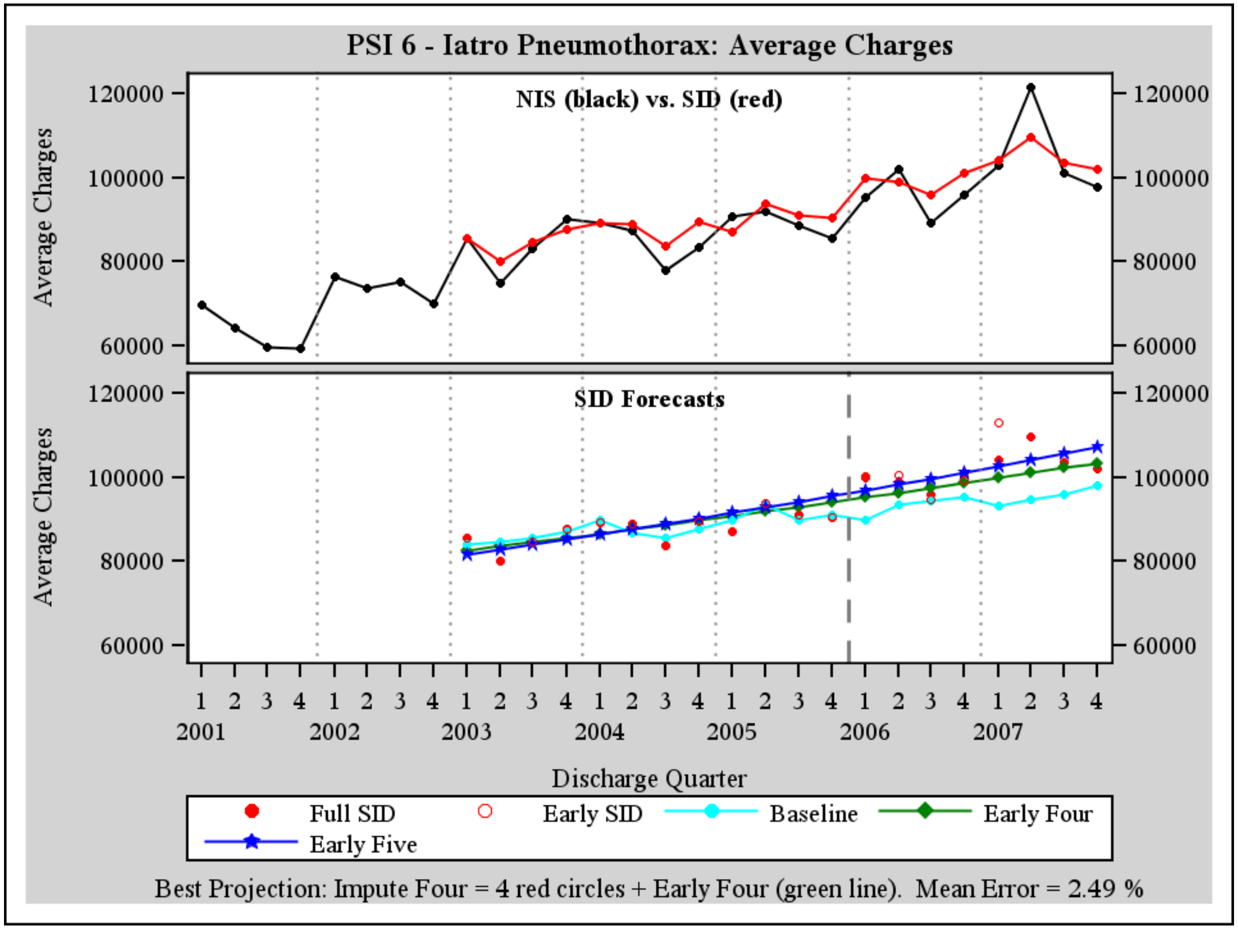

Prostate Cancer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
30000
25000
20000
15000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 2.34 %

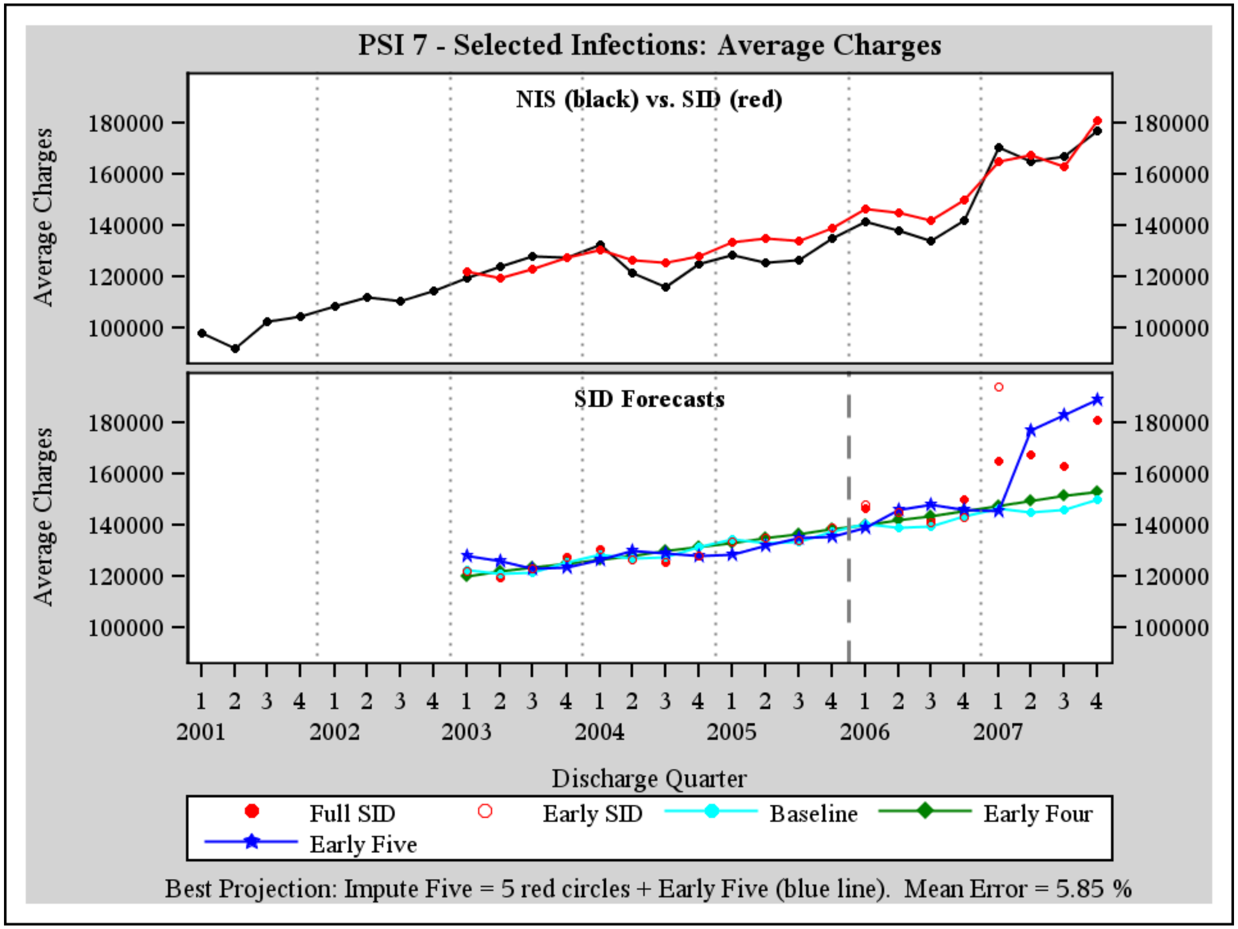

Septicemia: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
60000
50000
40000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.61 %

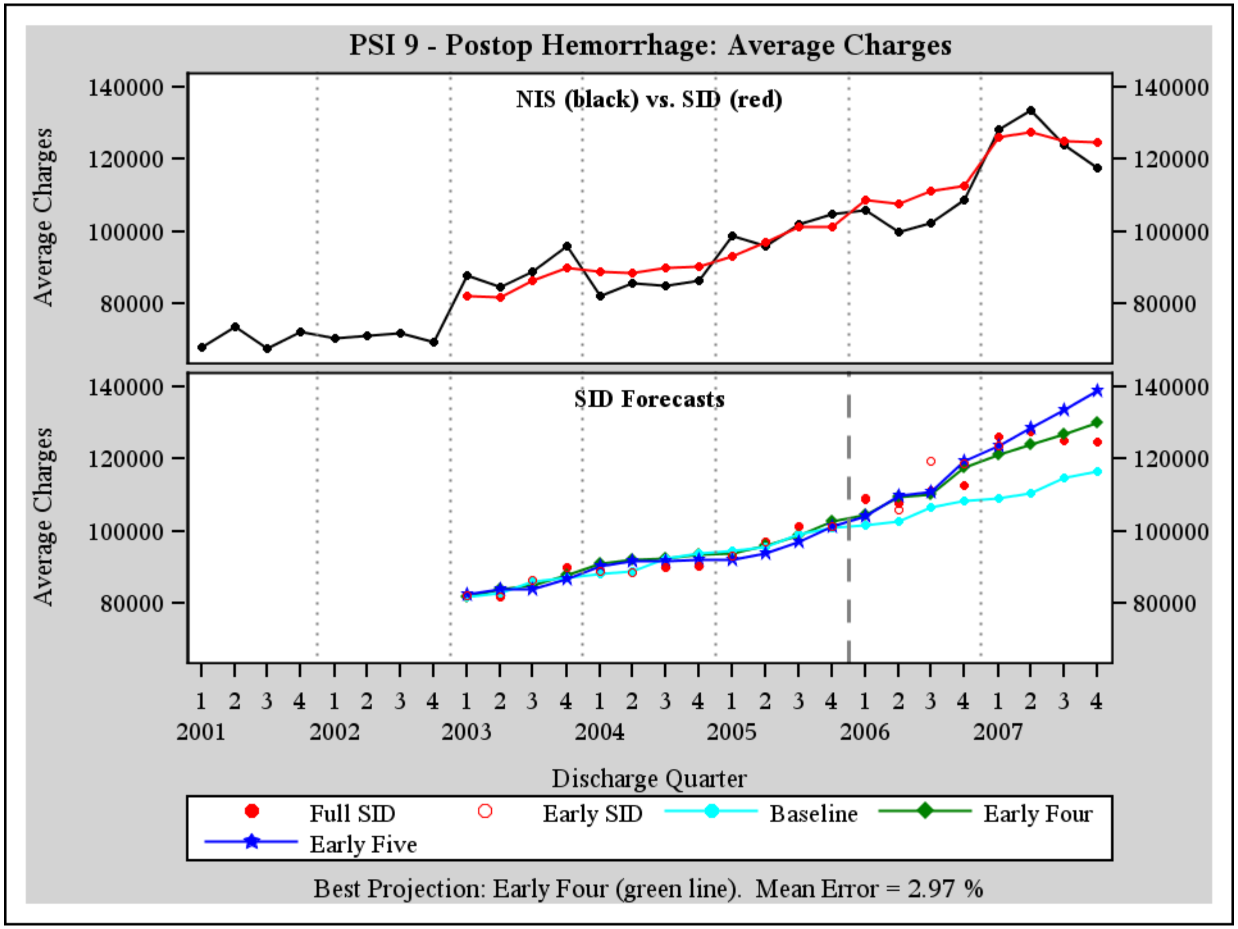

Spinal Fusion: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
80000
70000
60000
50000
40000
30000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.80 %

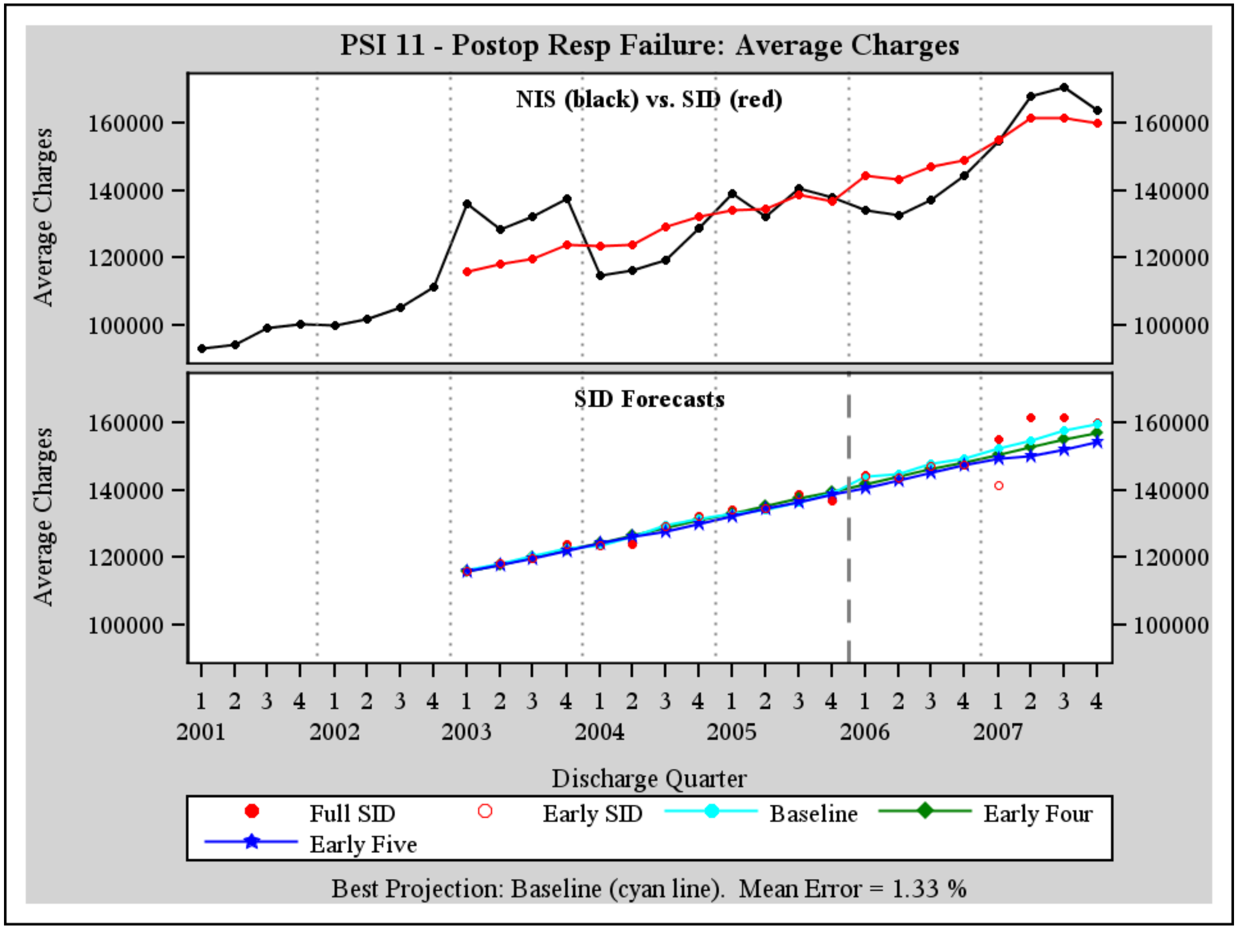

Postop Infection: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
35000
30000
25000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.99 %

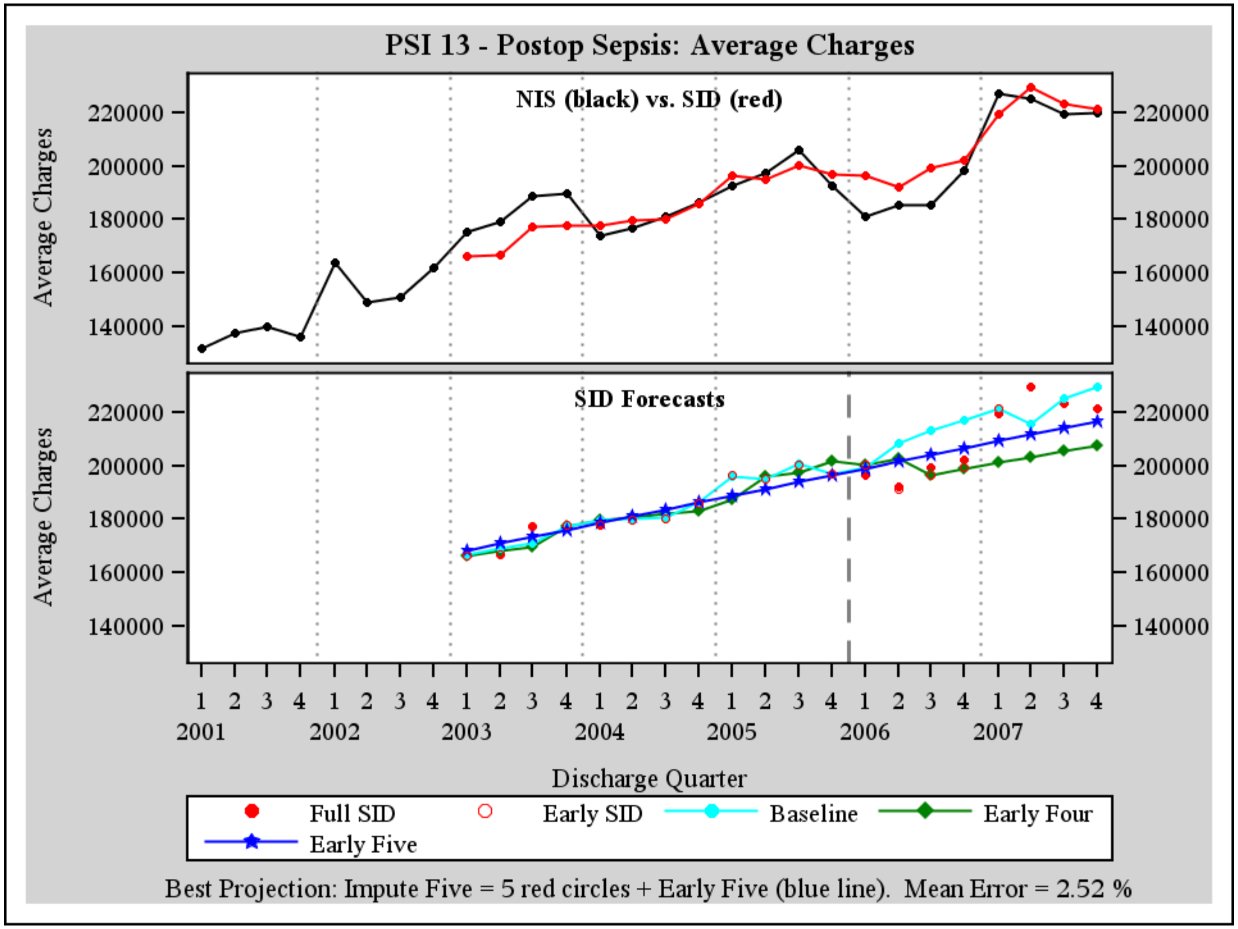

Clostridium Difficile: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
30000
25000
20000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.40 %

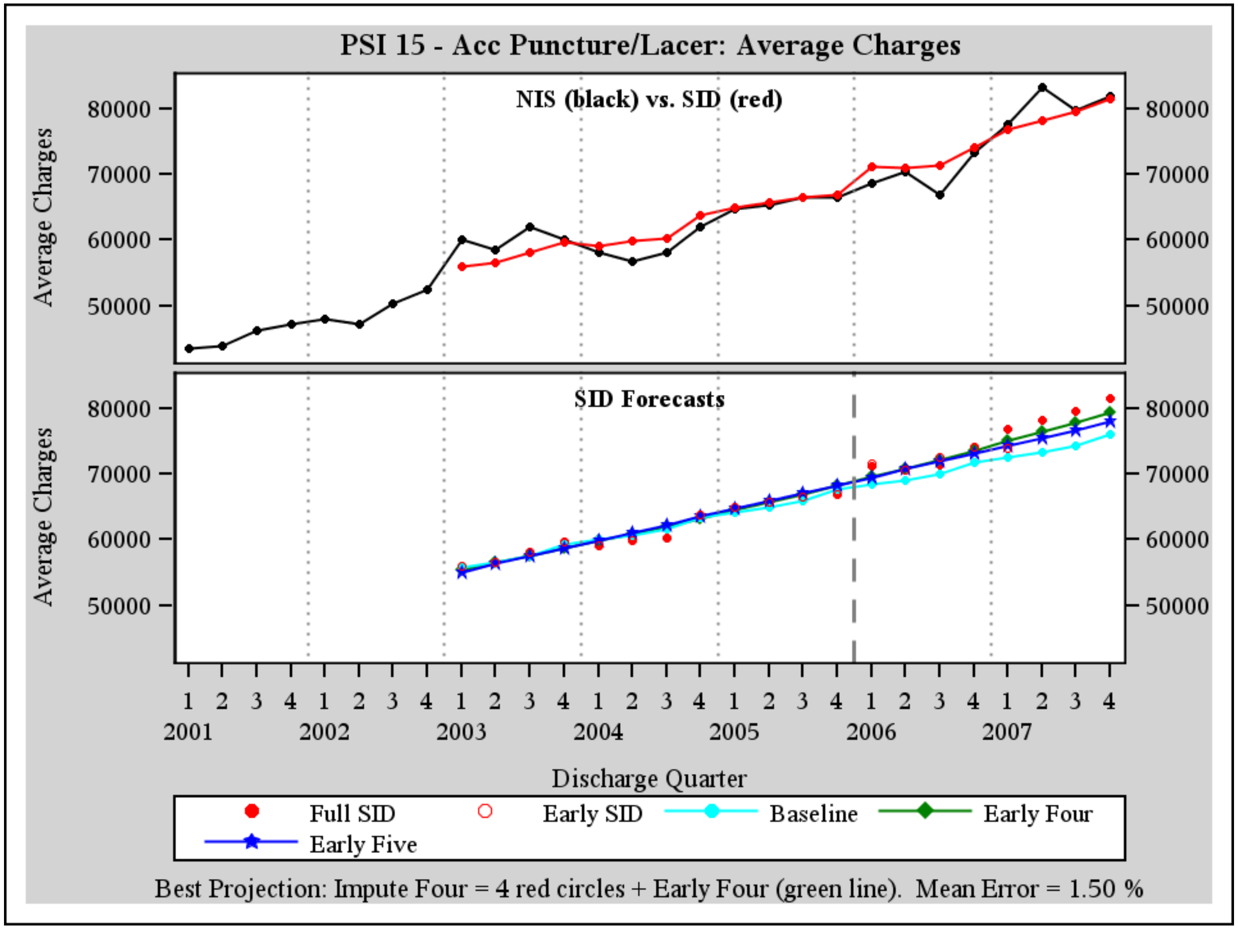

PSI 6 - Iatro Pneumothorax: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
120000
100000
80000
60000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.49 %


PSI 7 - Selected Infections: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
100000
120000
140000
160000
180000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 5.85 %

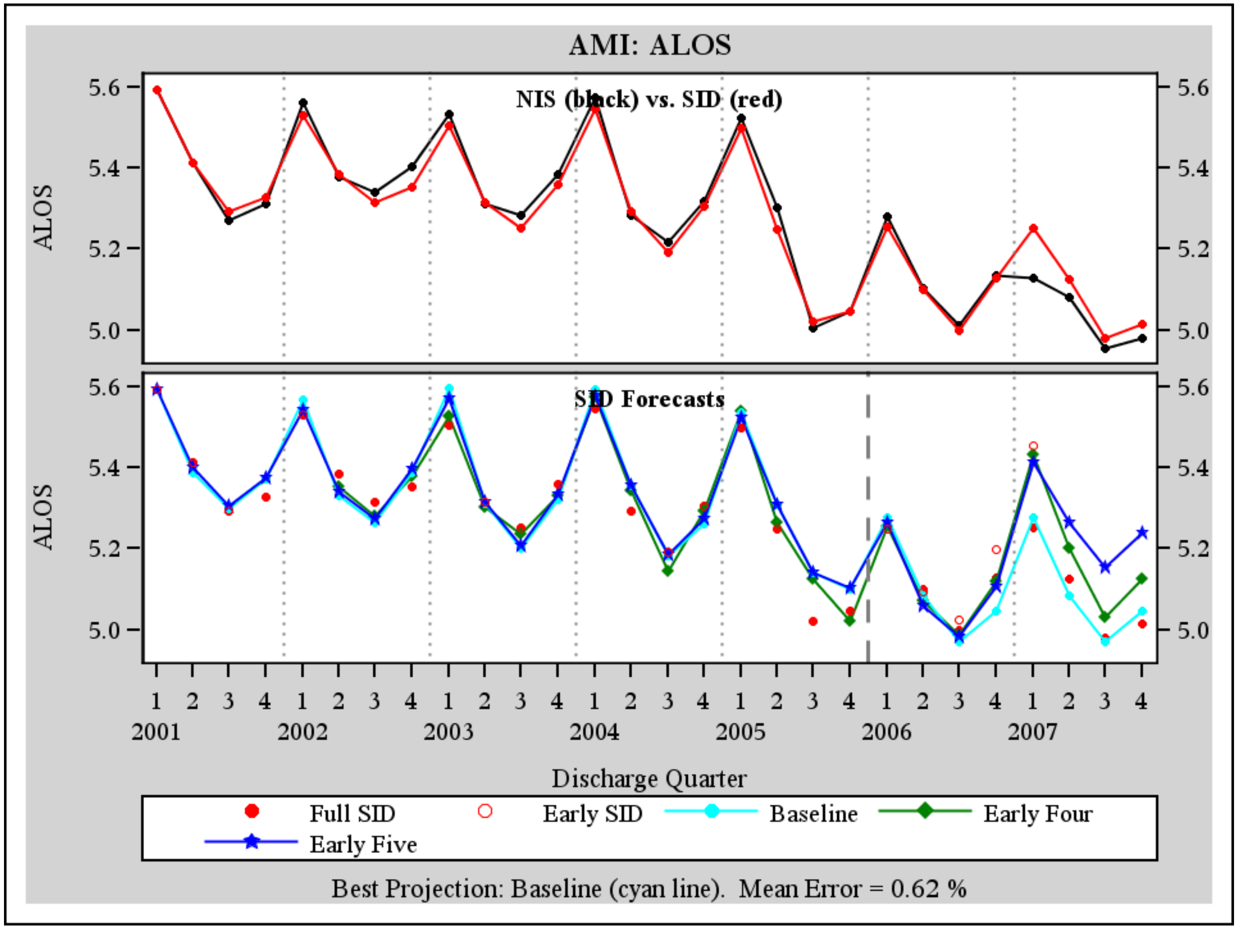

PSI 9 - Postop Hemorrhage: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
Average Charges
140000
120000
100000
80000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 2.97 %

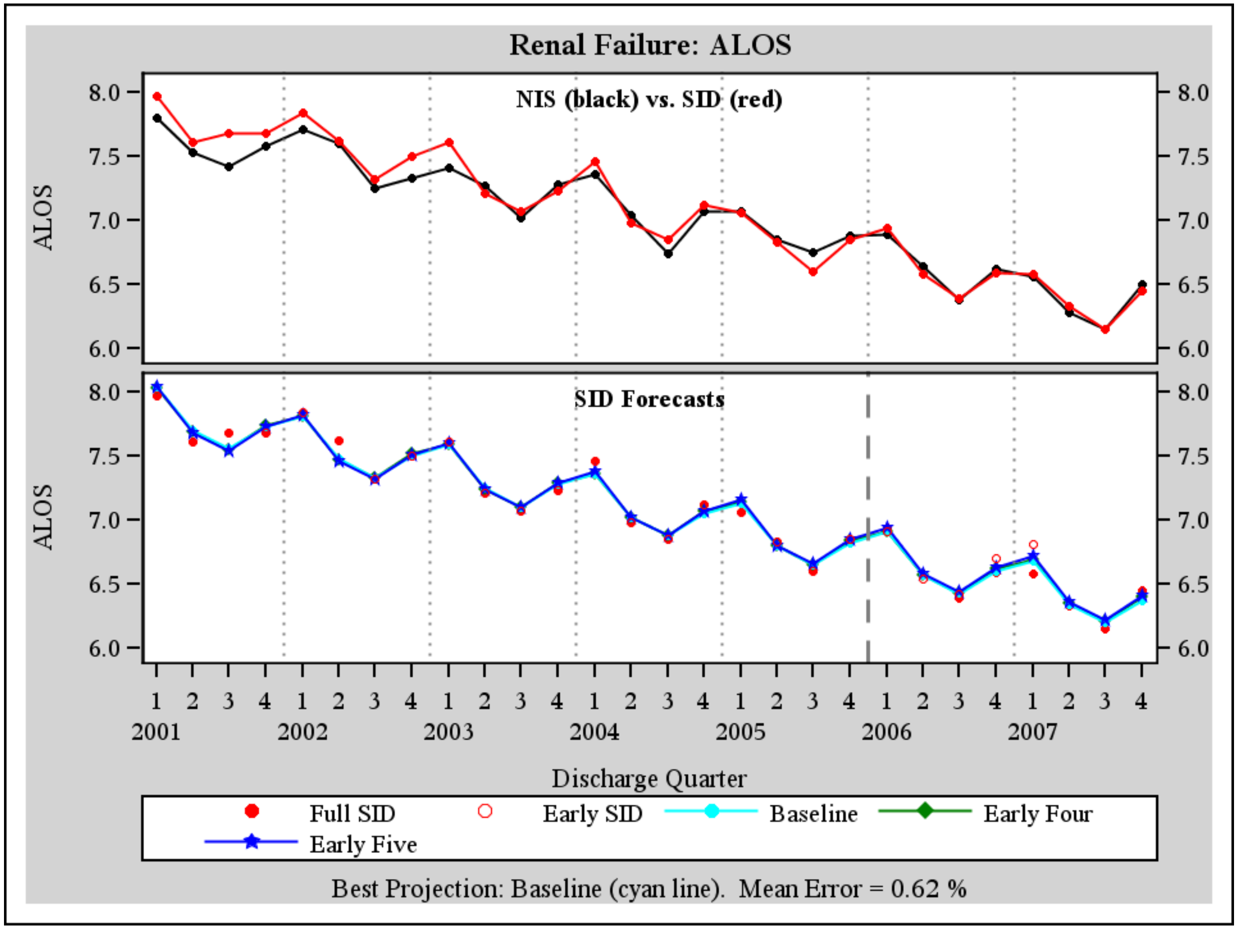

PSI 11 - Postop Resp Failure: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
100000
120000
140000
160000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.33 %

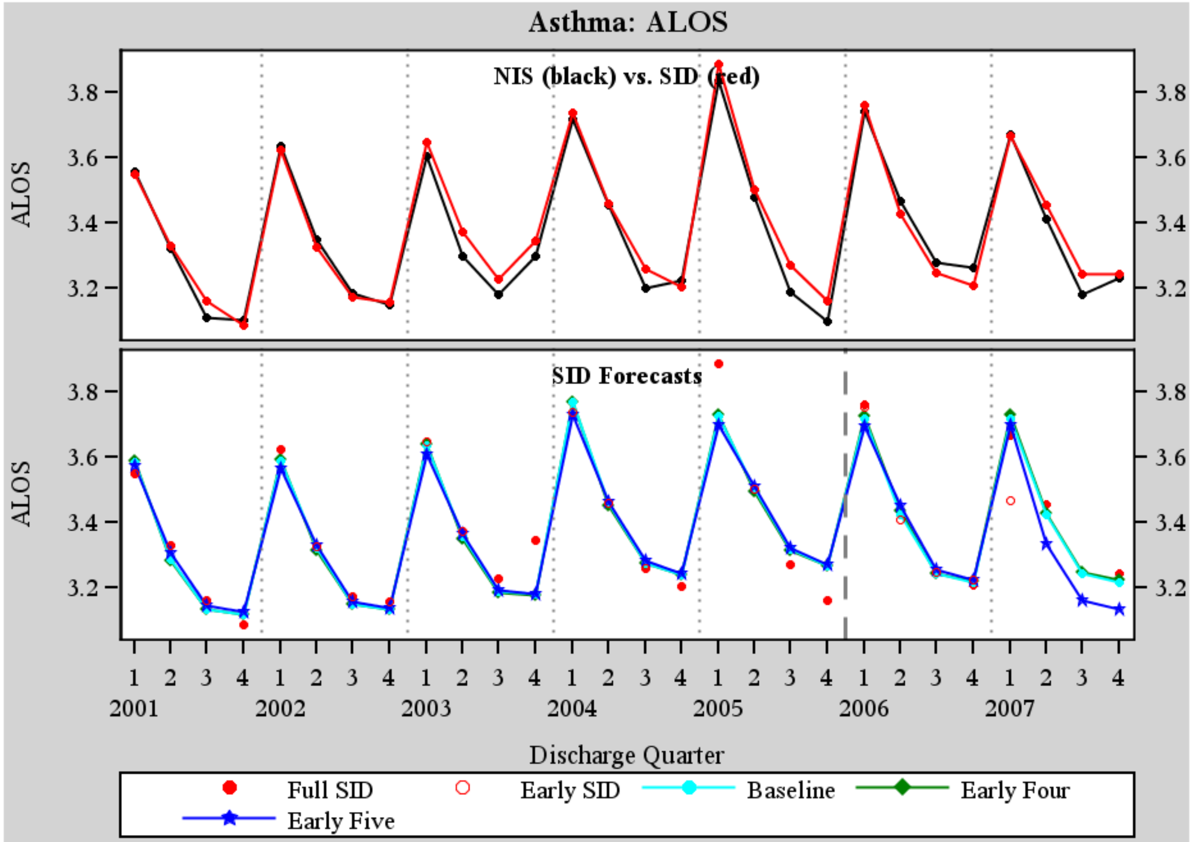

PSI 13 - Postop Sepsis: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
220000
200000
180000
160000
140000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 2.52 %


PSI 15 - Acc Puncture/Lacer: Average Charges
NIS (black) vs. SID (red)
SID Forecasts
Average Charges
80000
70000
60000
50000
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.50 %

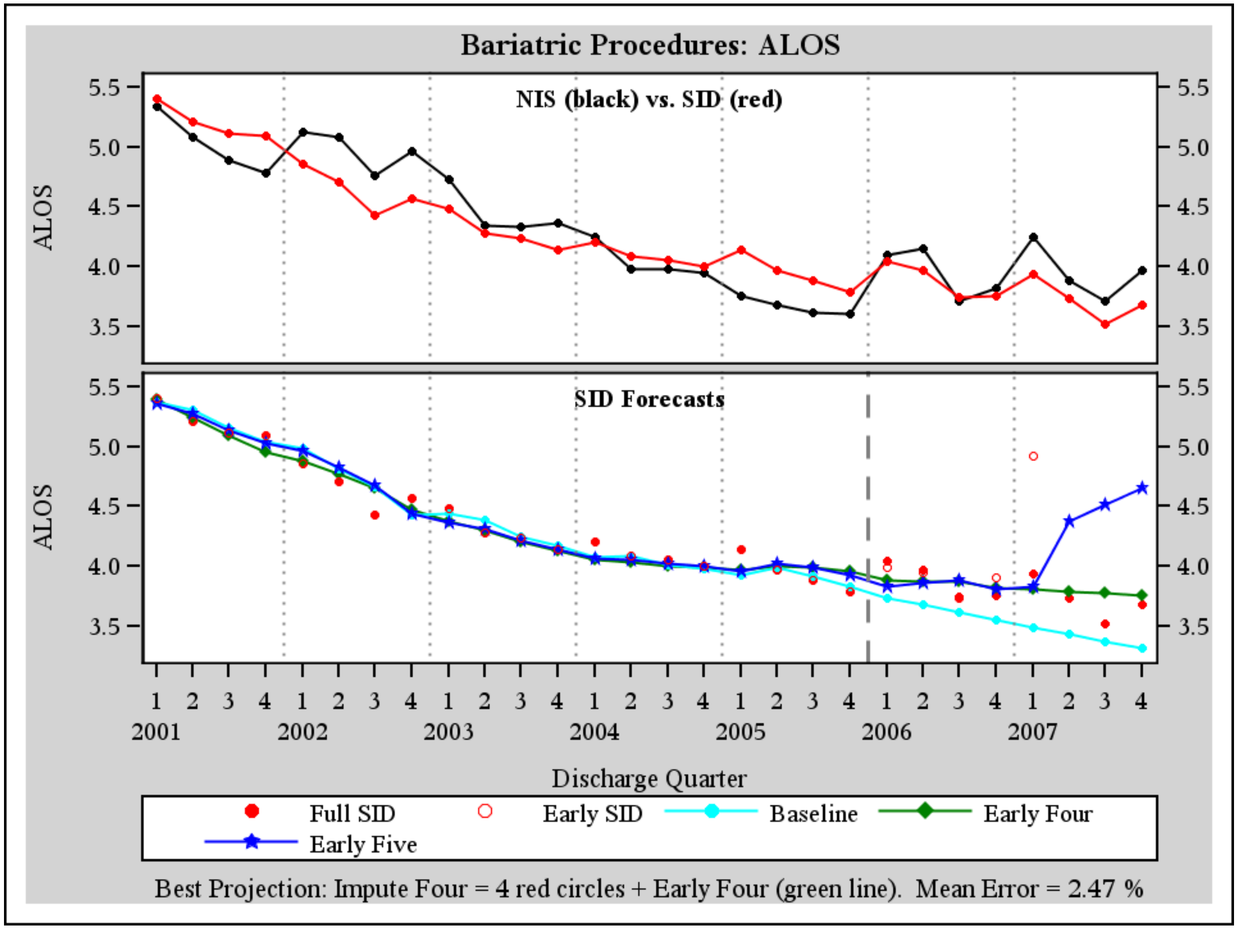
APPENDIX C: SID AVERAGE LENGTH OF STAY PROJECTIONS

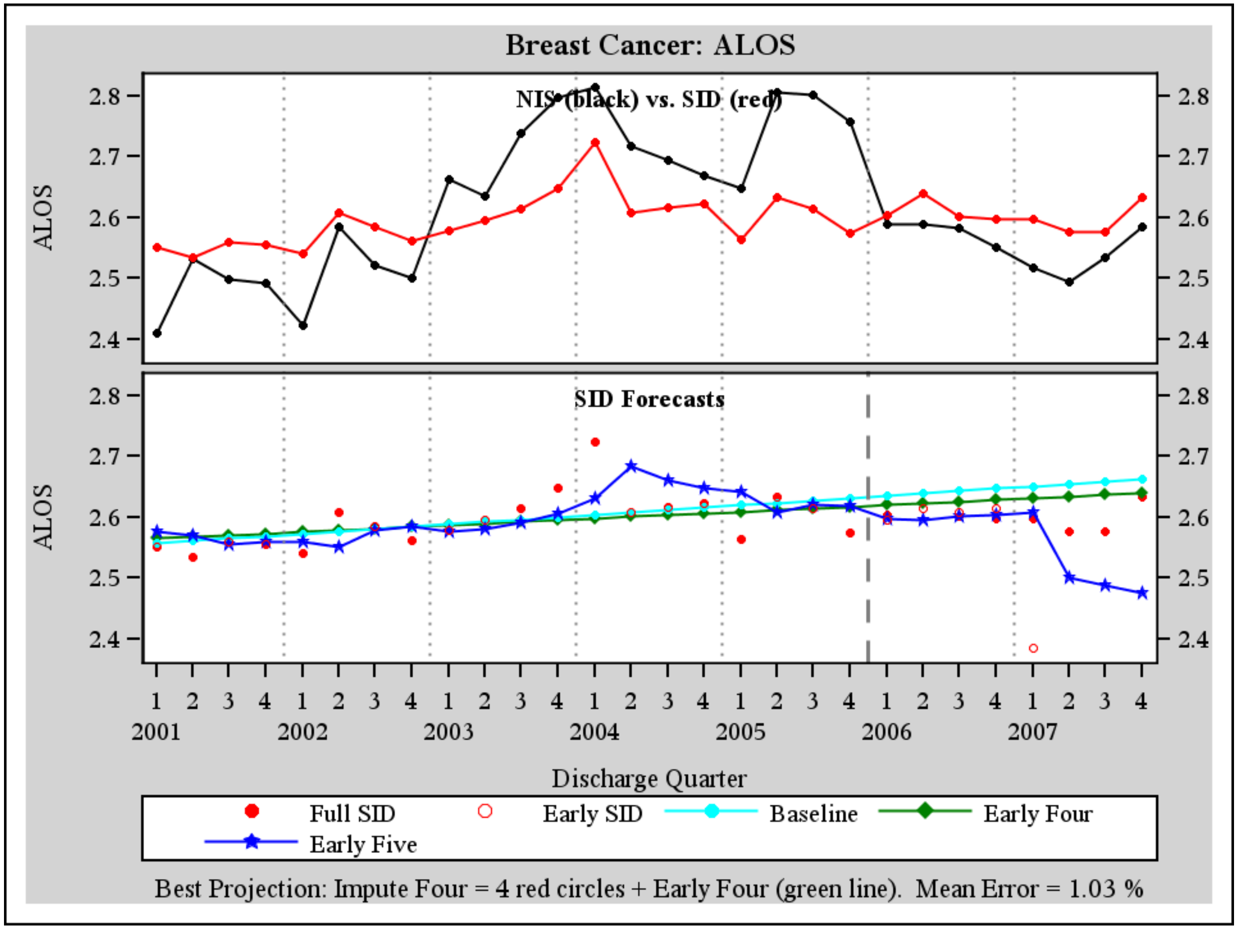

AMI: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
5.6
5.4
5.2
5.0
1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.62 %

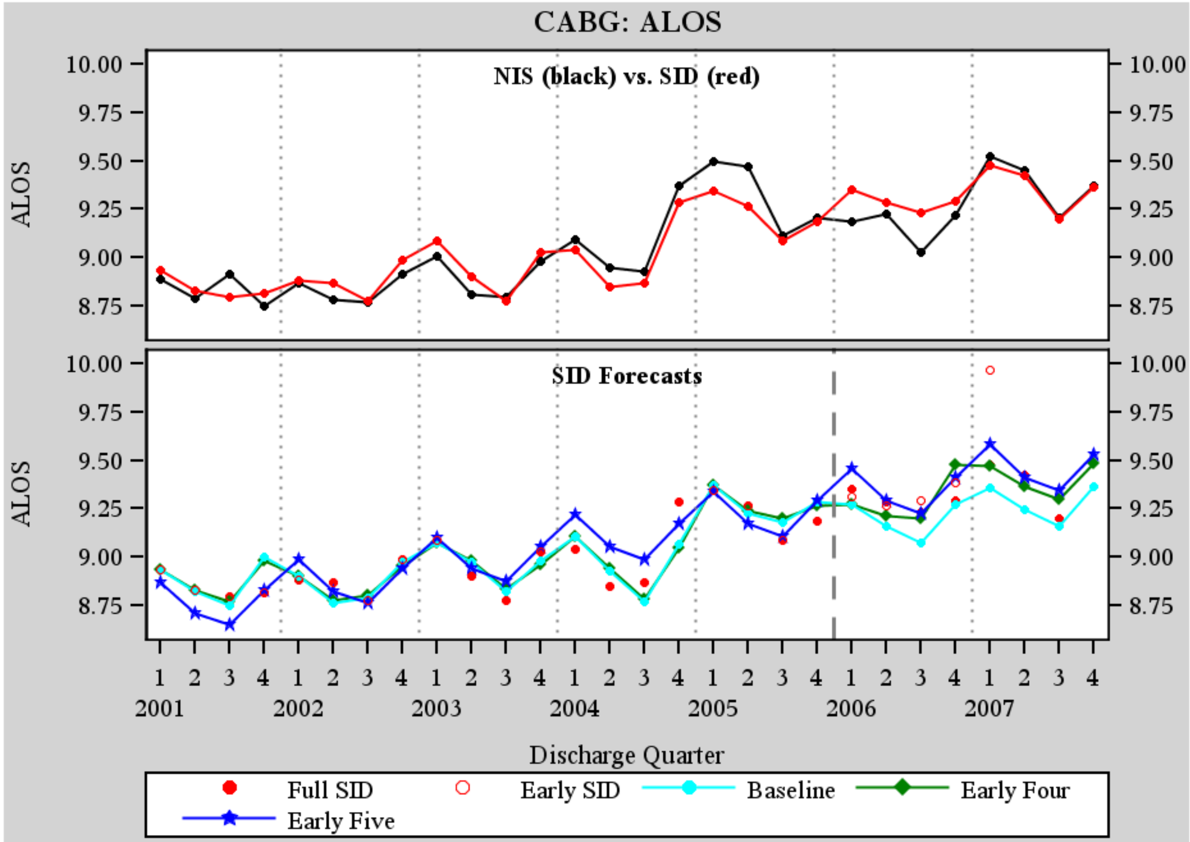

Renal Failure: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
8.0
7.5
7.0
6.5
6.0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.62 %



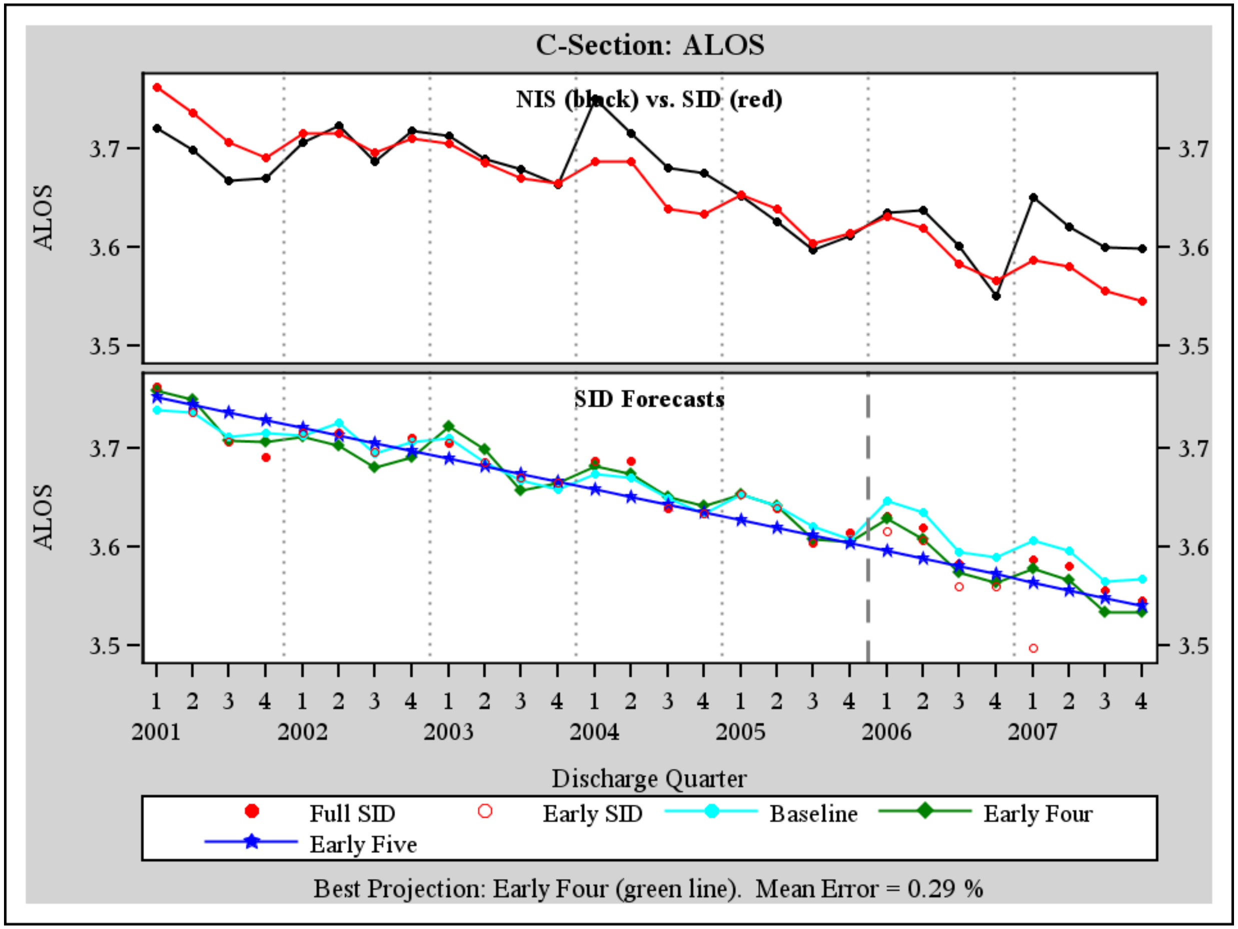
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.57 %

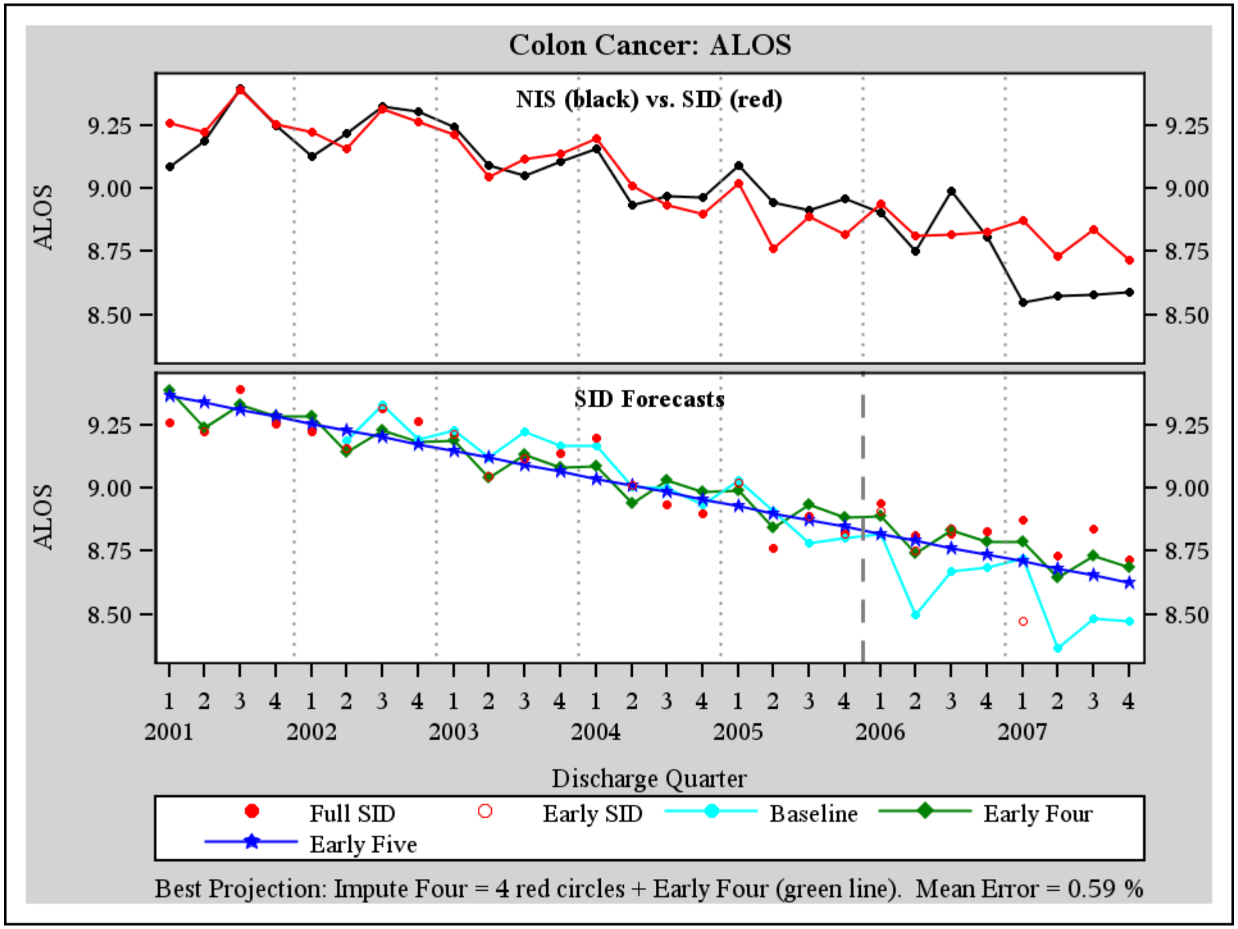

Bariatric Procedures: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
Discharge Quarter
2001
2002
2003
2004
2005
2006
2007
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.47 %


Breast Cancer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
2.4
2.5
2.6
2.7
2.8
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.03 %

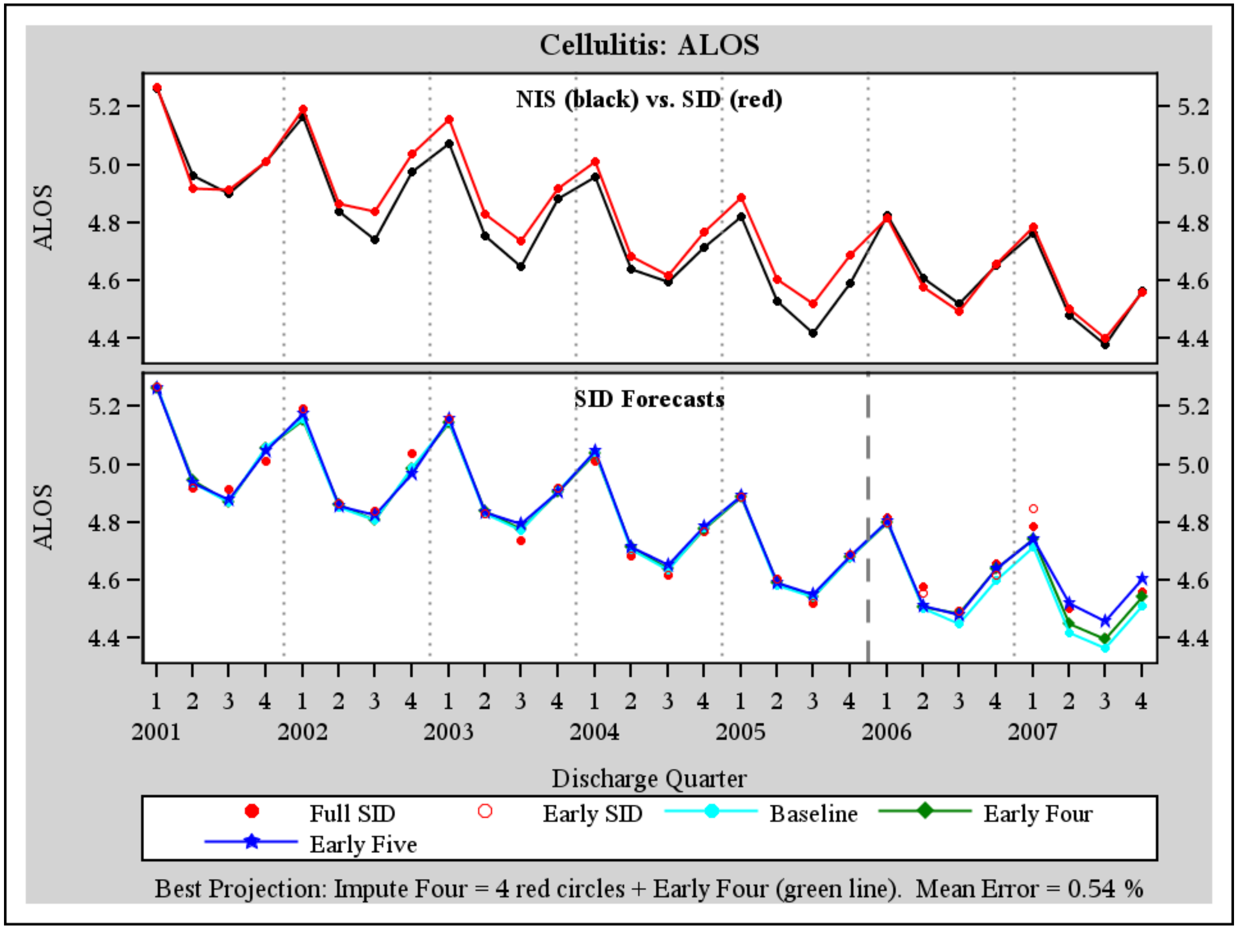


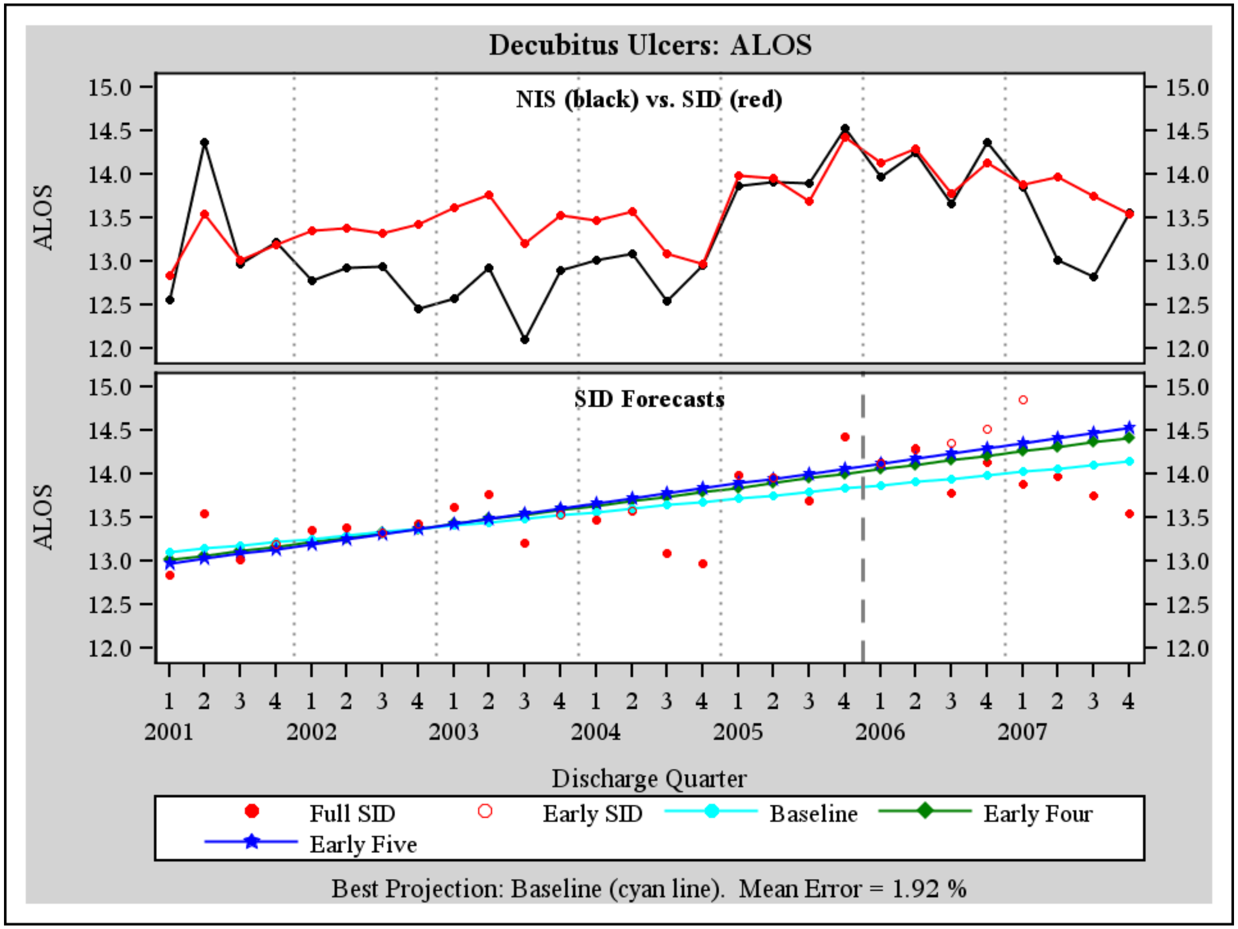
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.67 %


C-Section: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
3.5
3.6
3.7
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.29 %

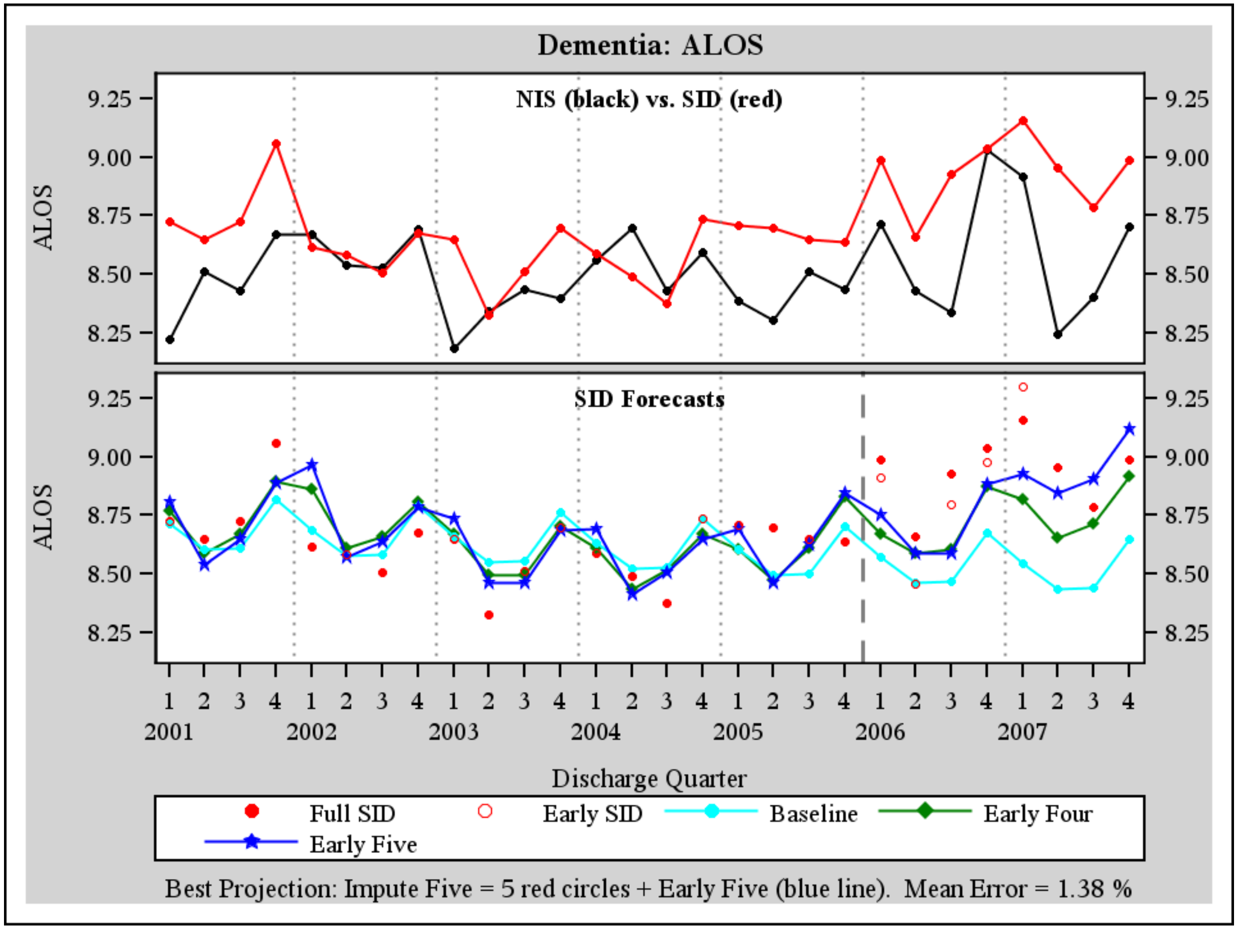


Colon Cancer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
9.25
9.00
8.75
8.50
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.59 %

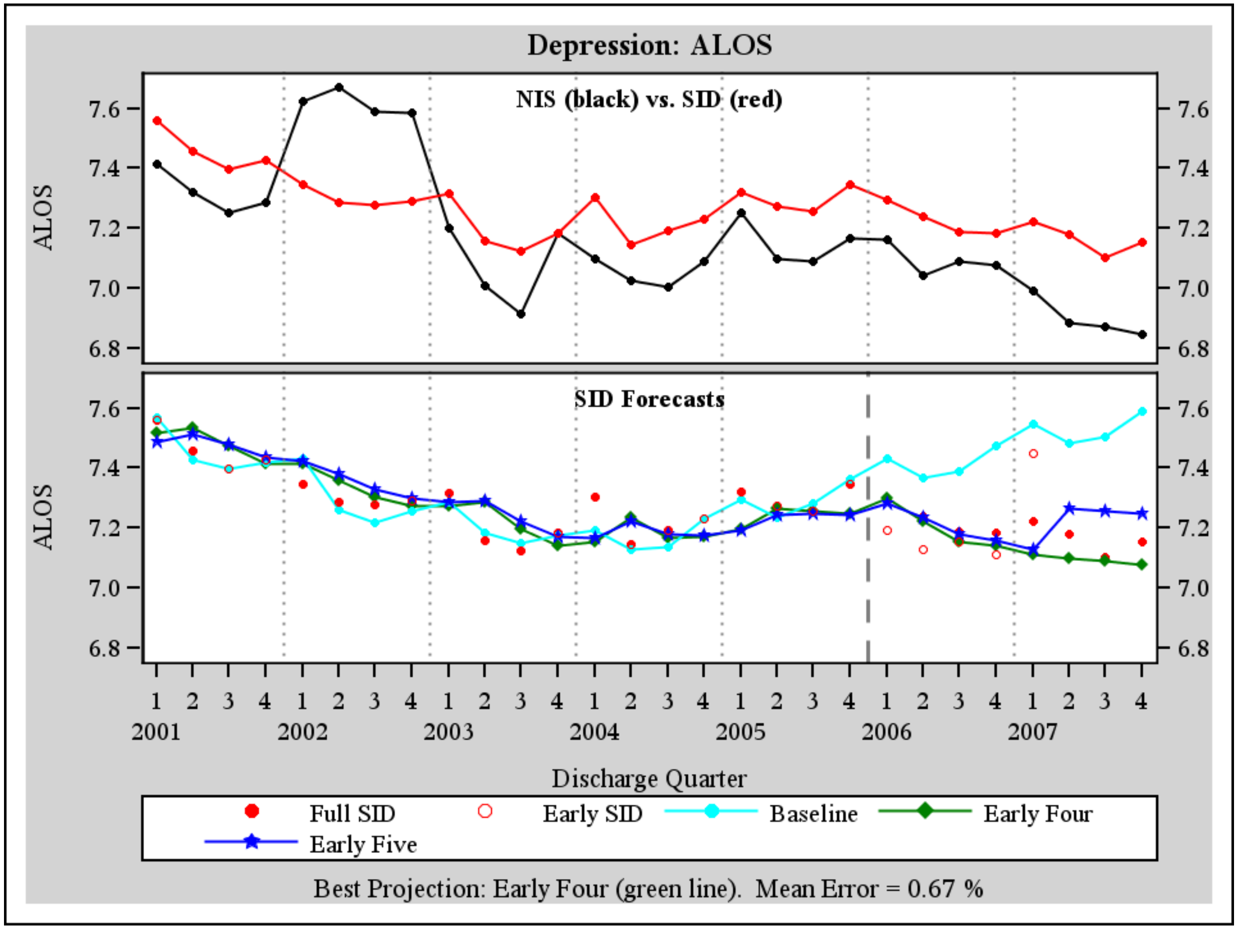

Cellulitis: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
5.2
5.0
4.8
4.6
4.4
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.54 %

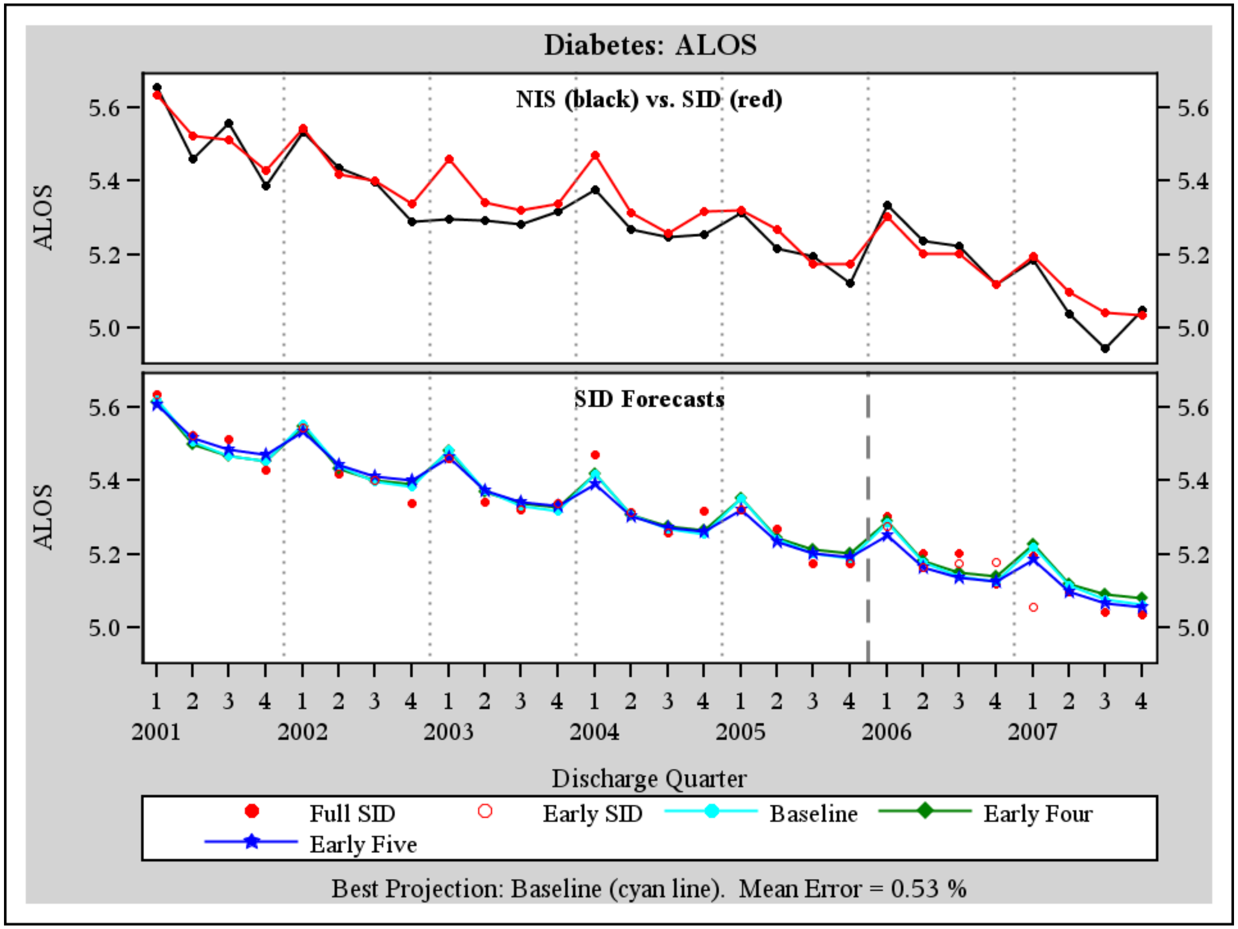


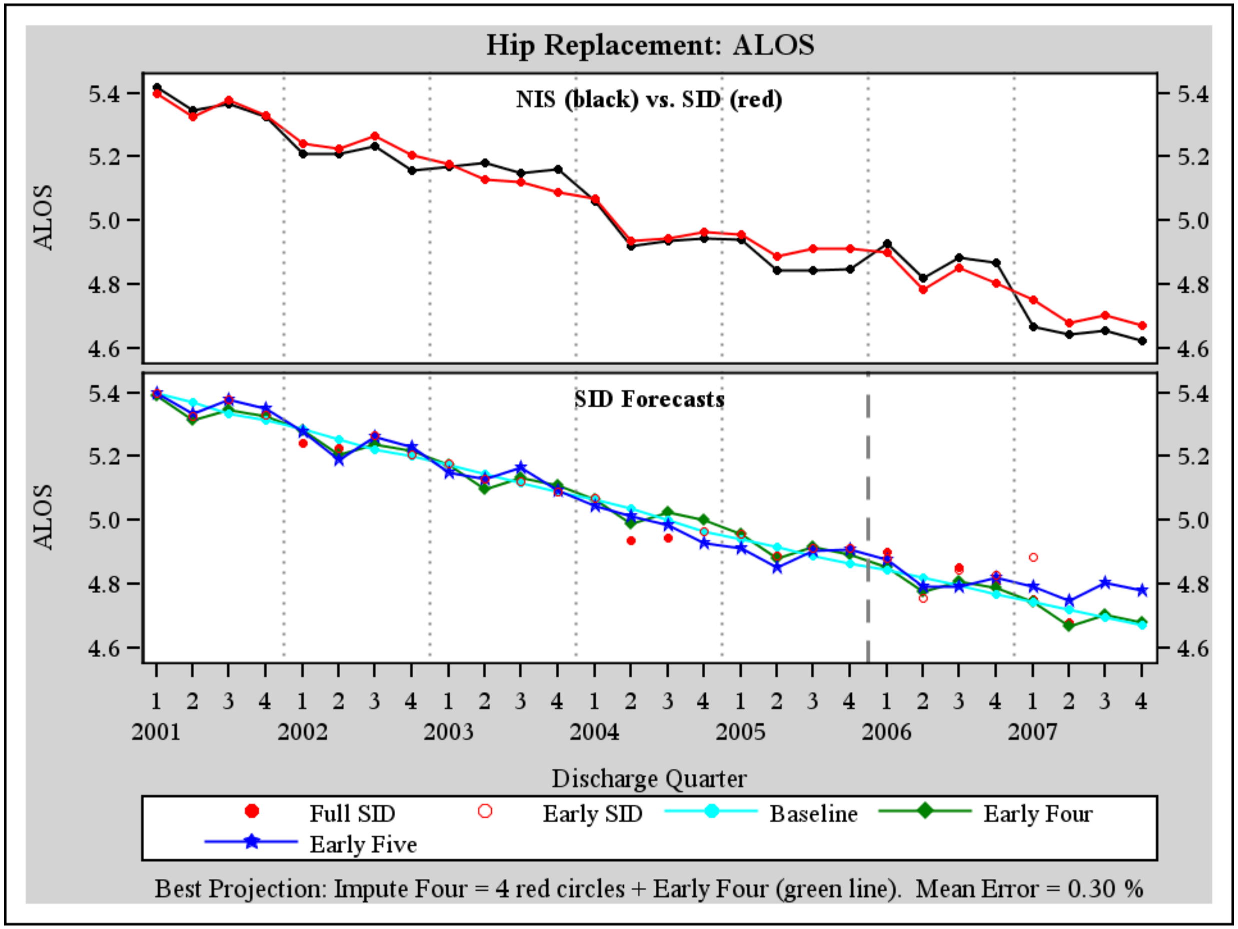
Decubitus Ulcers: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
15.0
14.5
14.0
13.5
13.0
12.5
12.0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.92 %

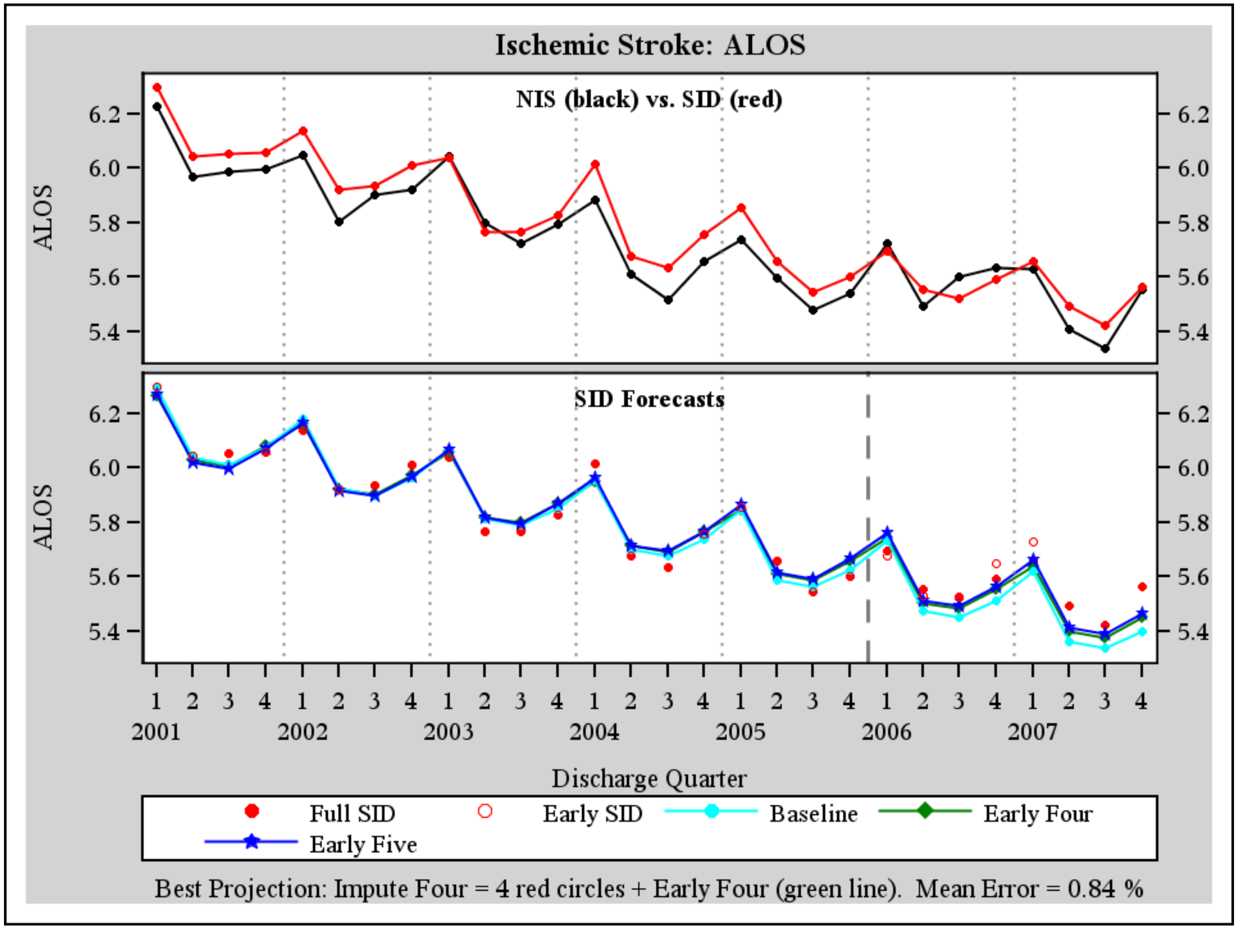


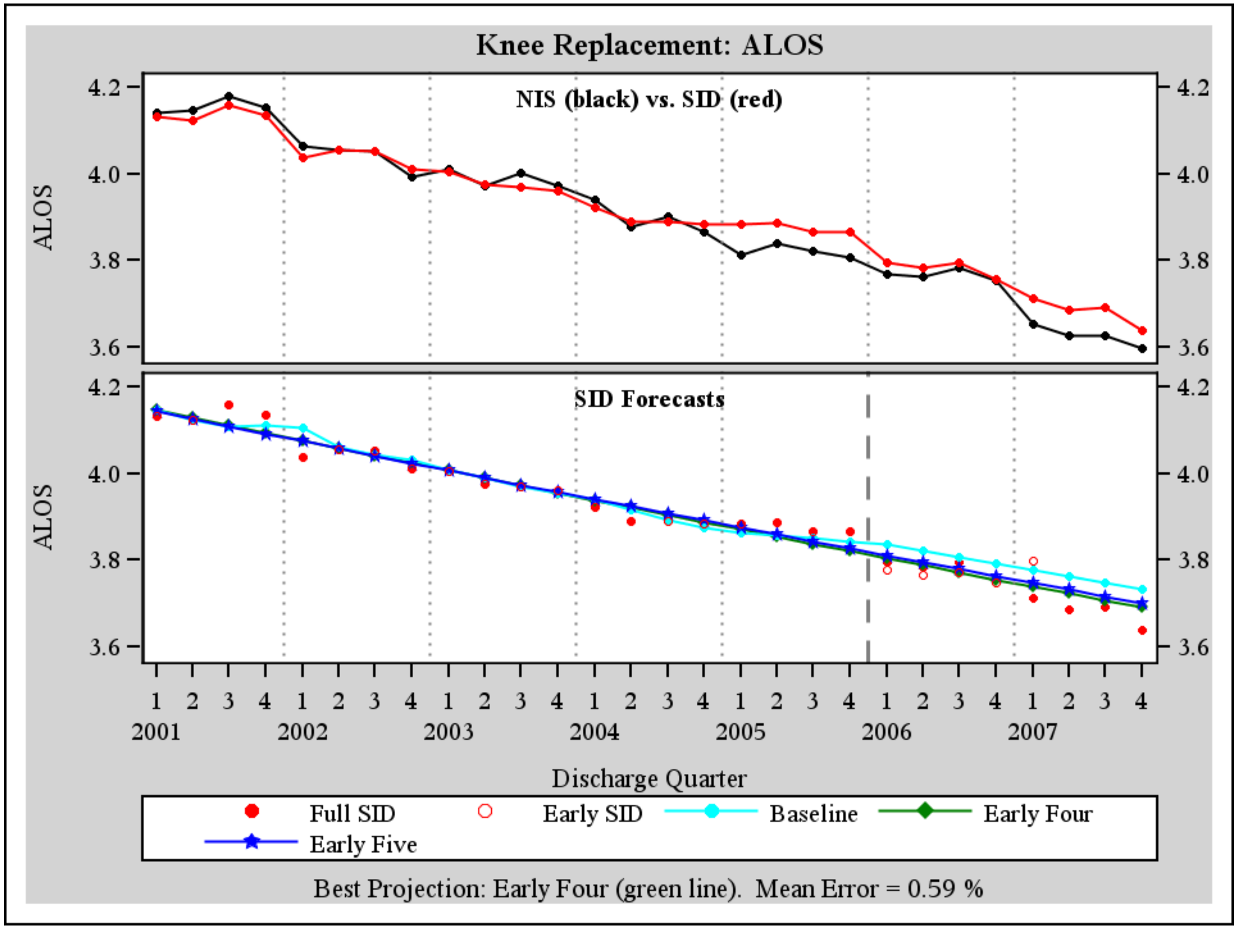
Dementia: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
9.25
9.00
8.75
8.50
8.25
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.38 %

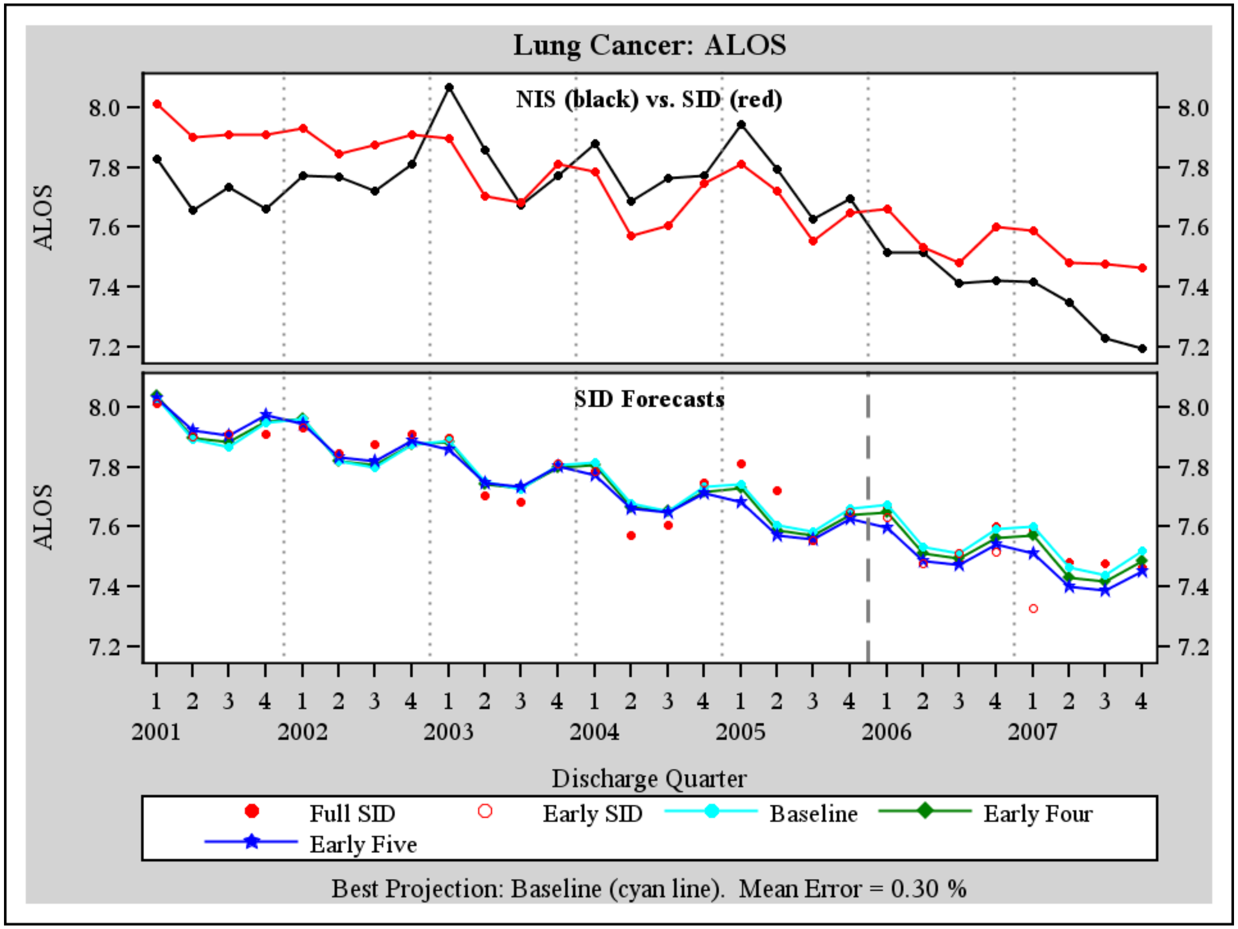

Depression: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
7.6
7.4
7.2
7.0
6.8
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.67 %

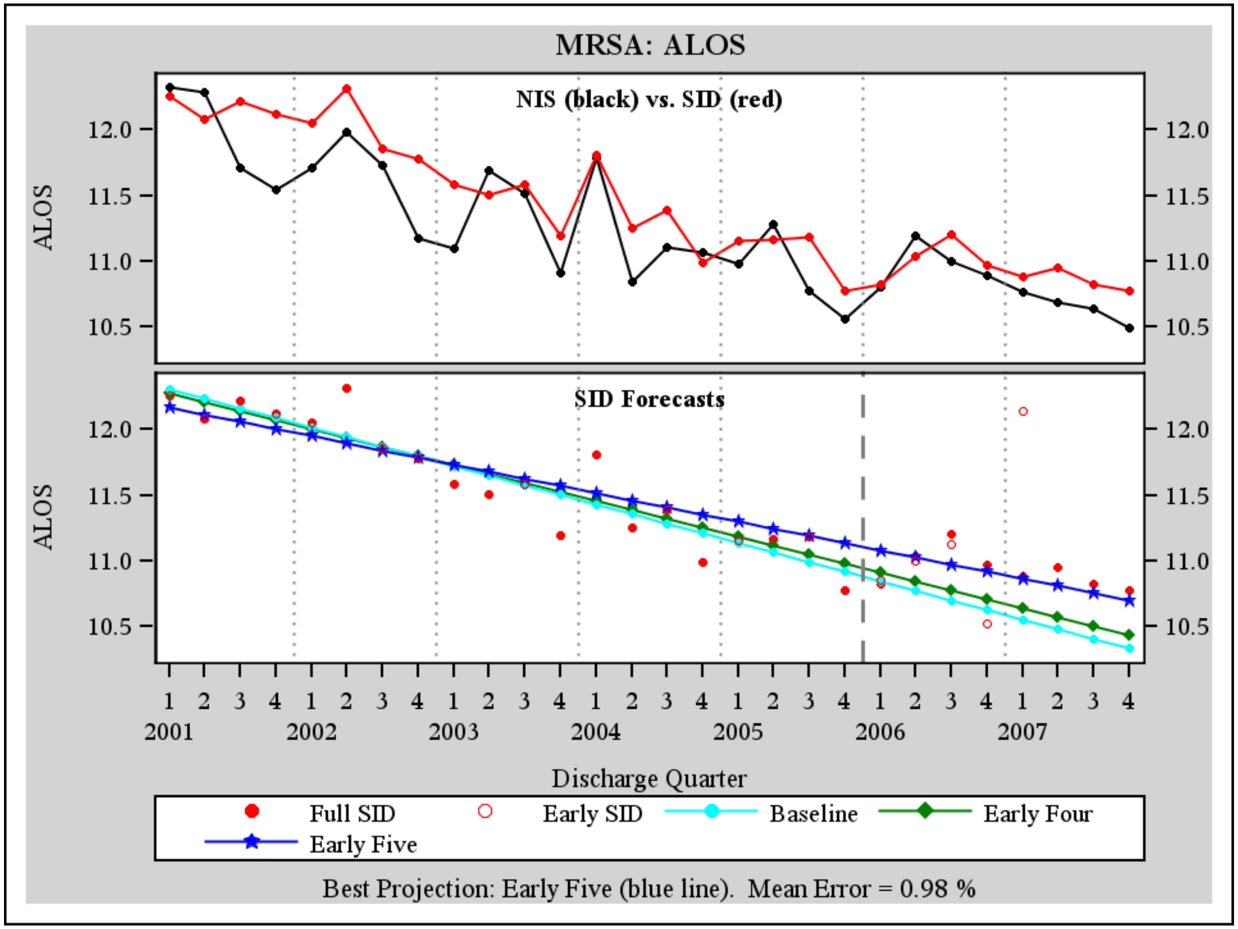

Diabetes: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
5.6
5.4
5.2
5.0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.53 %


Hip Replacement: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
5.4
5.2
5.0
4.8
4.6
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.30 %

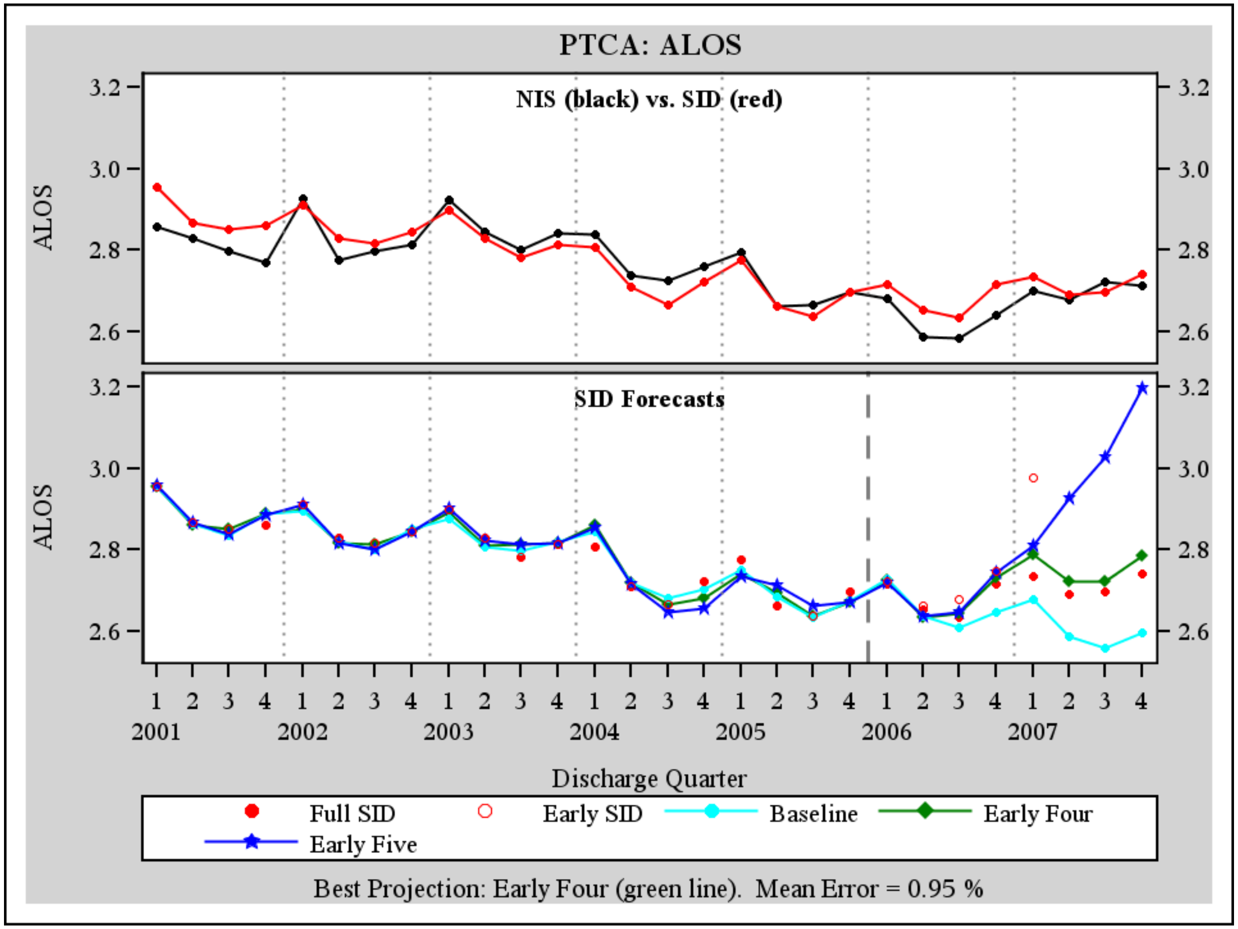

Ischemic Stroke: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
6.2
6.0
5.8
5.6
5.4
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.84 %

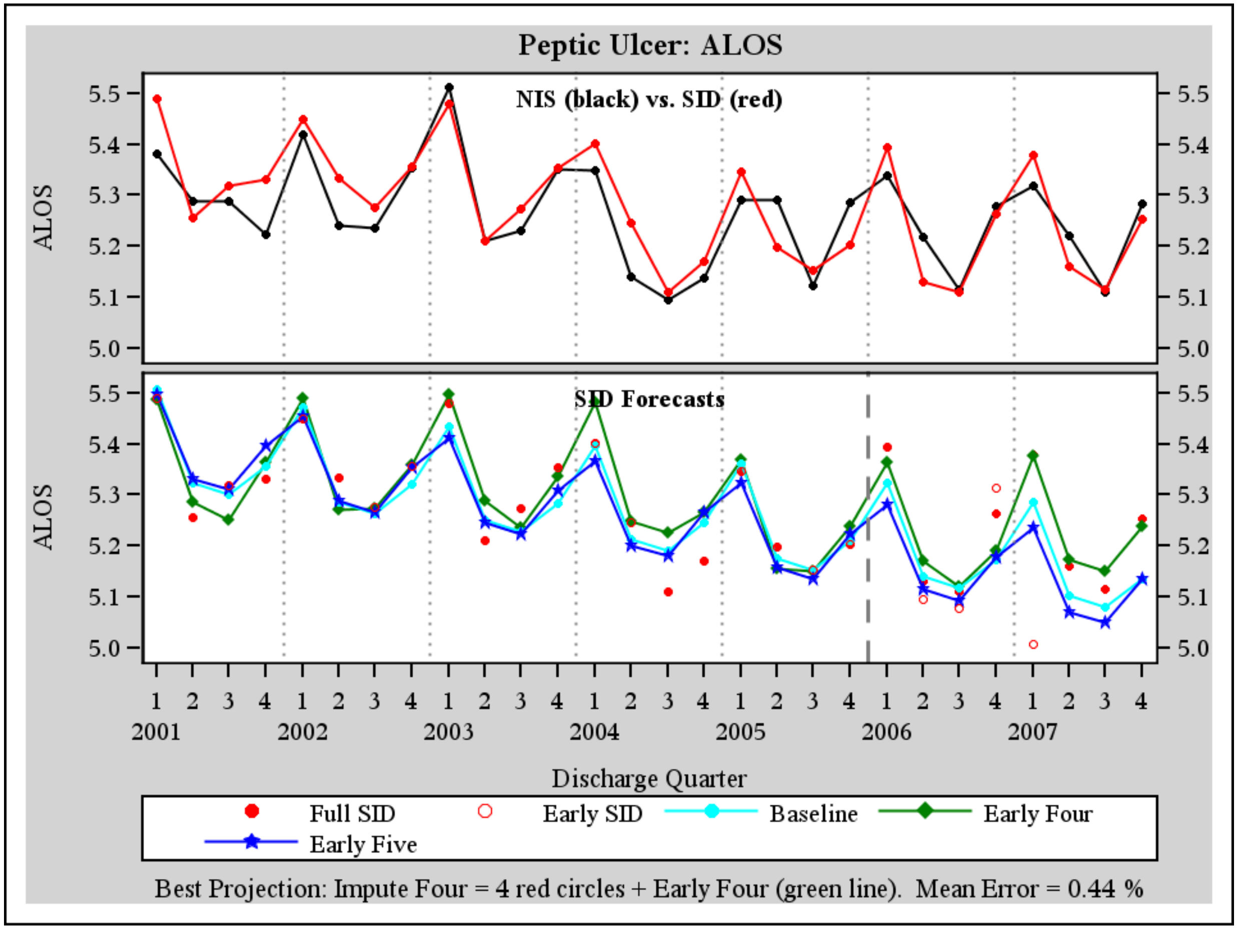

Knee Replacement: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
4.2
4.0
3.8
3.6
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.59 %

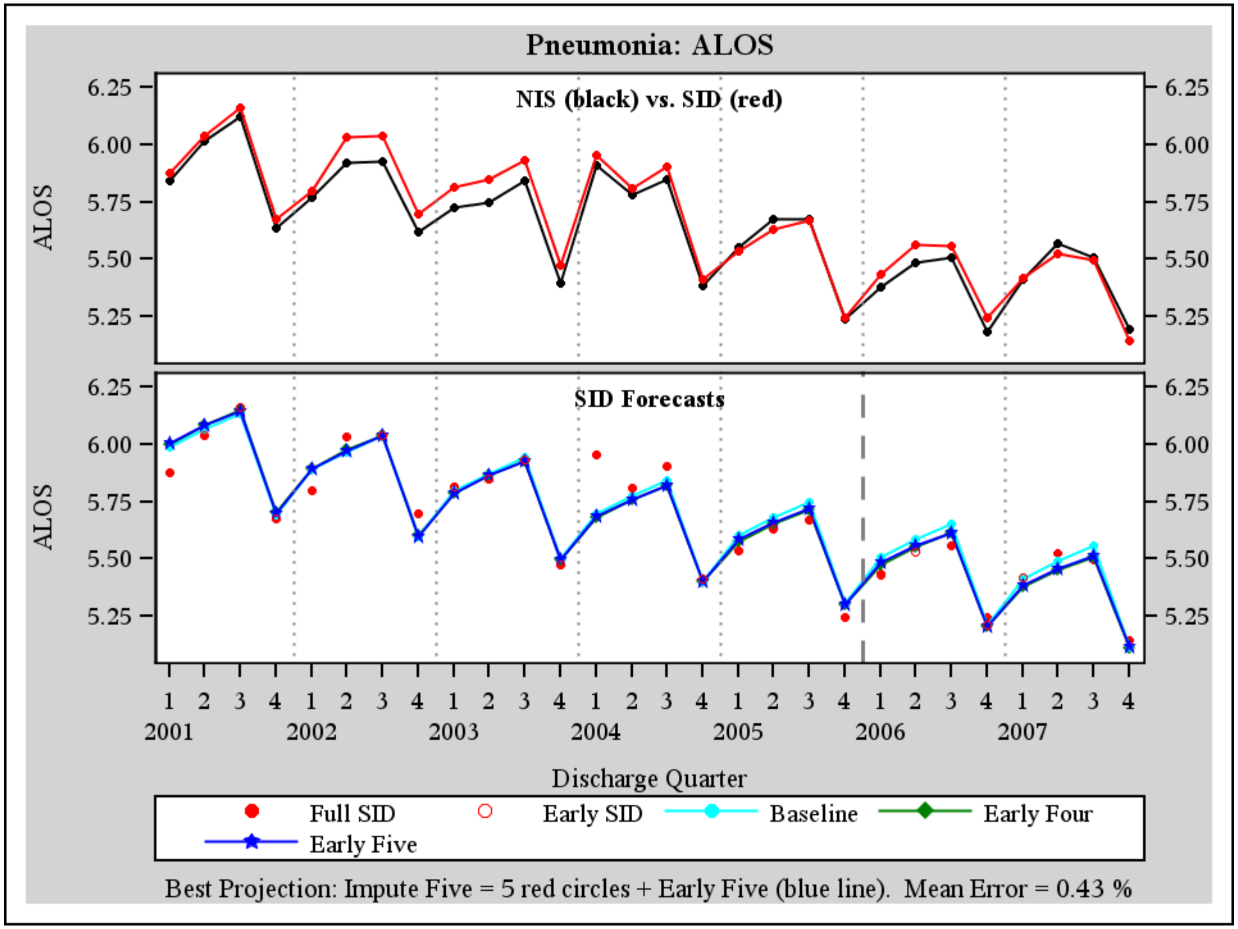

Lung Cancer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
8.0
7.8
7.6
7.4
7.2
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.30 %

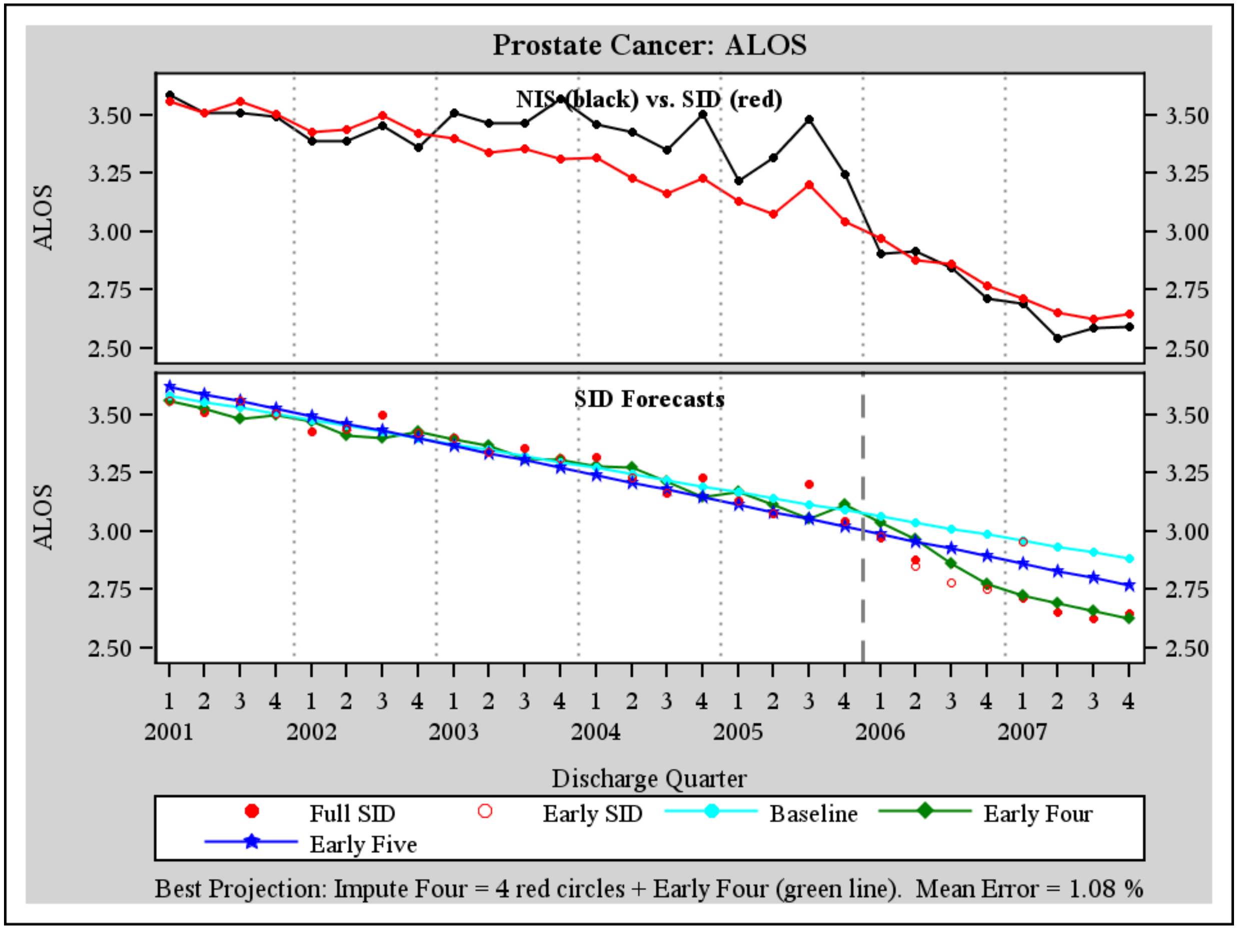


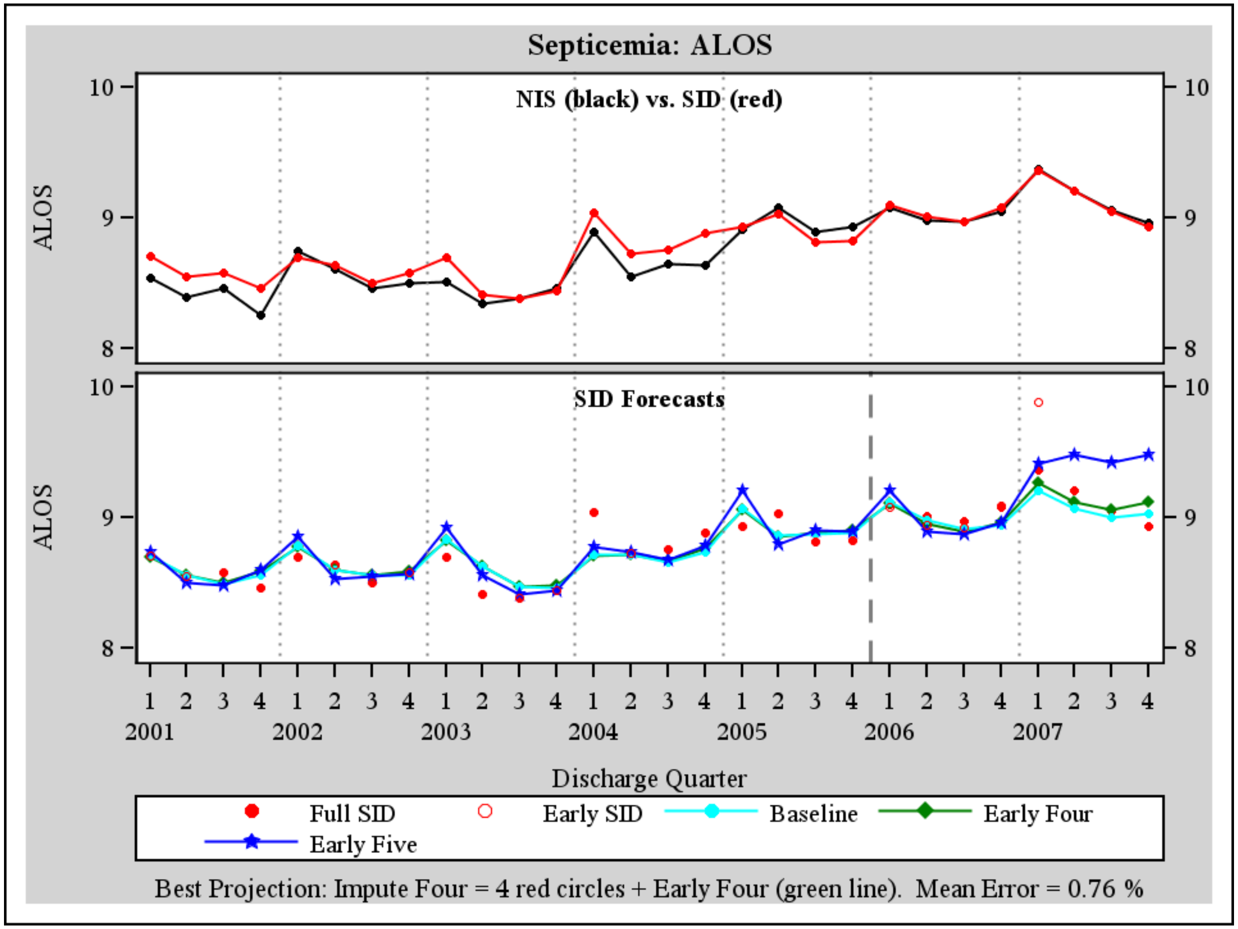
MRSA: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
12.0
11.5
11.0
10.5
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 0.98 %

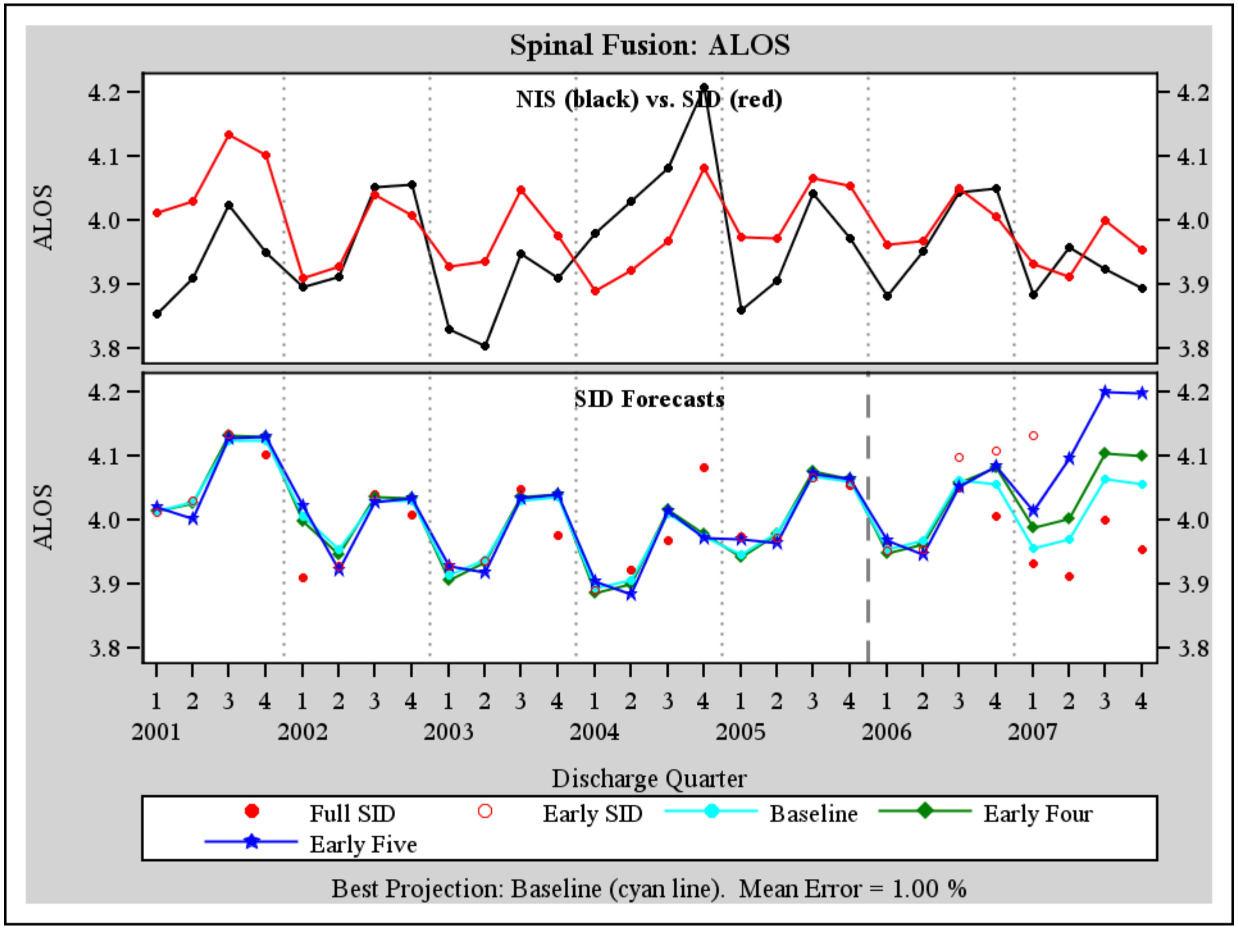

PTCA: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
3.2
3.0
2.8
2.6
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.95 %

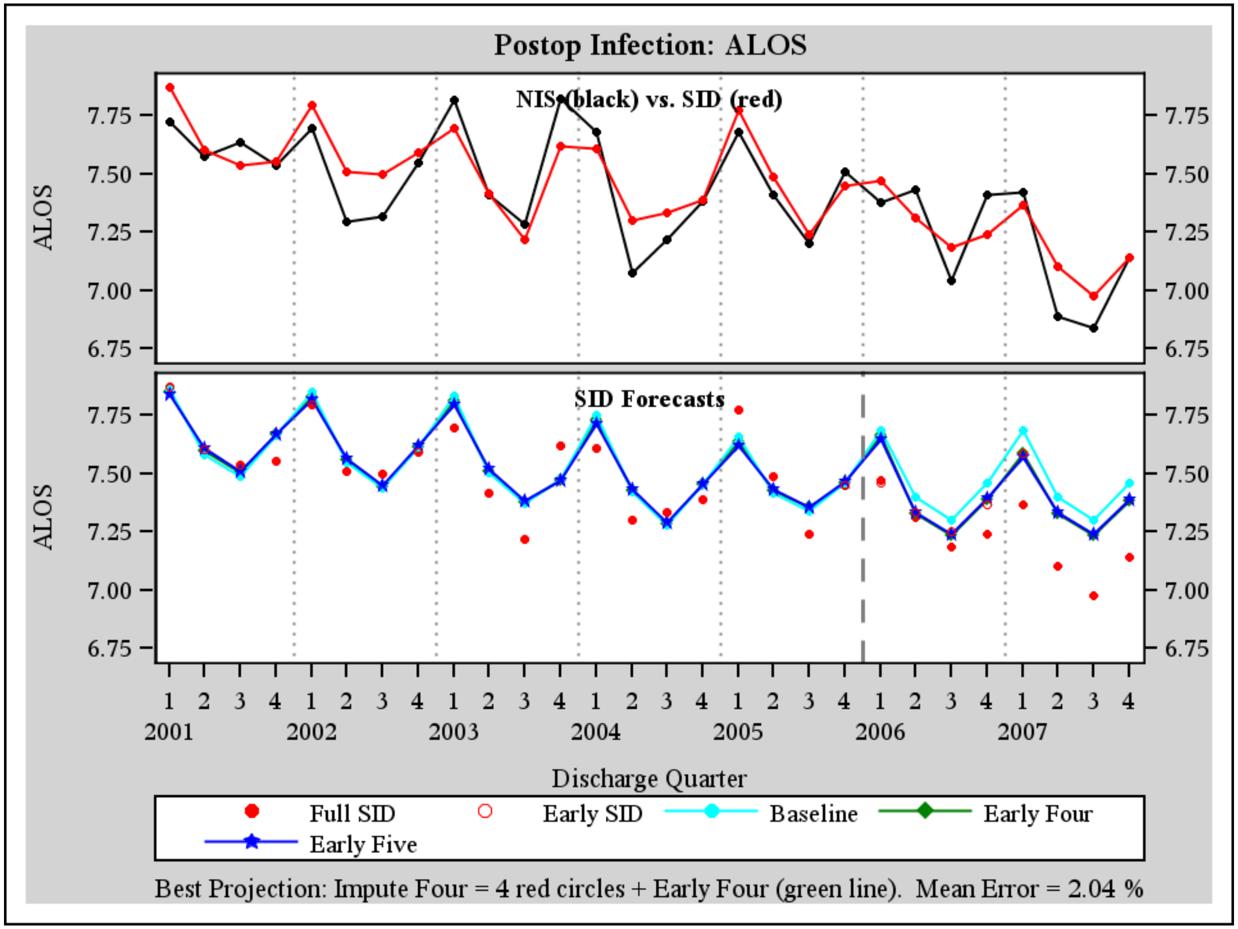

Peptic Ulcer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
ALOS
5.5
5.4
5.3
5.2
5.1
5.0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.44 %

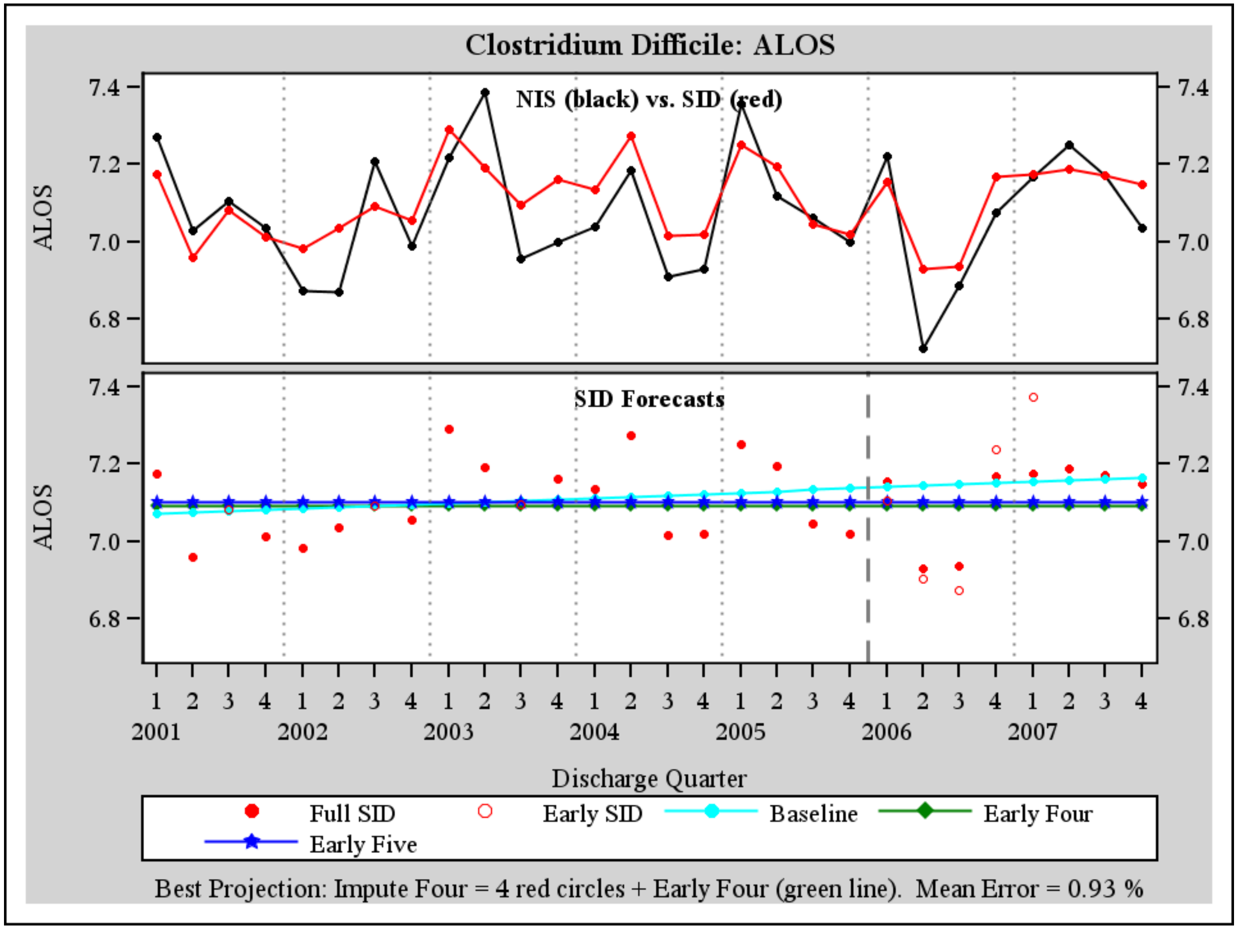

Pneumonia: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
6.25
6.00
5.75
5.50
5.25
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.43 %

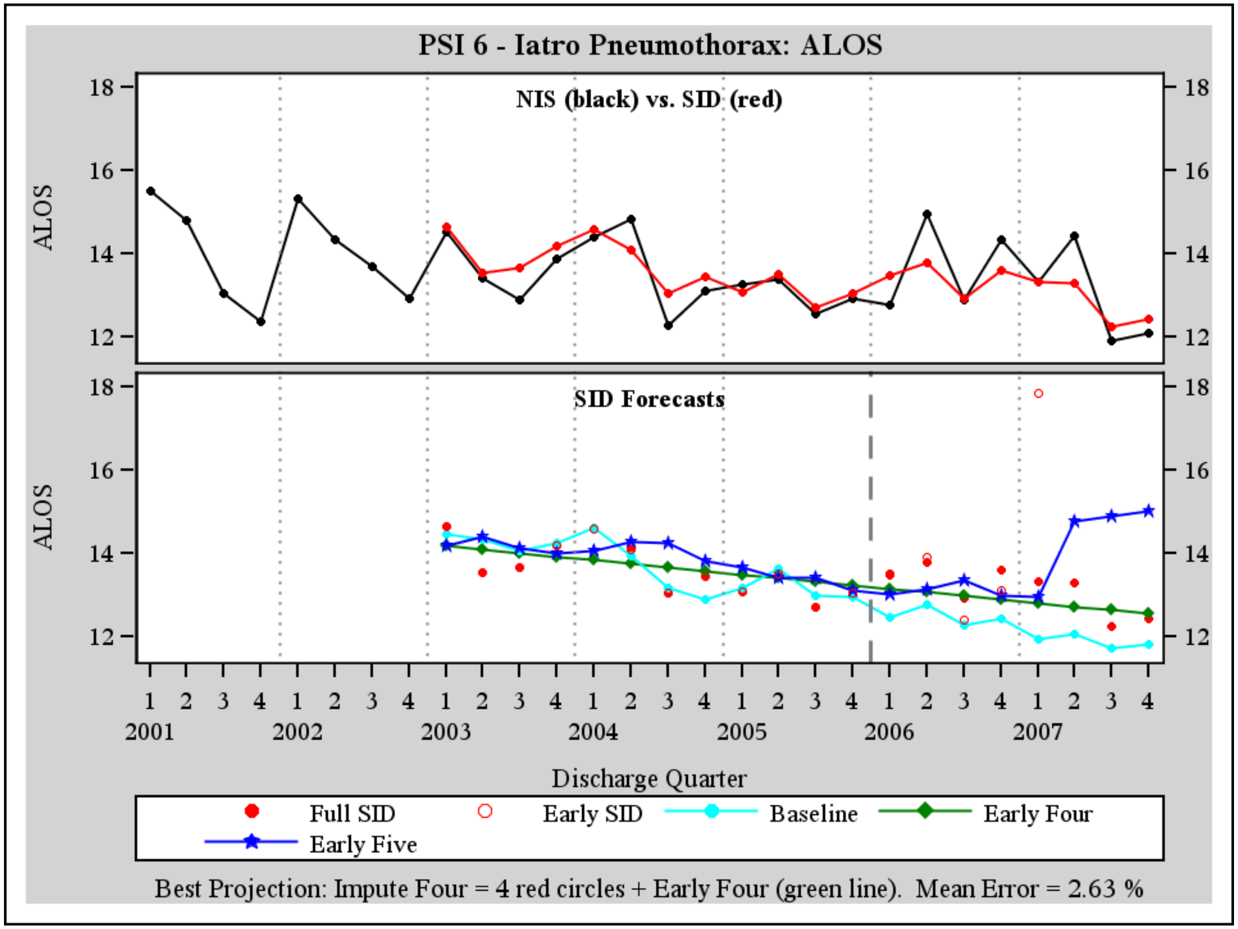

Prostate Cancer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
3.50
3.25
3.00
2.75
2.50
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.08 %

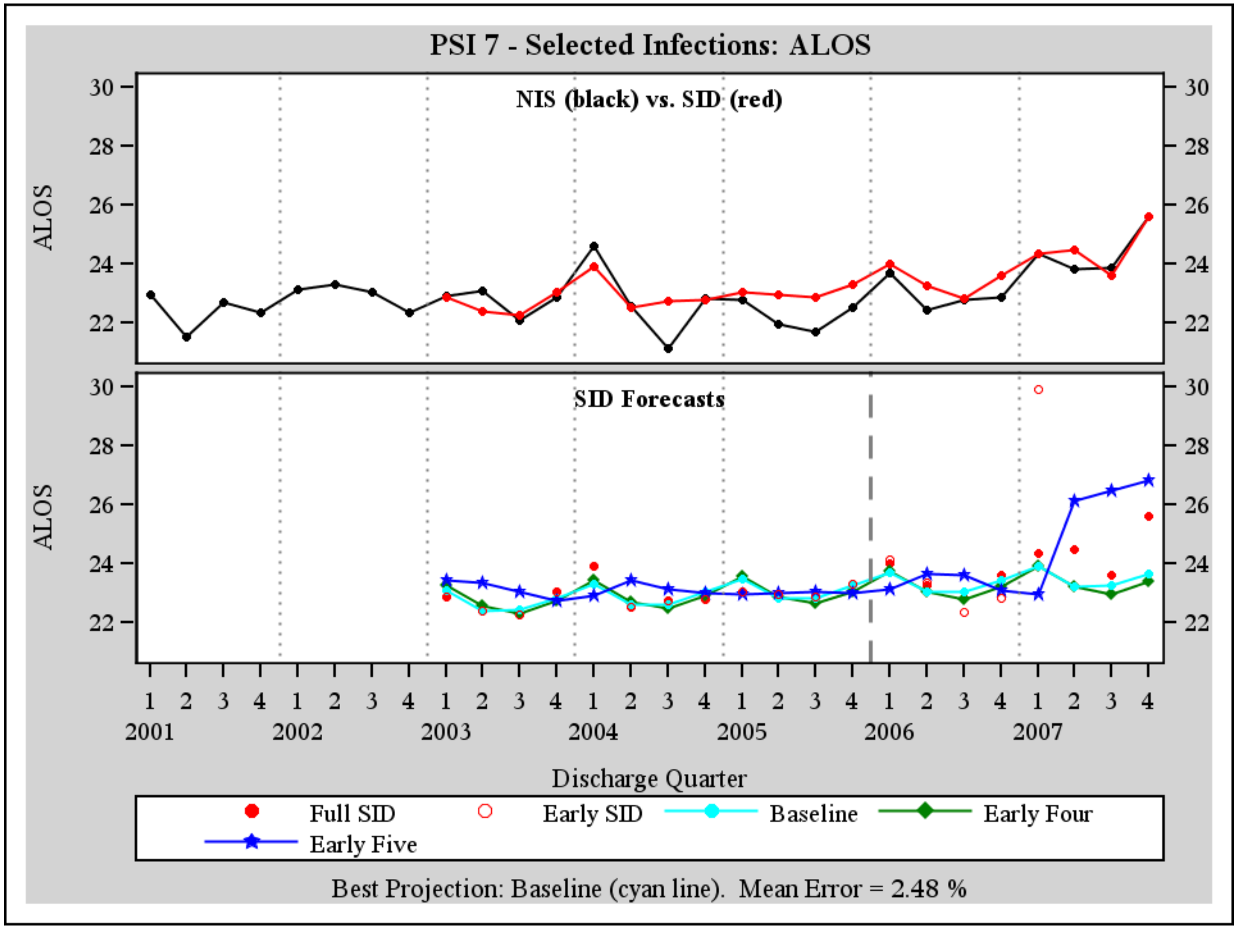

Septicemia: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
10
9
8
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.76 %

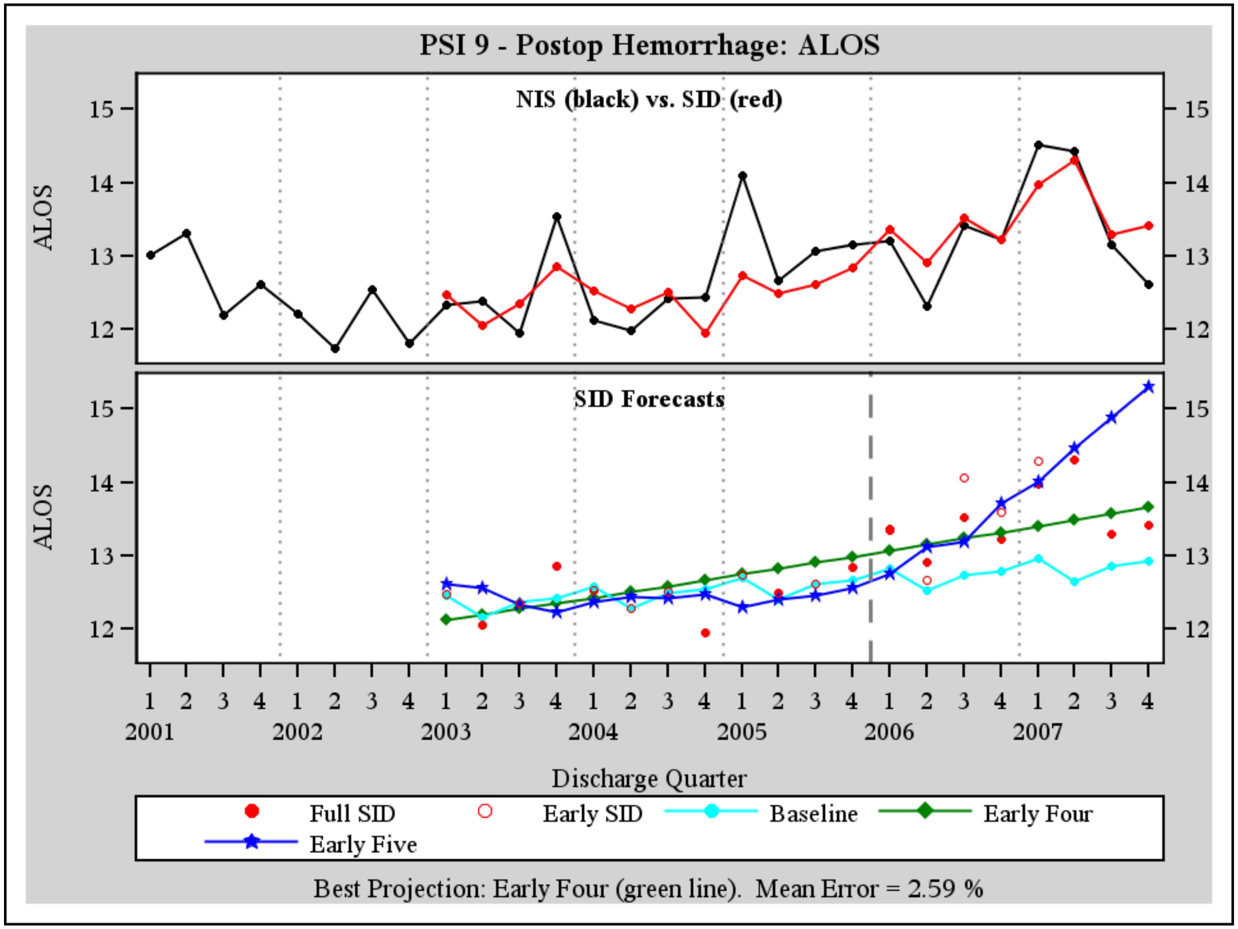

Spinal Fusion: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
4.2
4.1
4.0
3.9
3.8
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 1.00 %

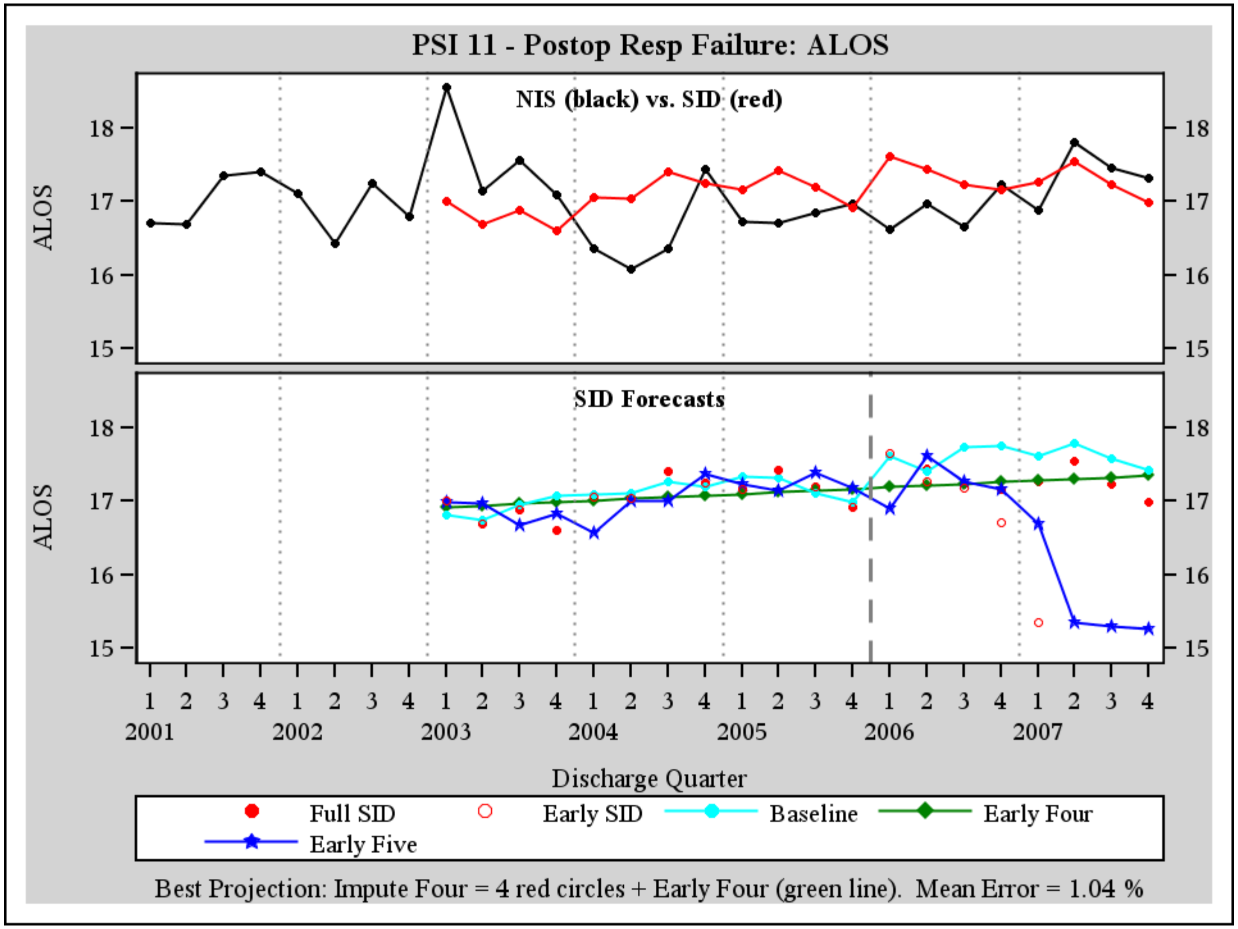

Postop Infection: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
7.75
7.50
7.25
7.00
6.75
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.04 %

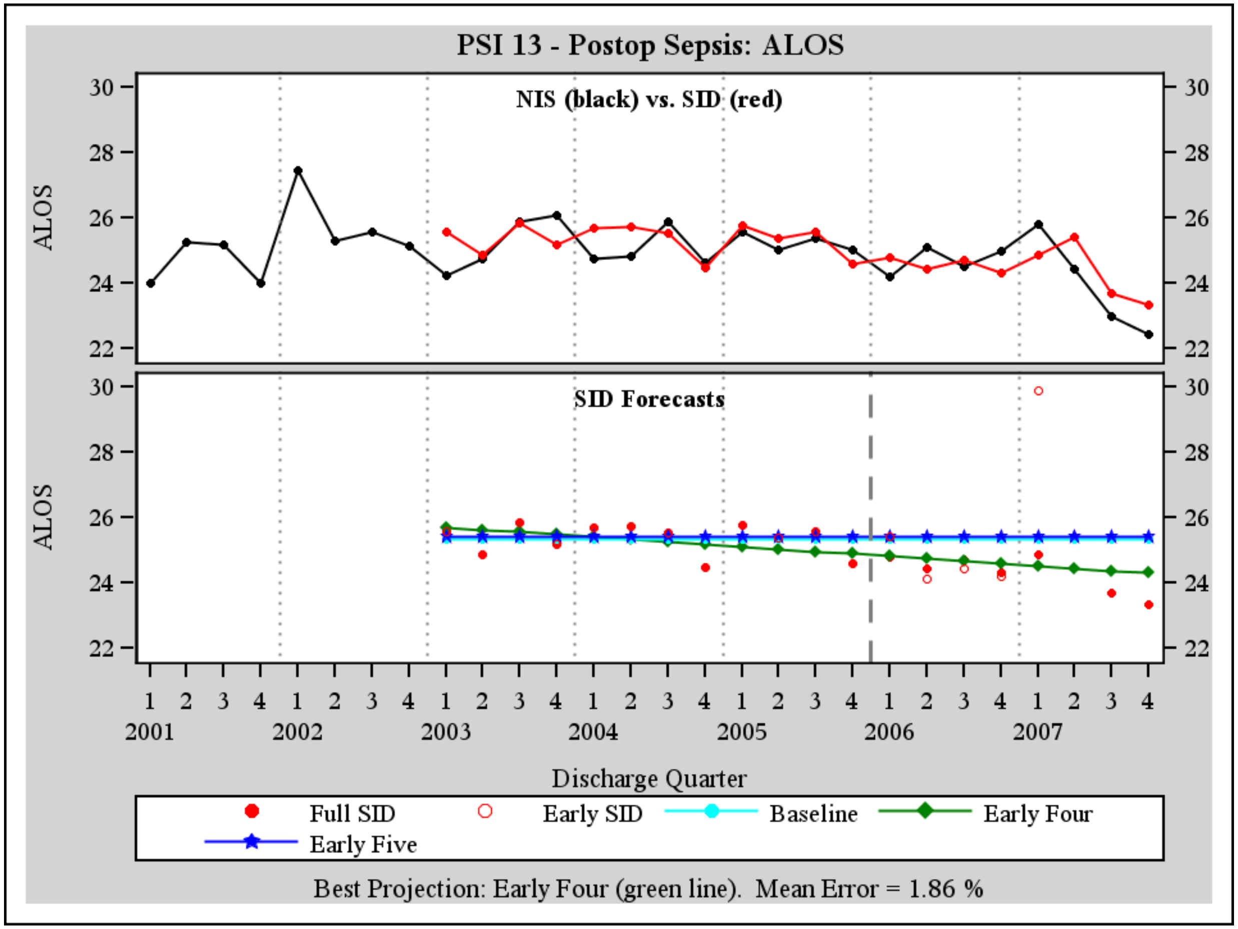

Clostridium Difficile: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
7.4
7.2
7.0
6.8
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.93 %


PSI 6 - Iatro Pneumothorax: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
18
16
14
12
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 2.63 %

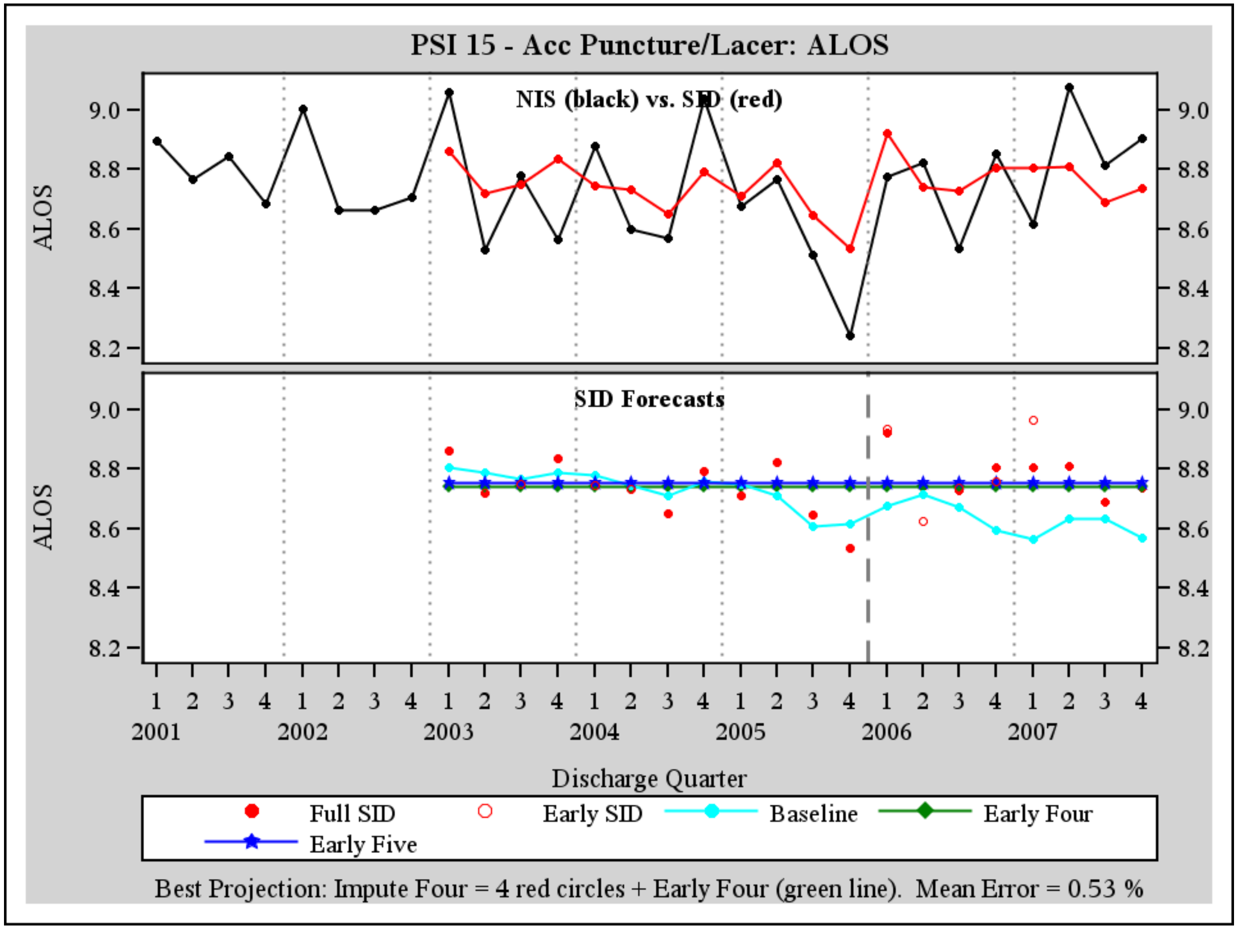

PSI 7 - Selected Infections: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
30
28
26
24
22
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 2.48 %


PSI 9 - Postop Hemorrhage: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
15
14
13
12
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 2.59 %

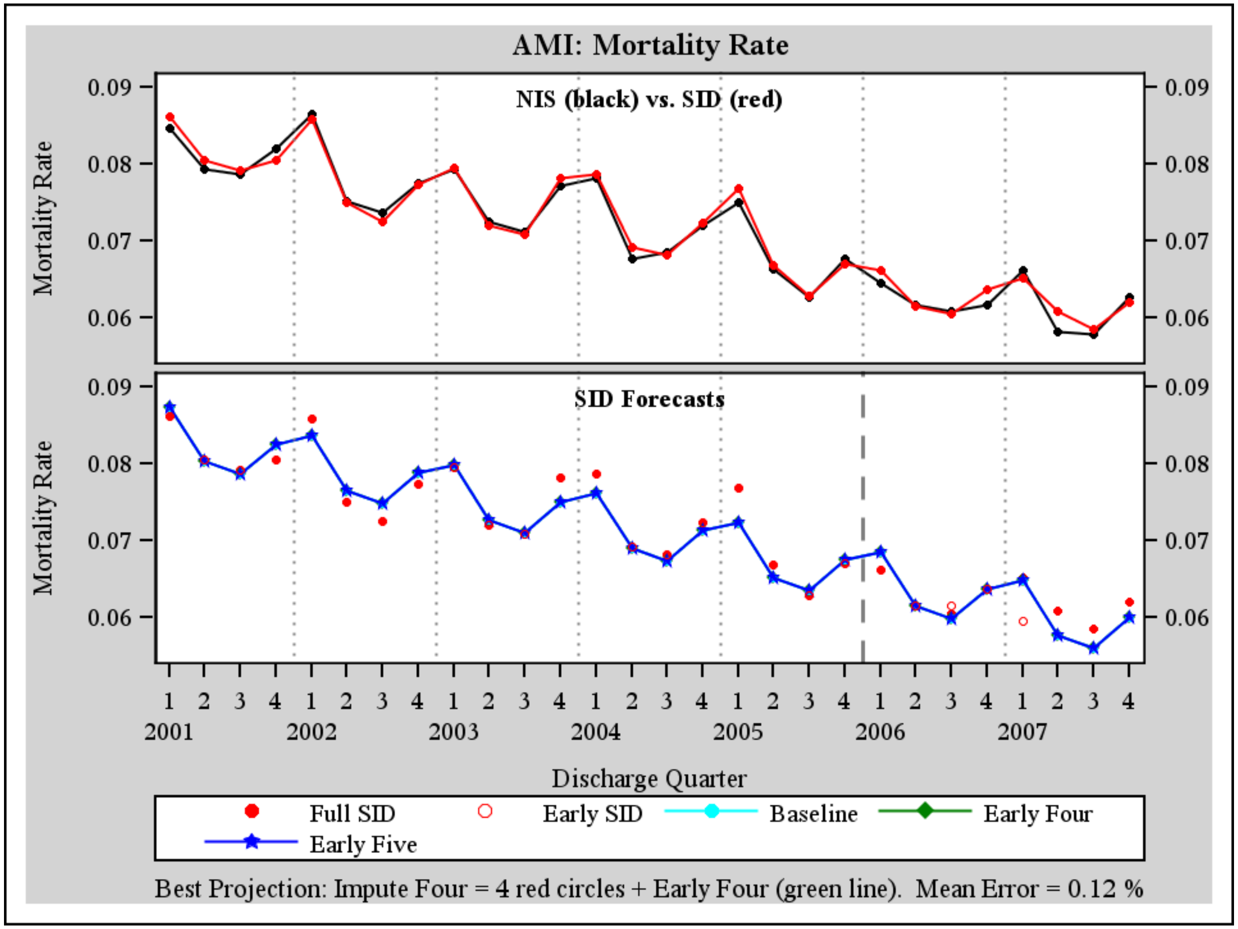

PSI 11 - Postop Resp Failure: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
15
16
17
18
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 1.04 %

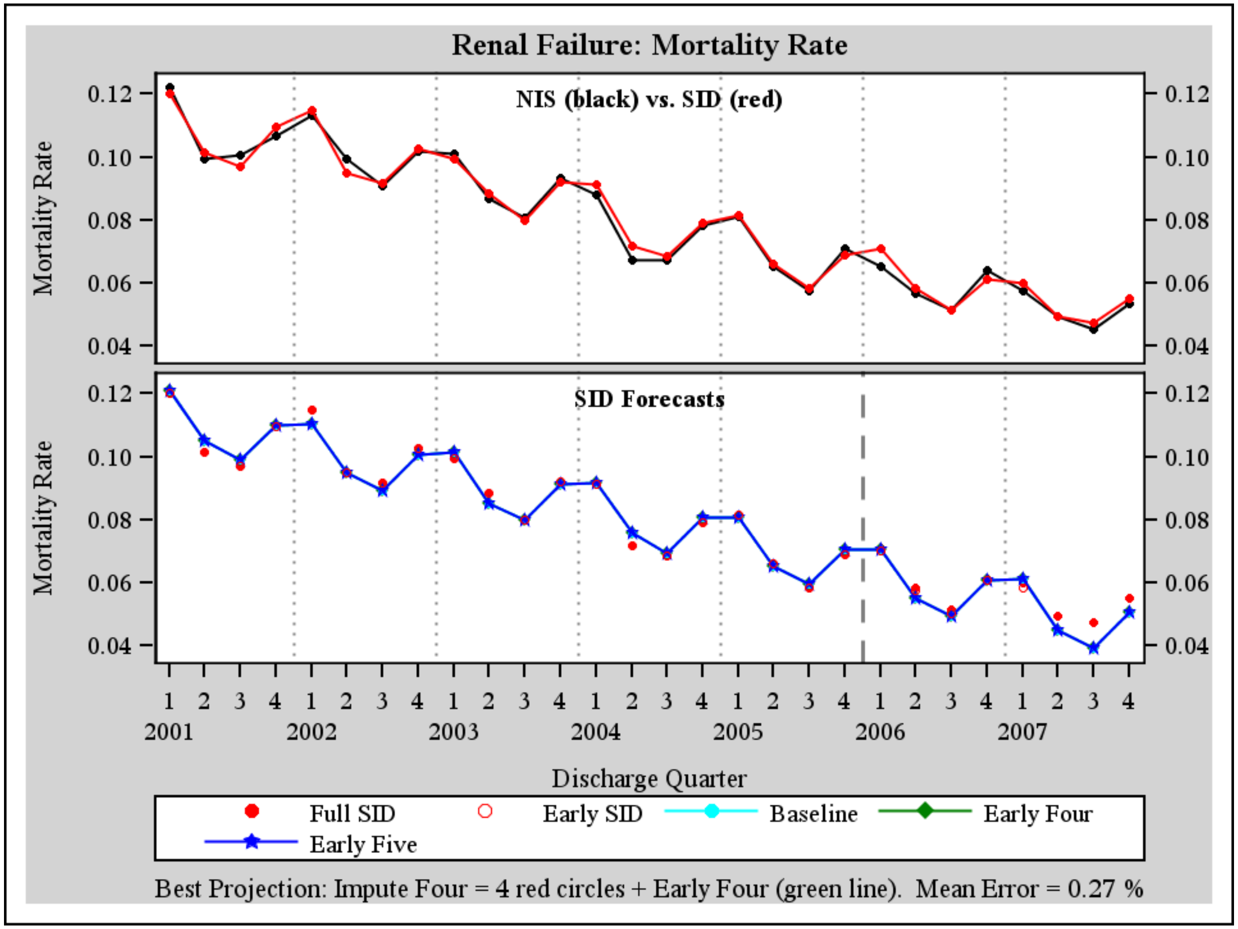


PSI 13 - Postop Sepsis: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
30
28
26
24
22
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 1.86 %

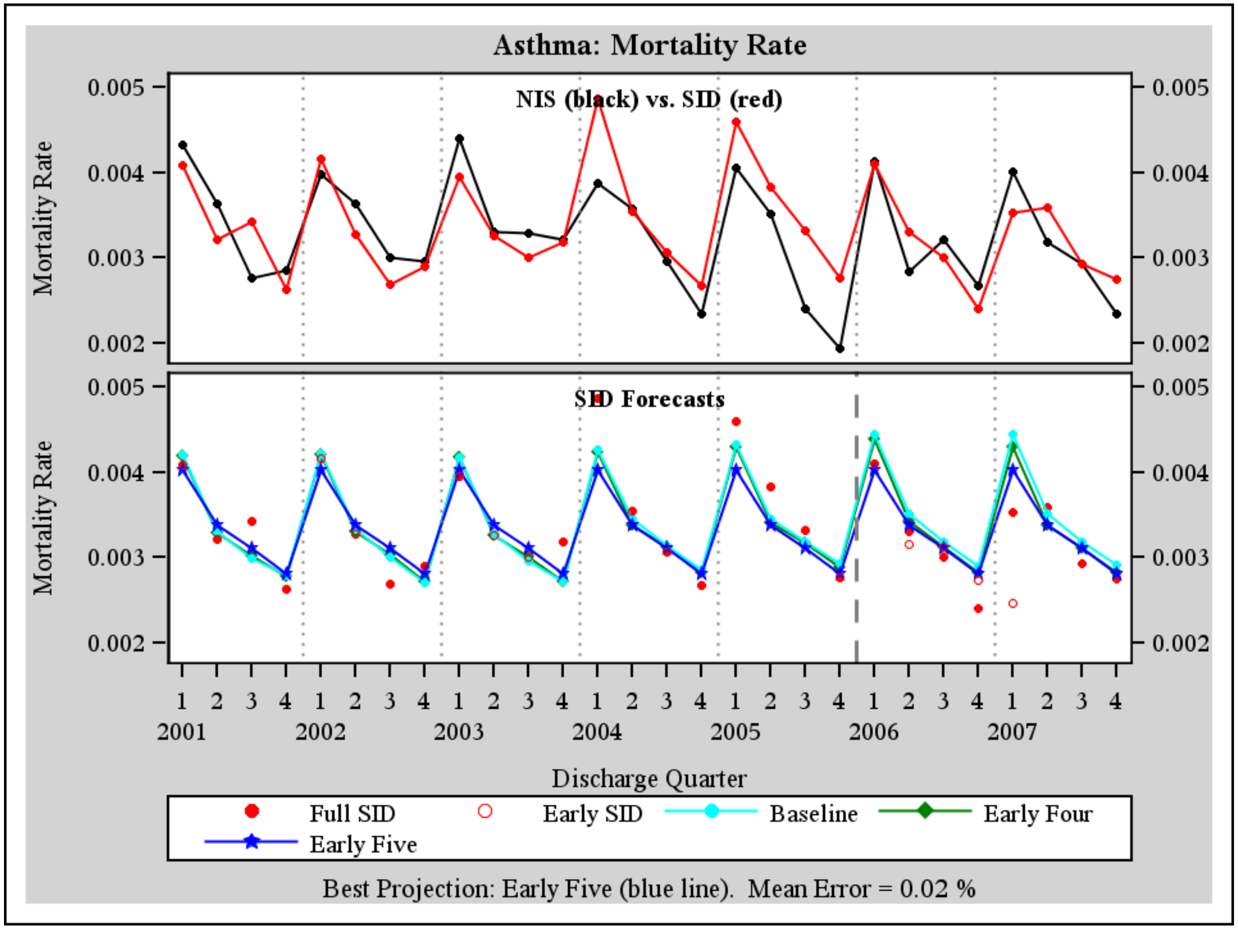

PSI 15 - Acc Puncture/Lacer: ALOS
NIS (black) vs. SID (red)
SID Forecasts
ALOS
9.0
8.8
8.6
8.4
8.2
1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.53 %

APPENDIX D: SID IN-HOSPITAL MORTALITY RATE PROJECTIONS

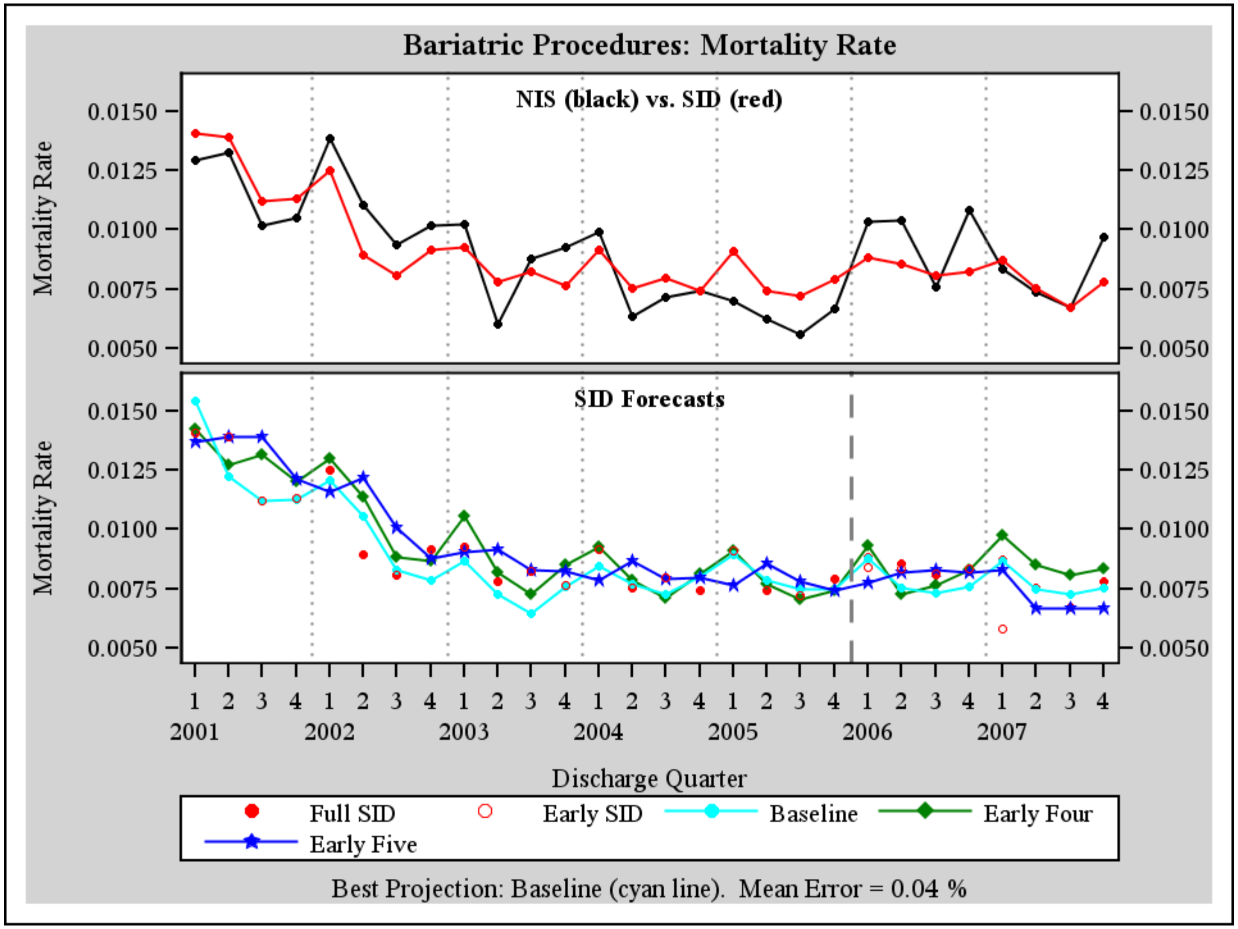

AMI: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.09
0.08
0.07
0.06
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.12 %

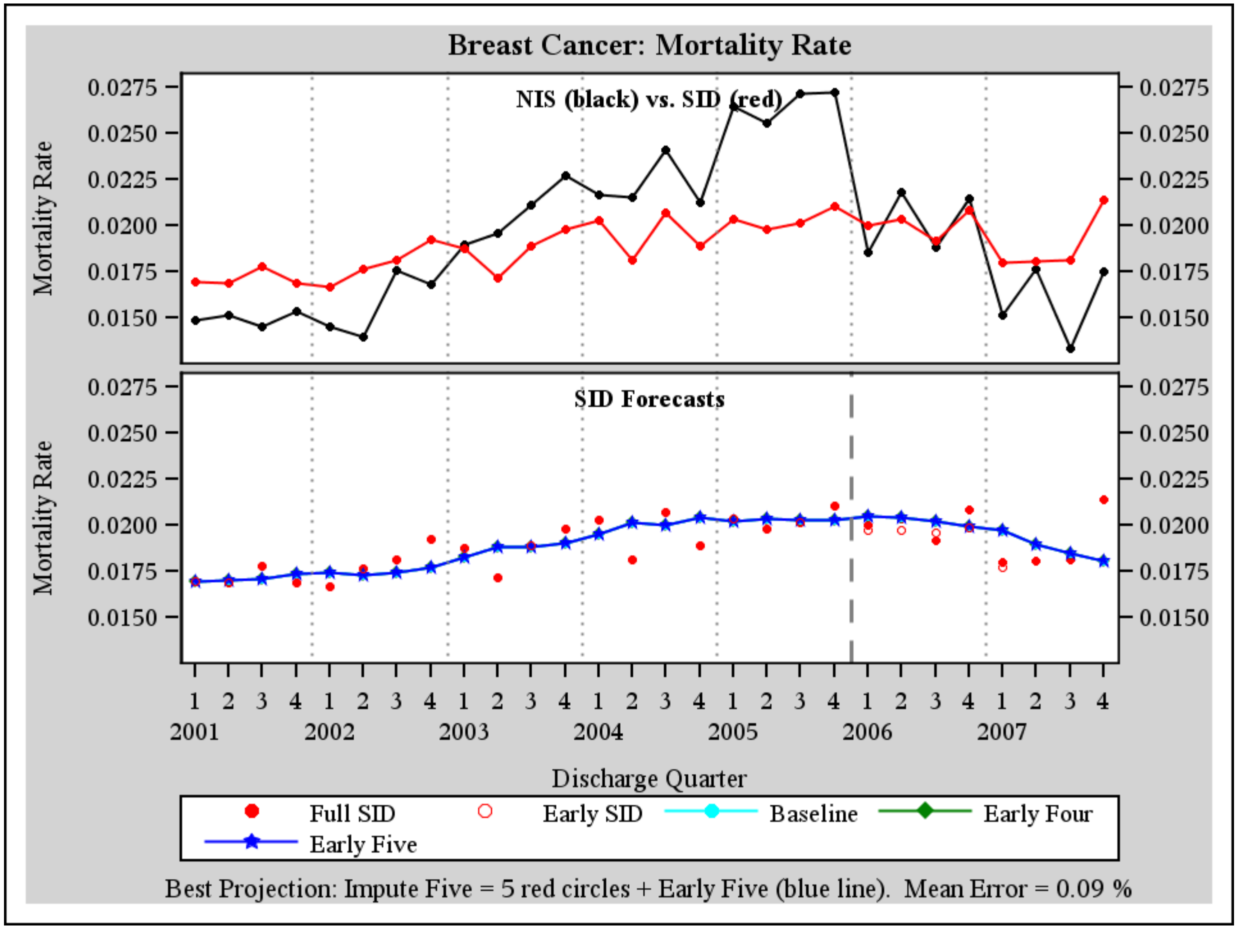


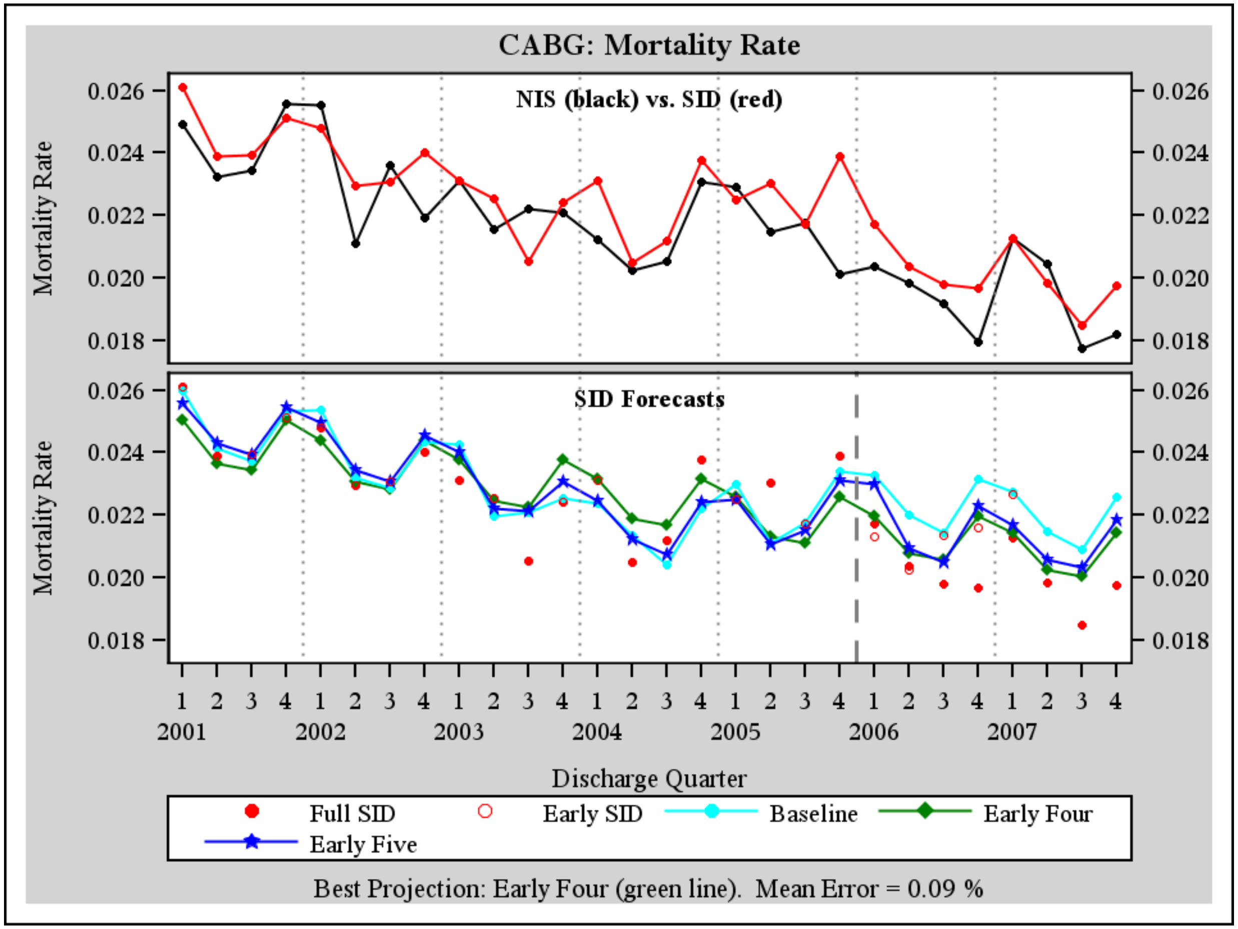
Renal Failure: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.12
0.10
0.08
0.06
0.04
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.27 %

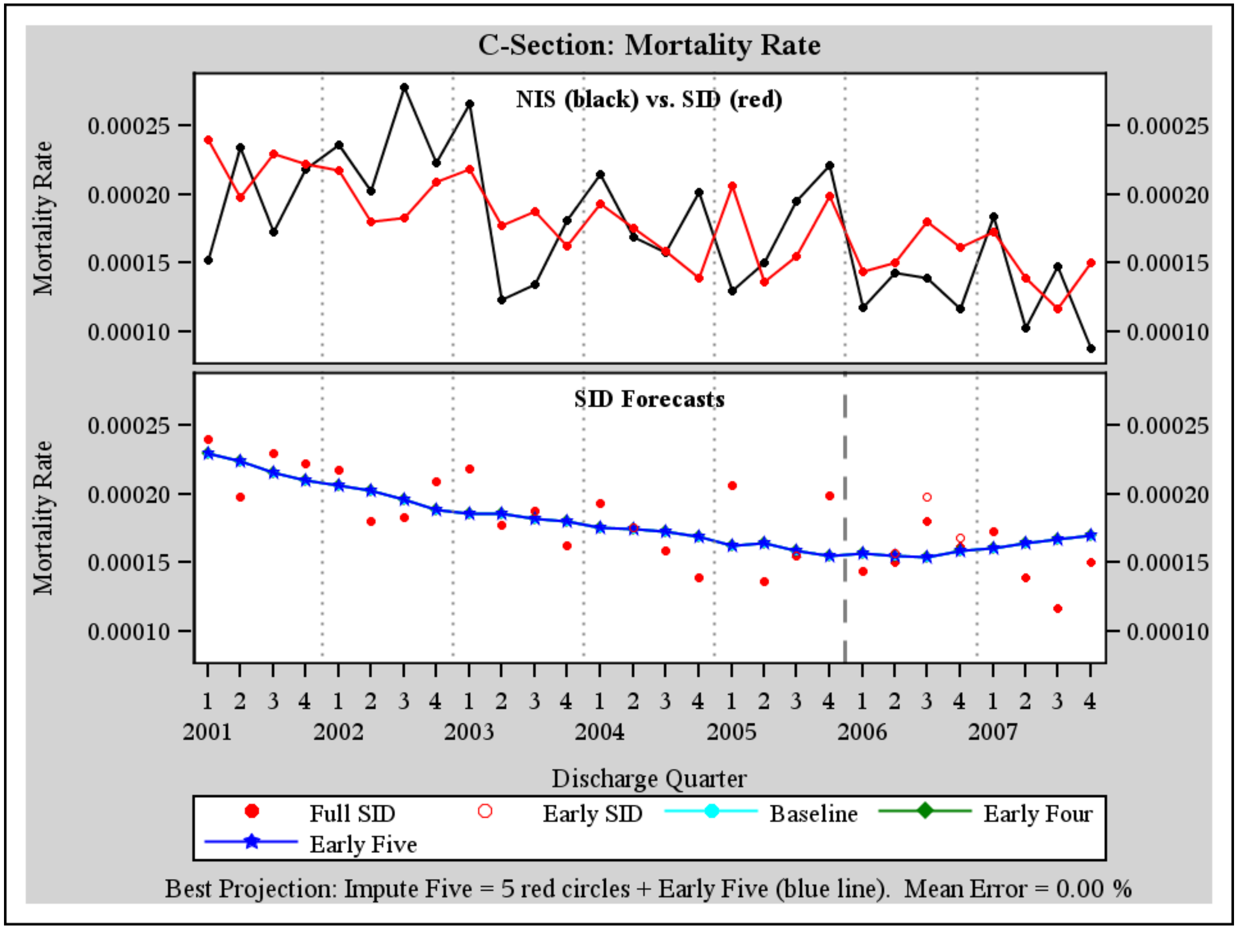


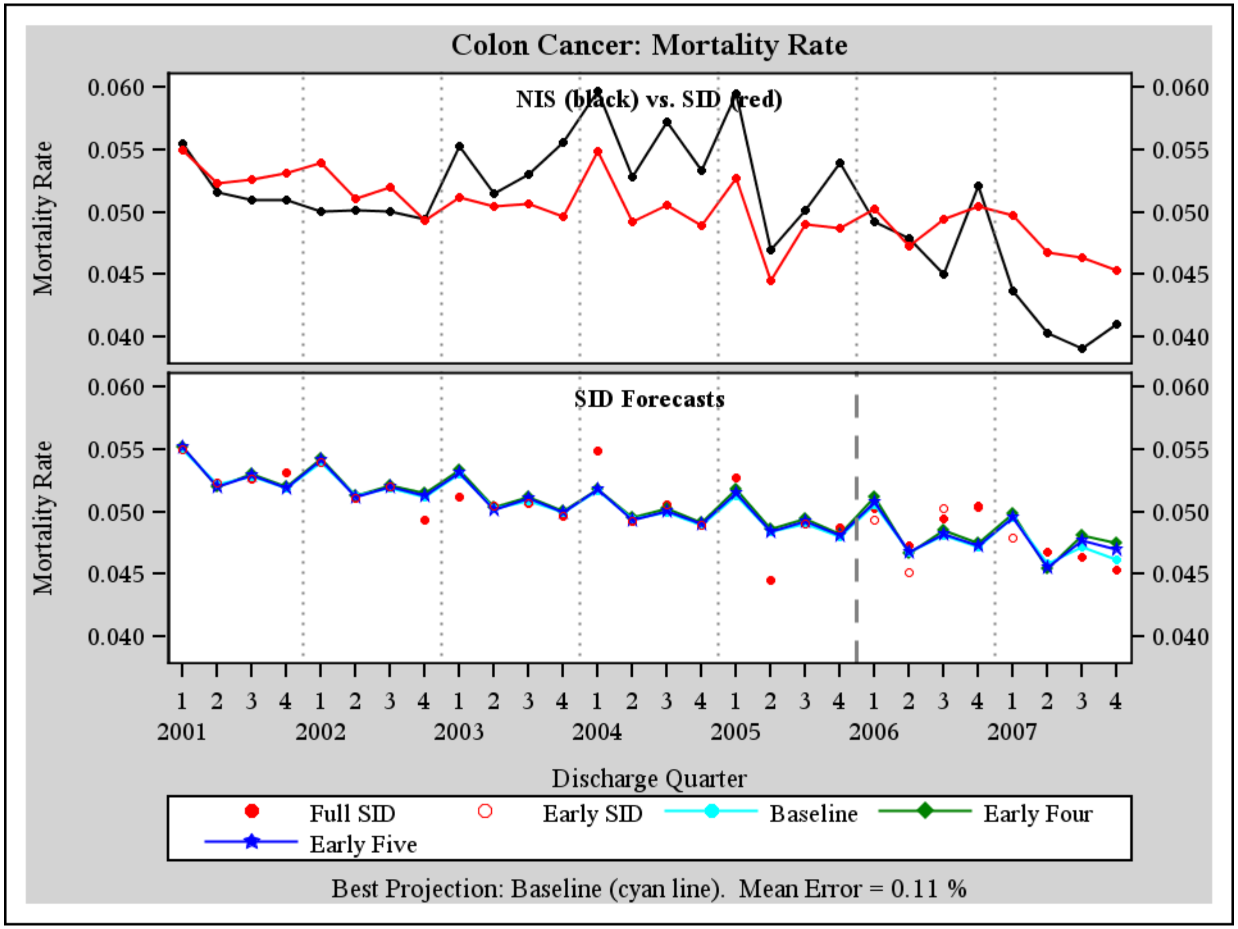
Asthma: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.005
0.004
0.003
0.002
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 0.02 %

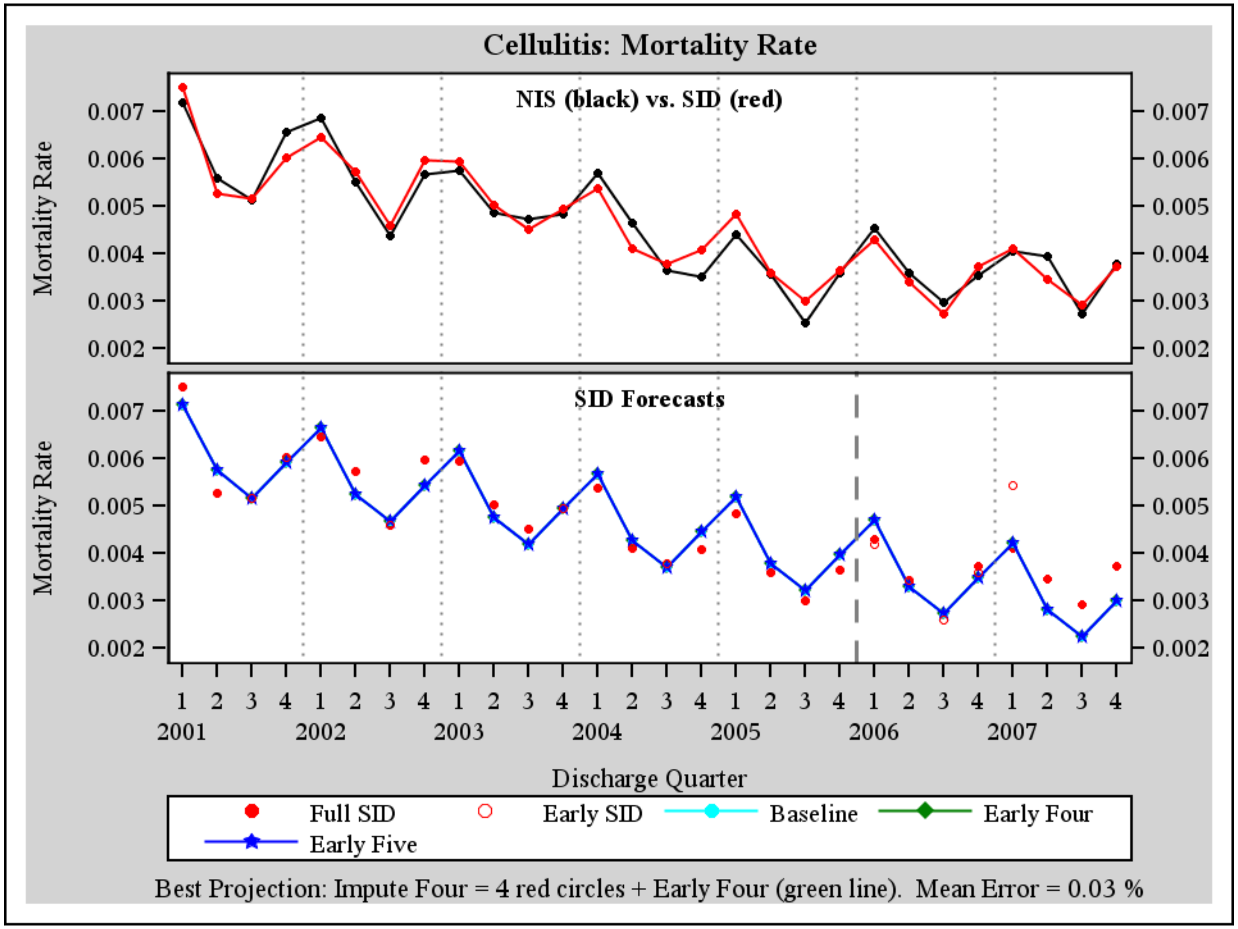

Bariatric Procedures: Mortality Rate
NIS (black) vs. SID (red)
Mortality Rate
0.0150
0.0125
0.0100
0.0075
0.0050
SID Forecasts
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.04 %

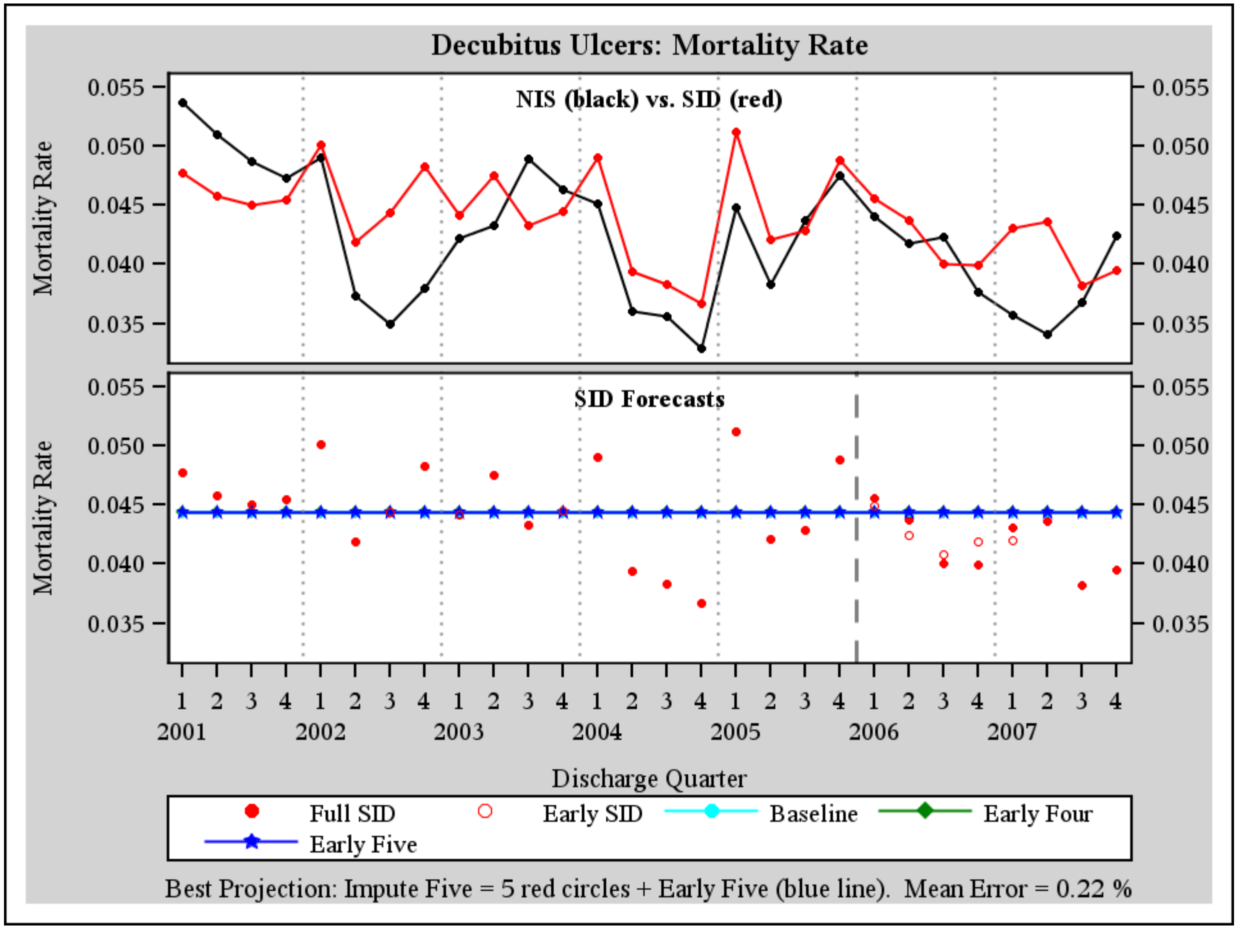

Breast Cancer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.0275
0.0250
0.0225
0.0200
0.0175
0.0150
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.09 %


CABG: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.026
0.024
0.022
0.020
0.018
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.09 %

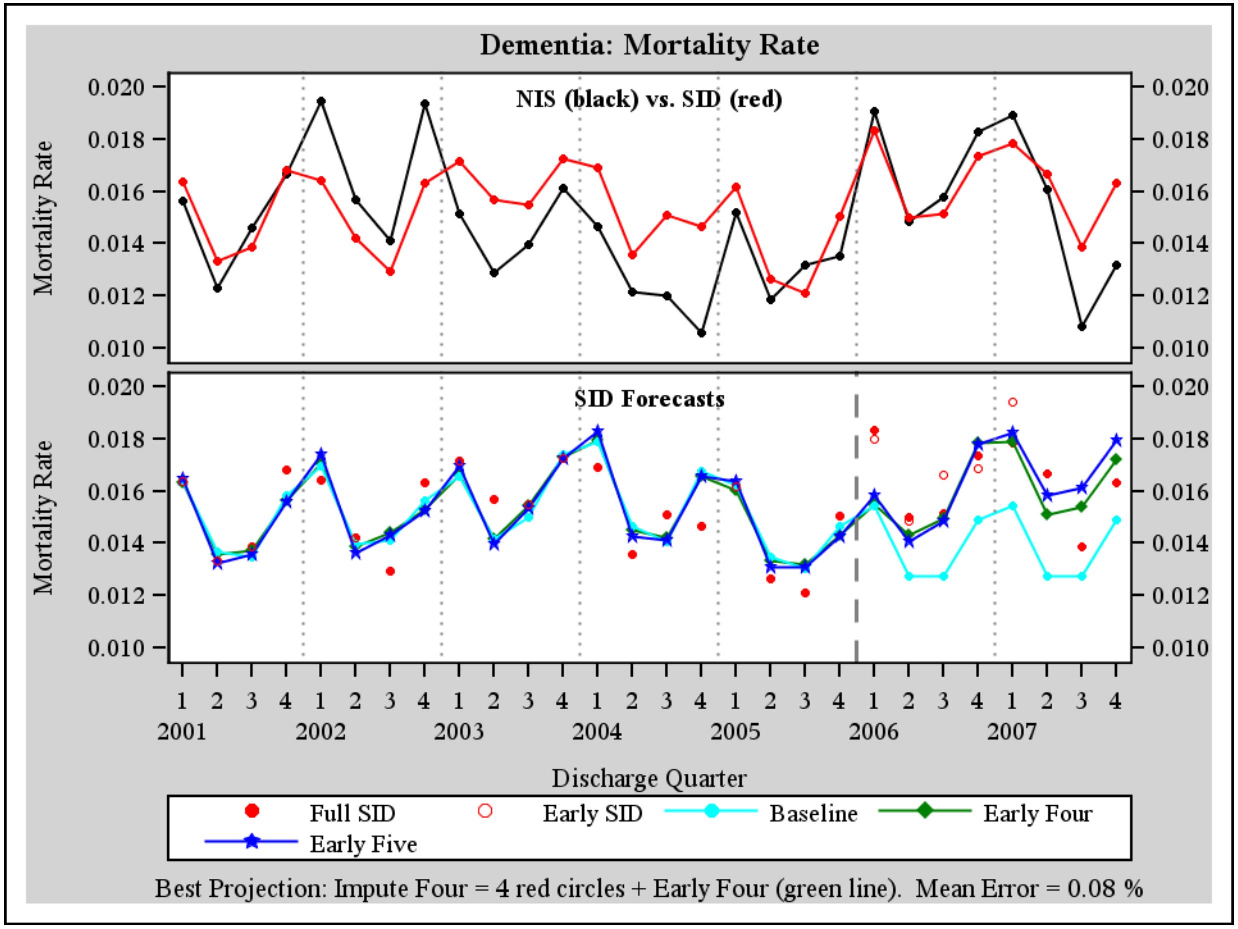

C-Section: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.00025
0.00020
0.00015
0.00010
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.00 %

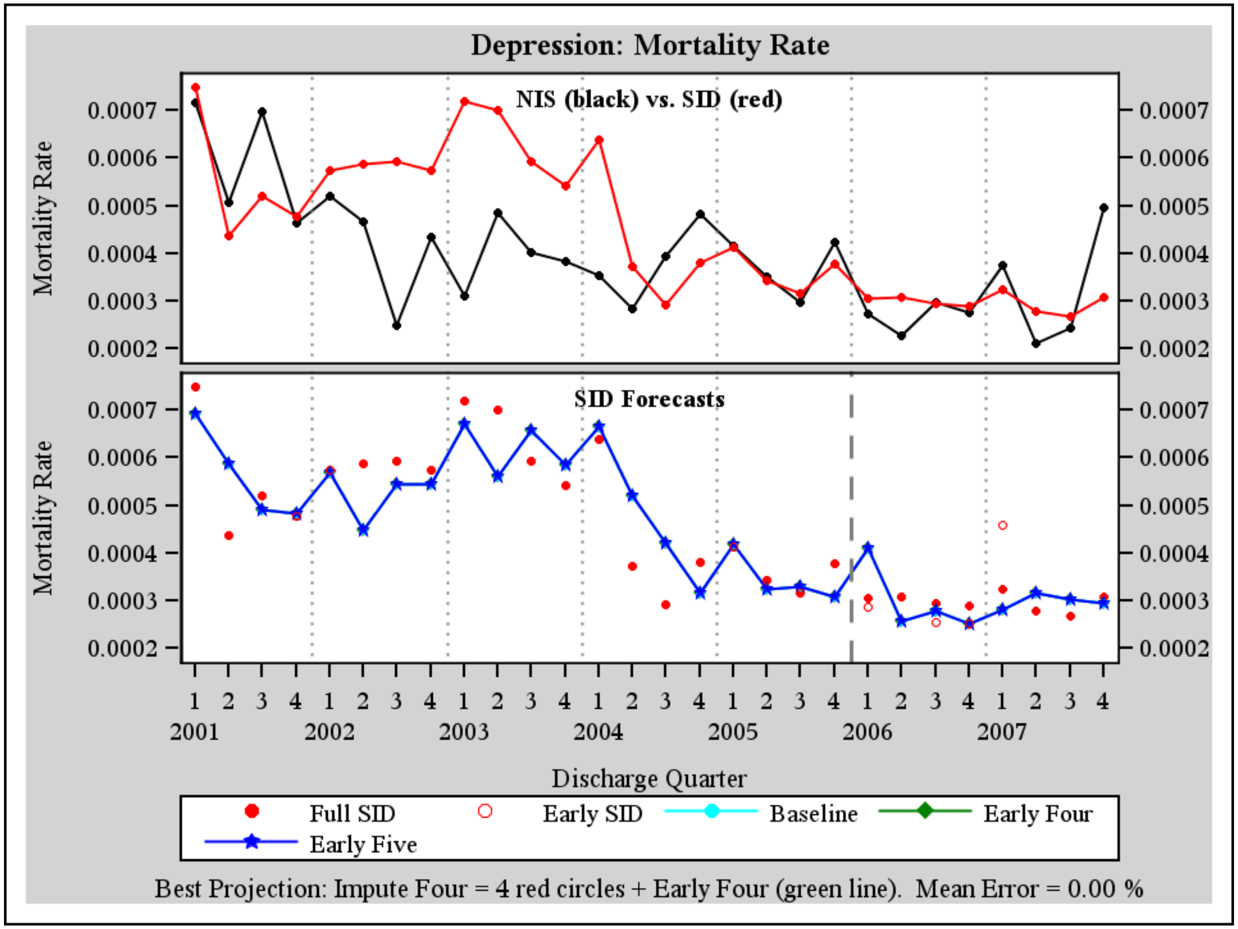

Colon Cancer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.060
0.055
0.050
0.045
0.040
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.11 %


Cellulitis: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.007
0.006
0.005
0.004
0.003
0.002
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.03 %

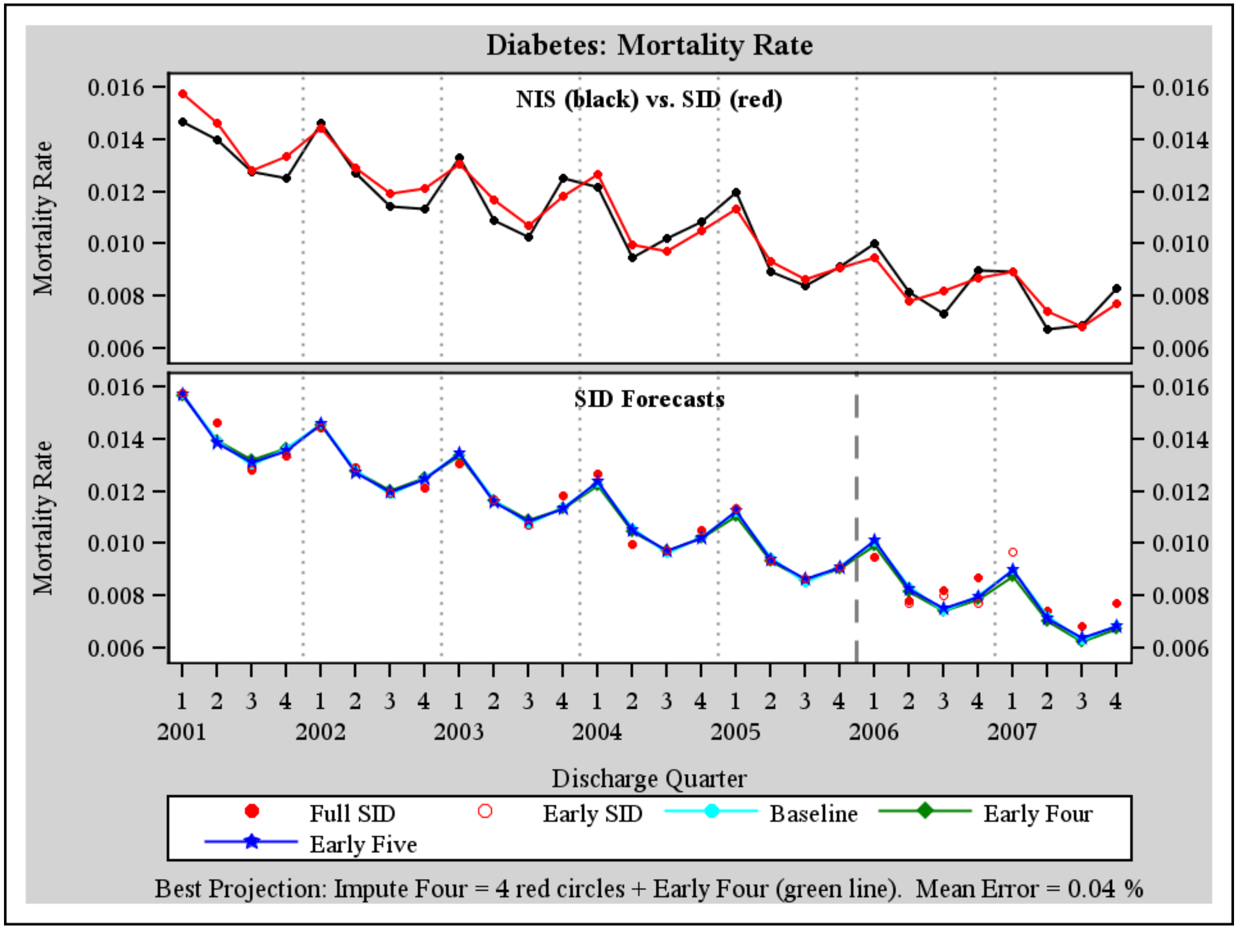


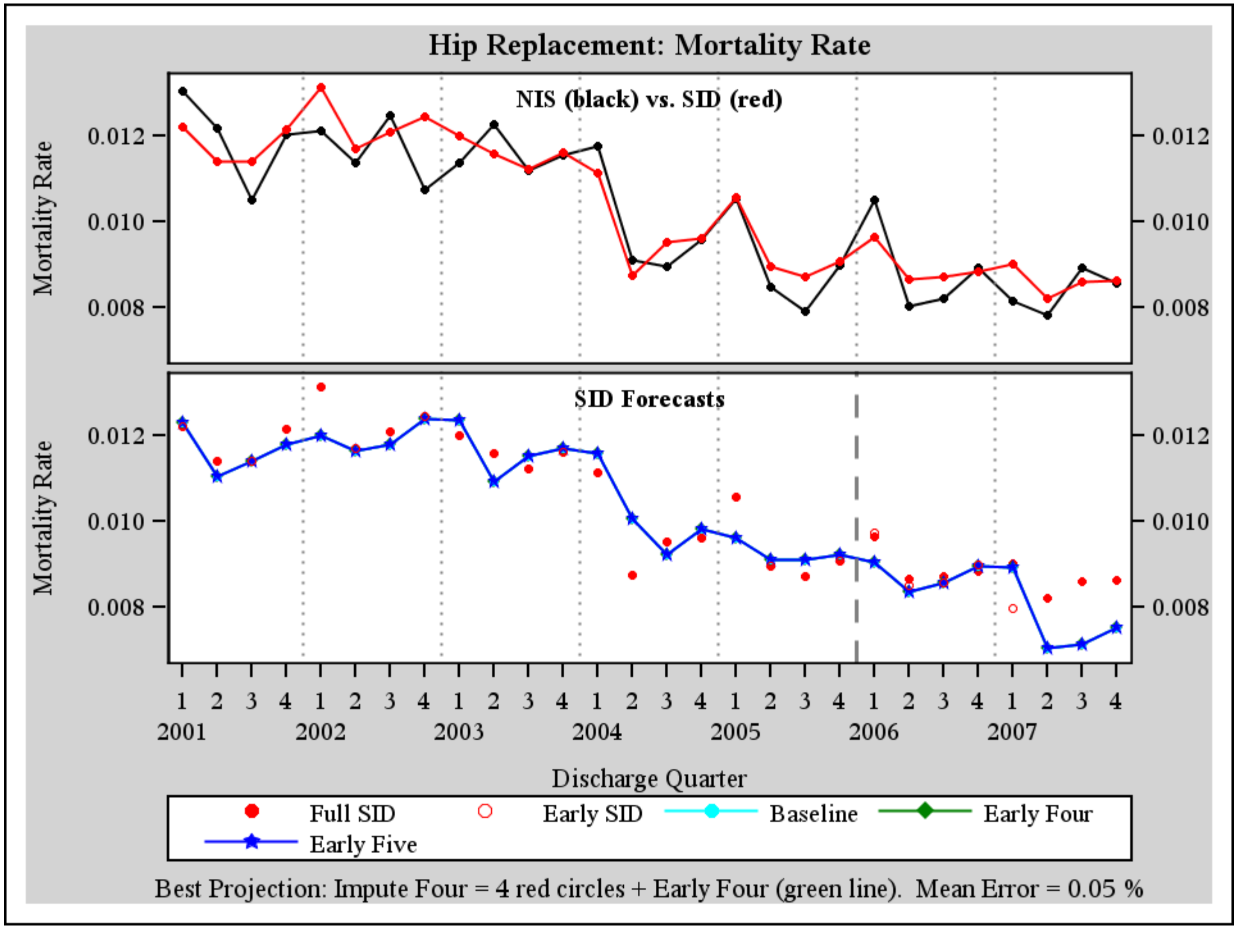
Decubitus Ulcers: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.055
0.050
0.045
0.040
0.035
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.22 %


Dementia: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.020
0.018
0.016
0.014
0.012
0.010
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.08 %

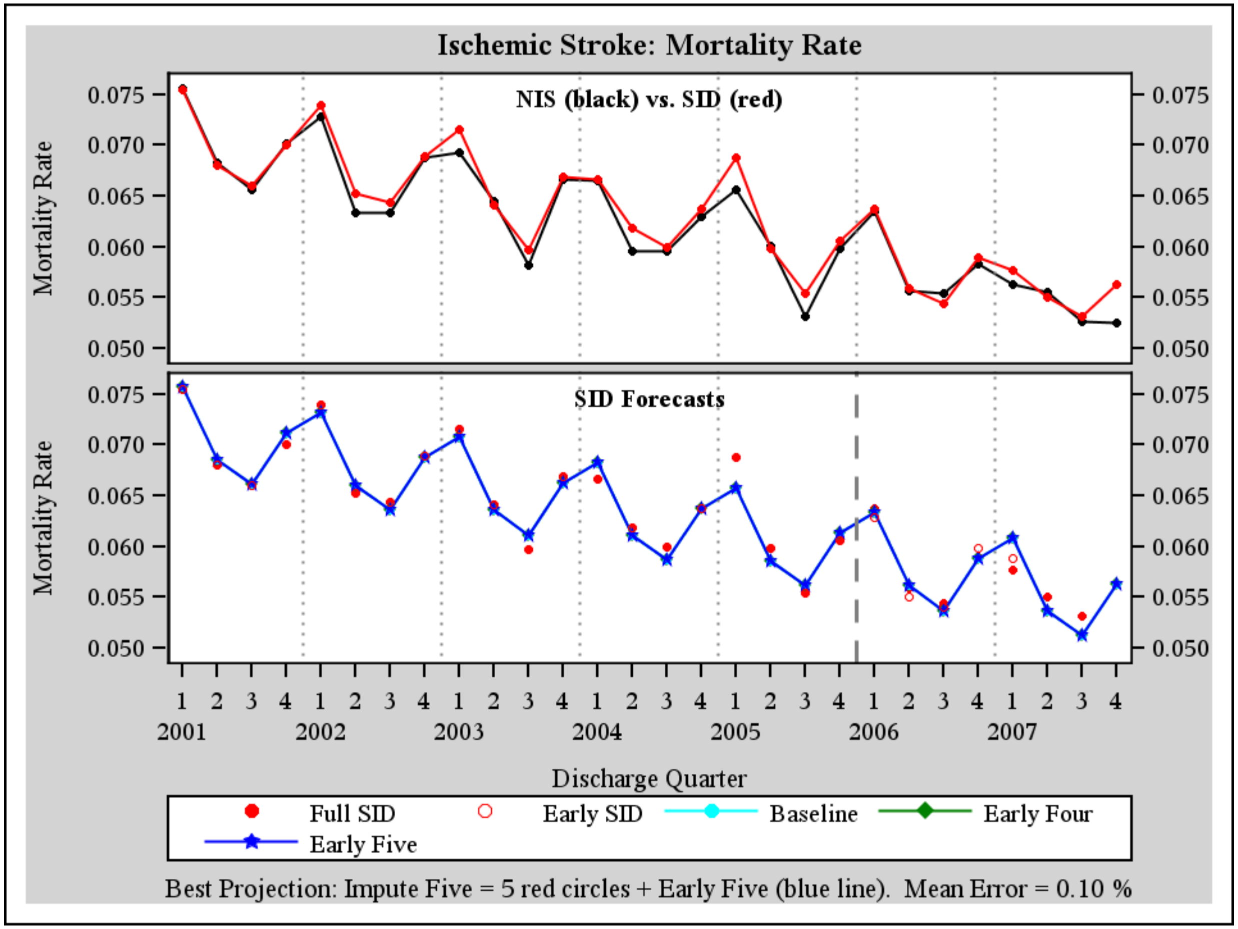


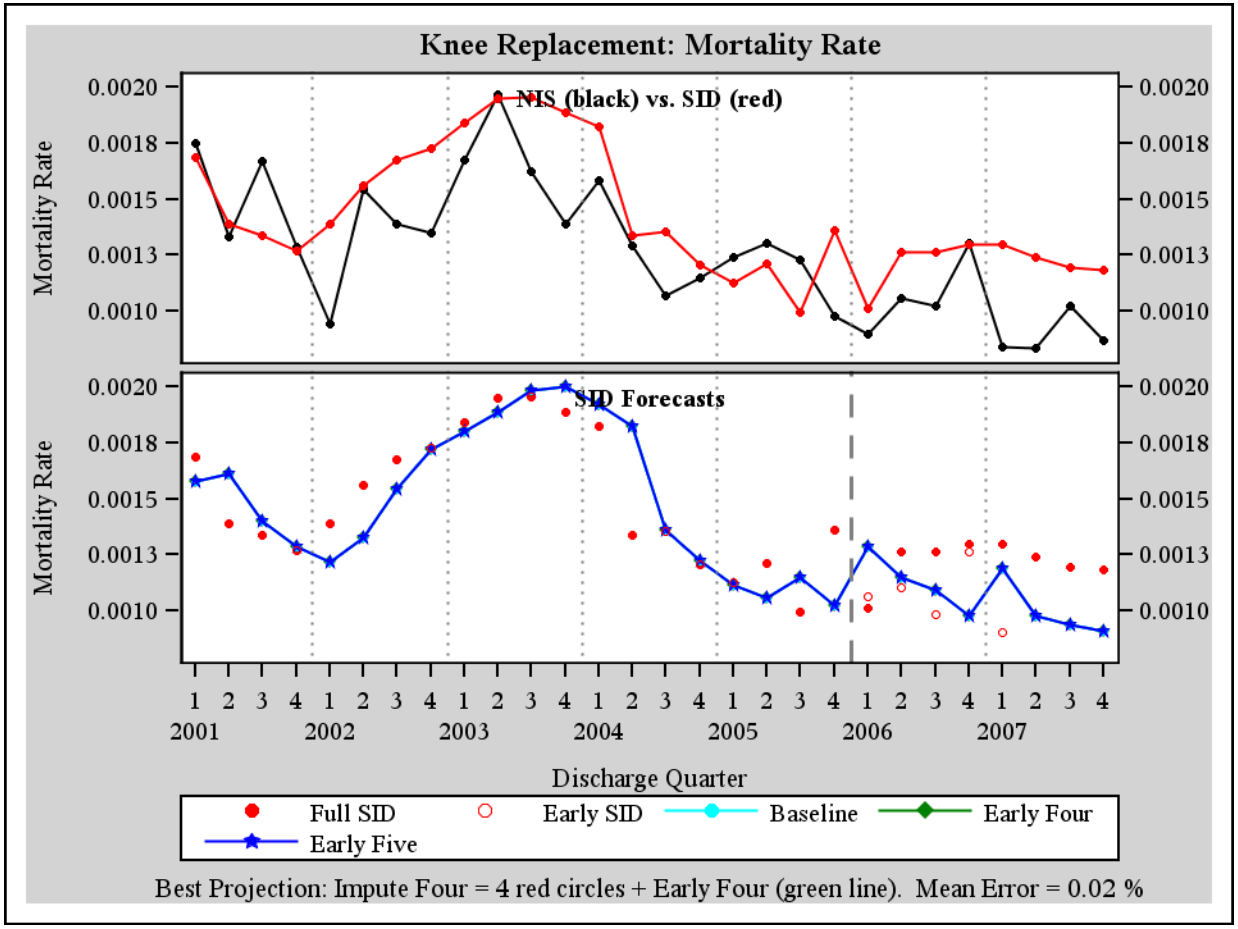
Depression: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.00 %

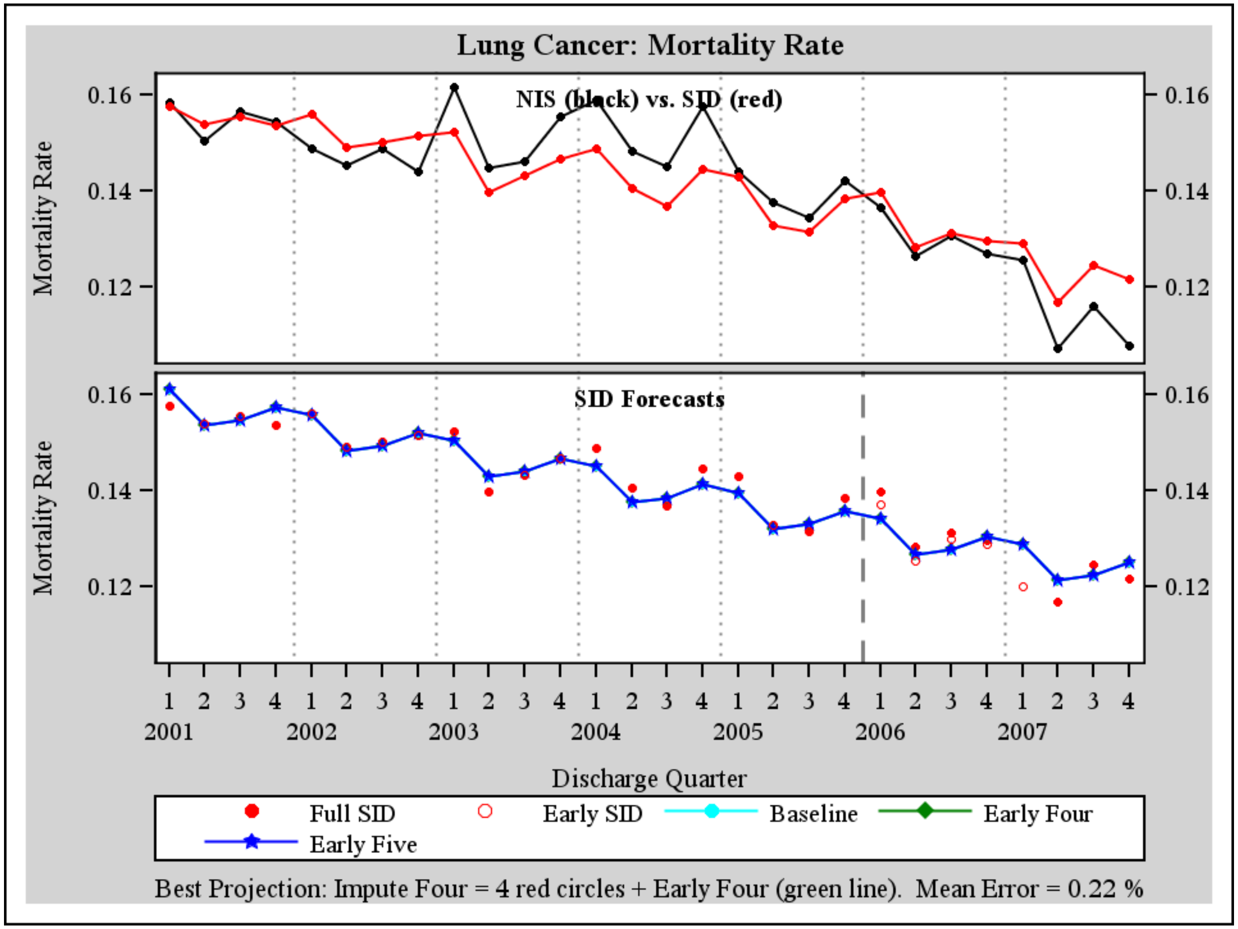

Diabetes: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.016
0.014
0.012
0.010
0.008
0.006
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.04 %



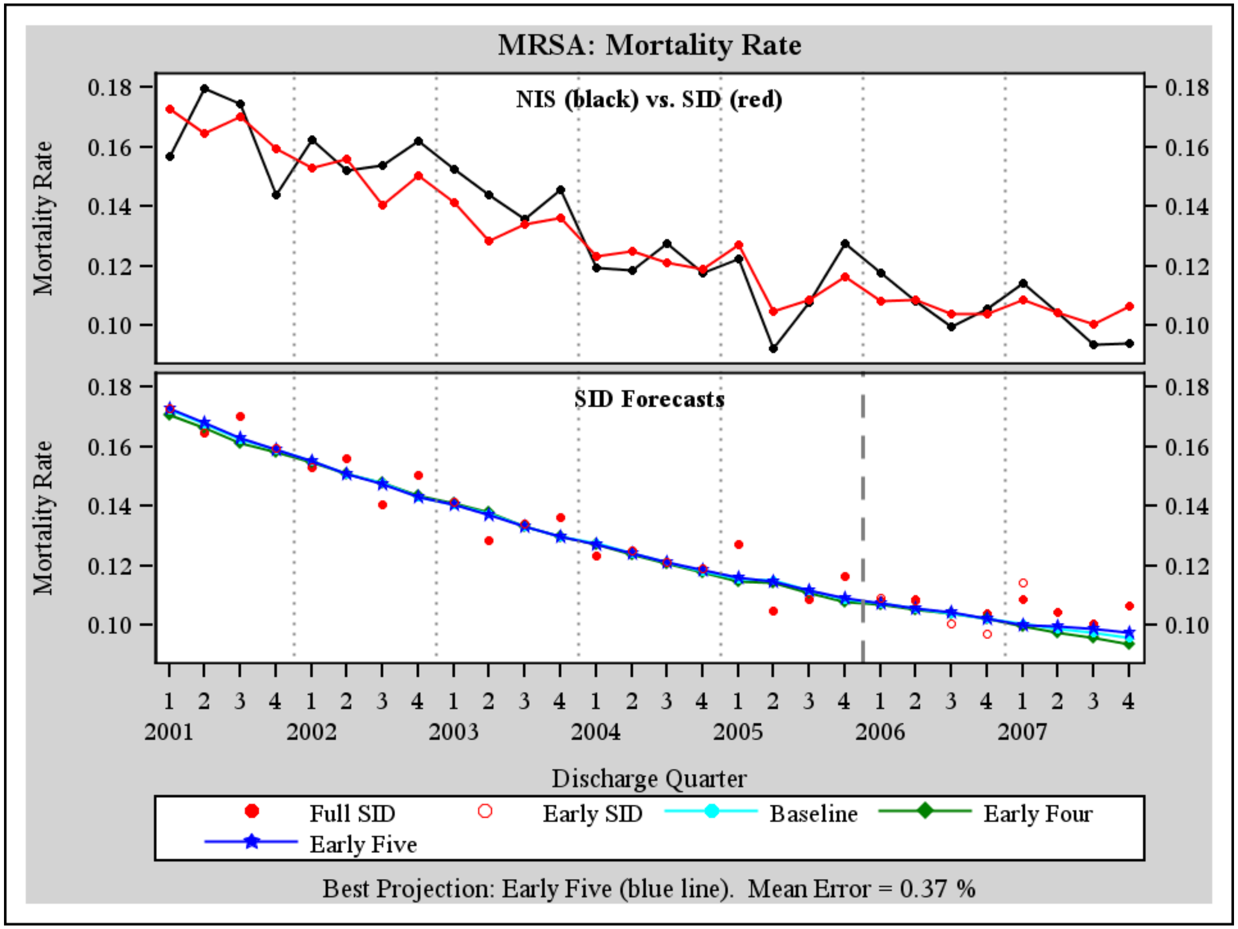
Hip Replacement: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.012
0.010
0.008
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.05 %


Ischemic Stroke: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.075
0.070
0.065
0.060
0.055
0.050
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.10 %

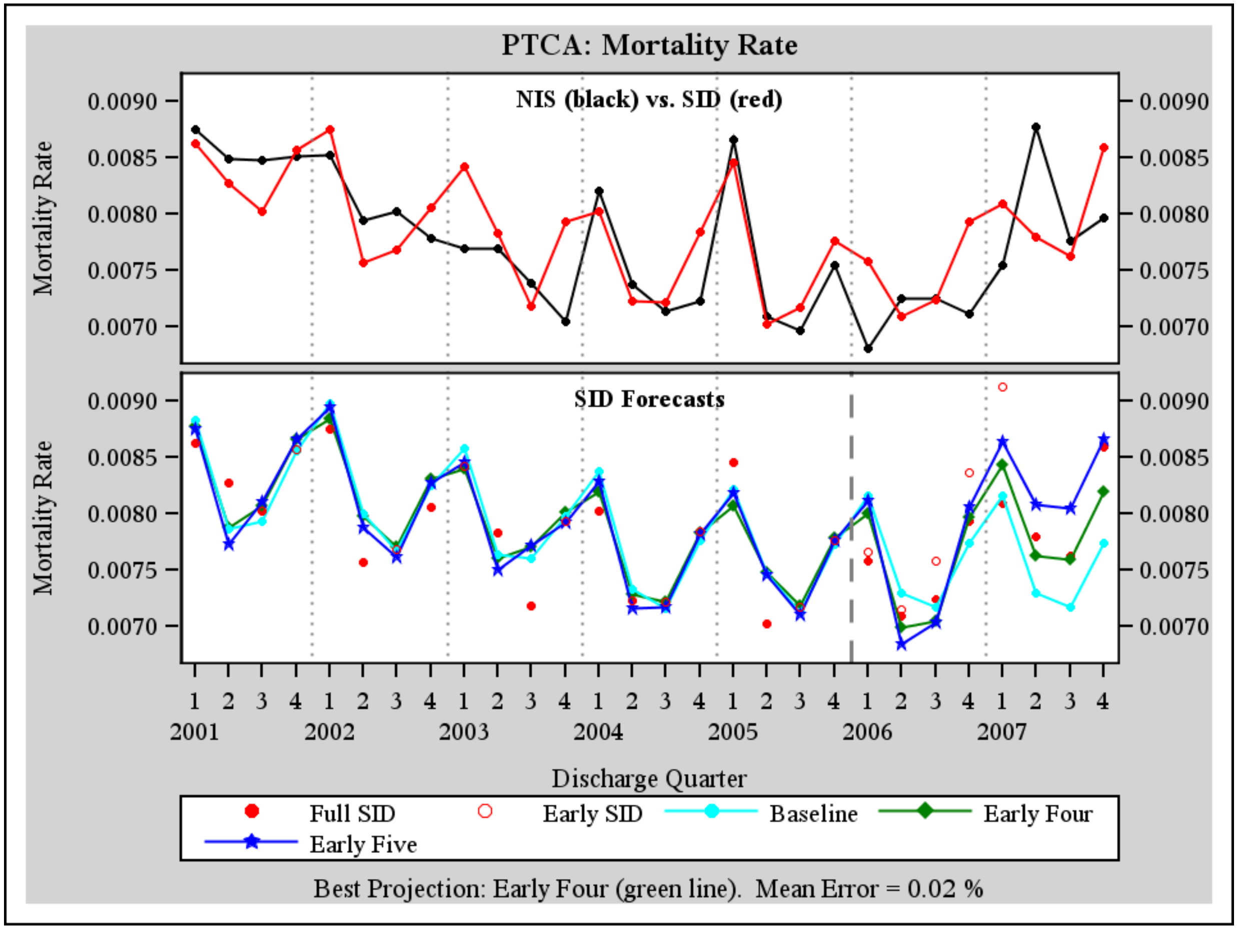

Knee Replacement: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.0020
0.0018
0.0015
0.0013
0.0010
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.02 %

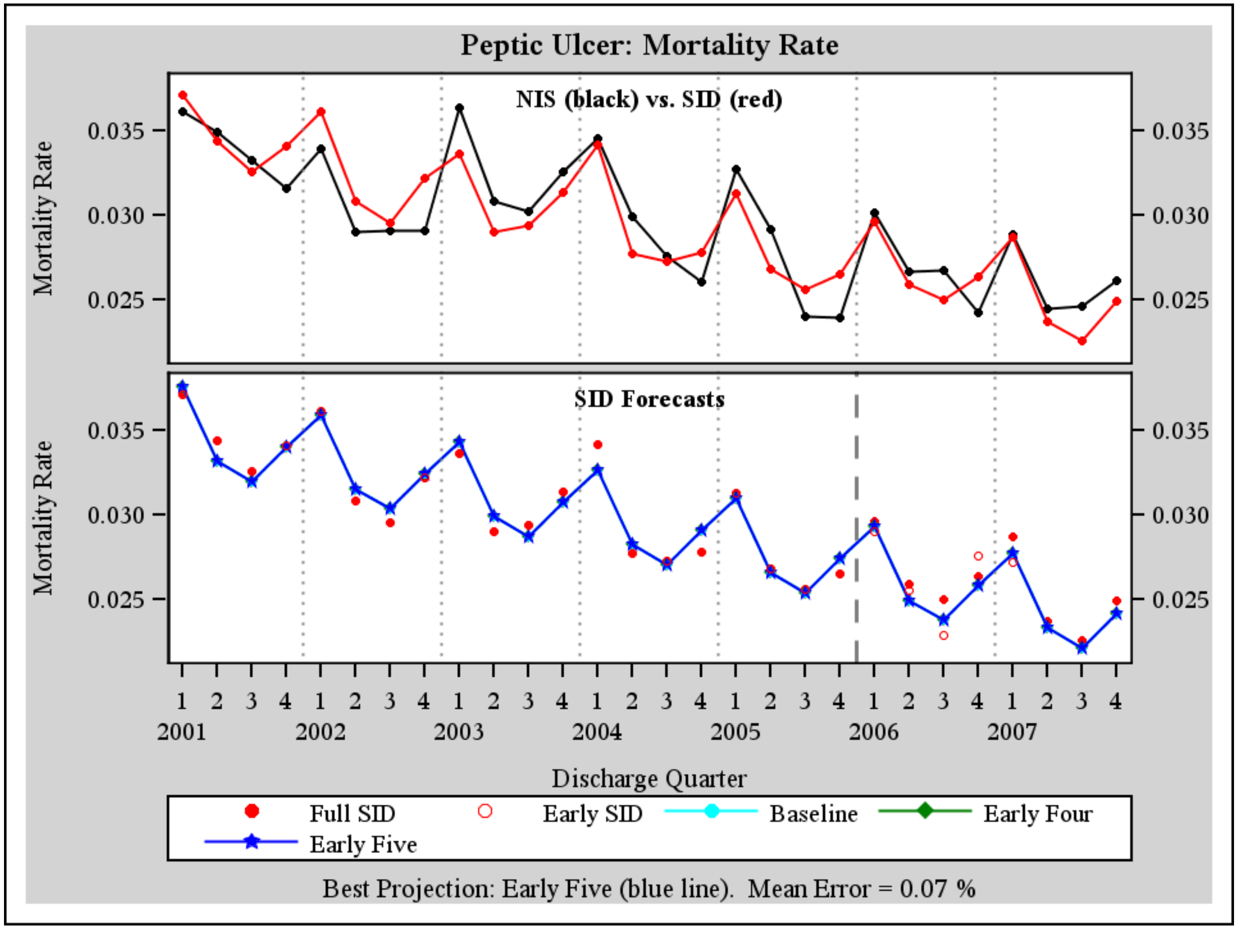


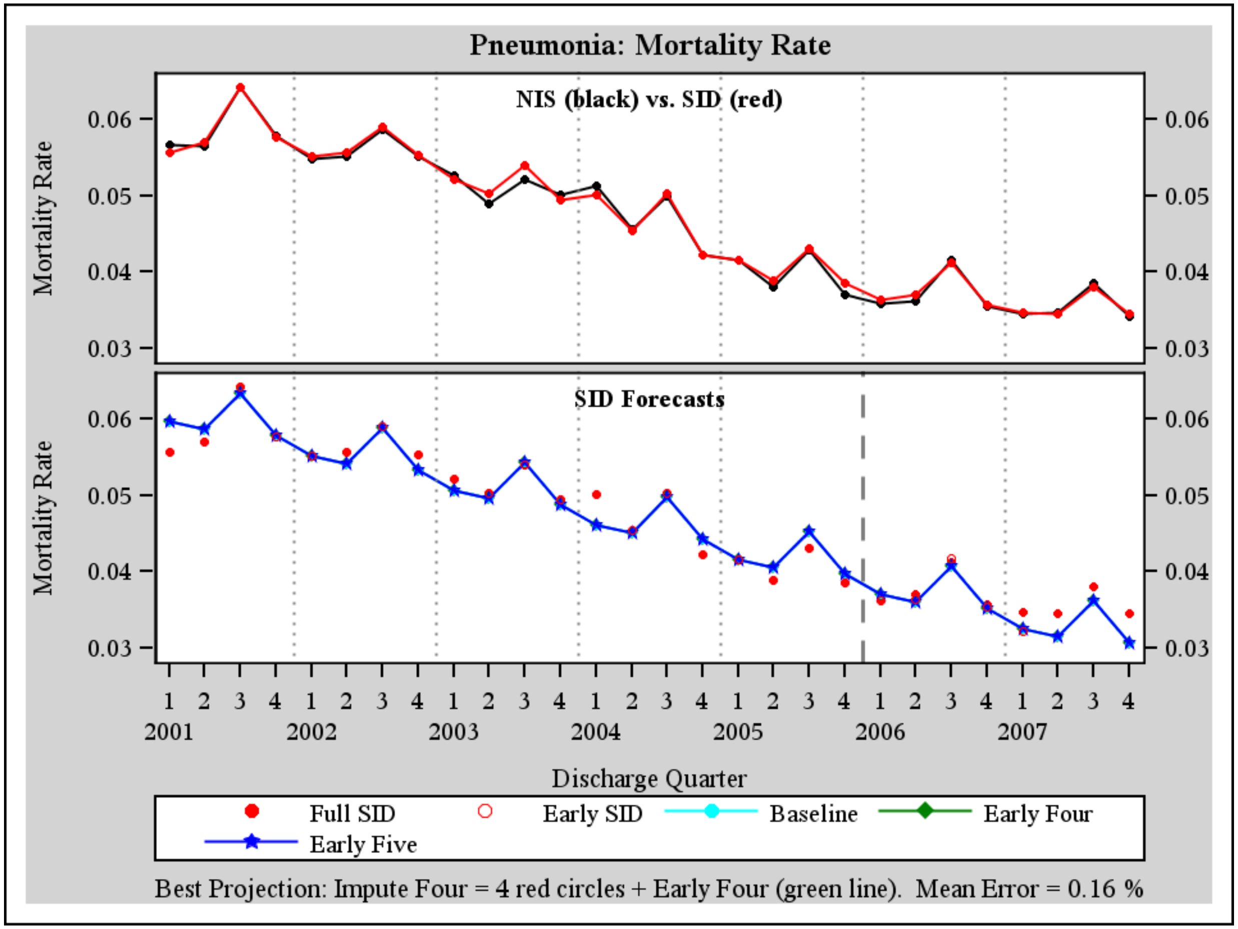
Lung Cancer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.16
0.14
0.12
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.22 %

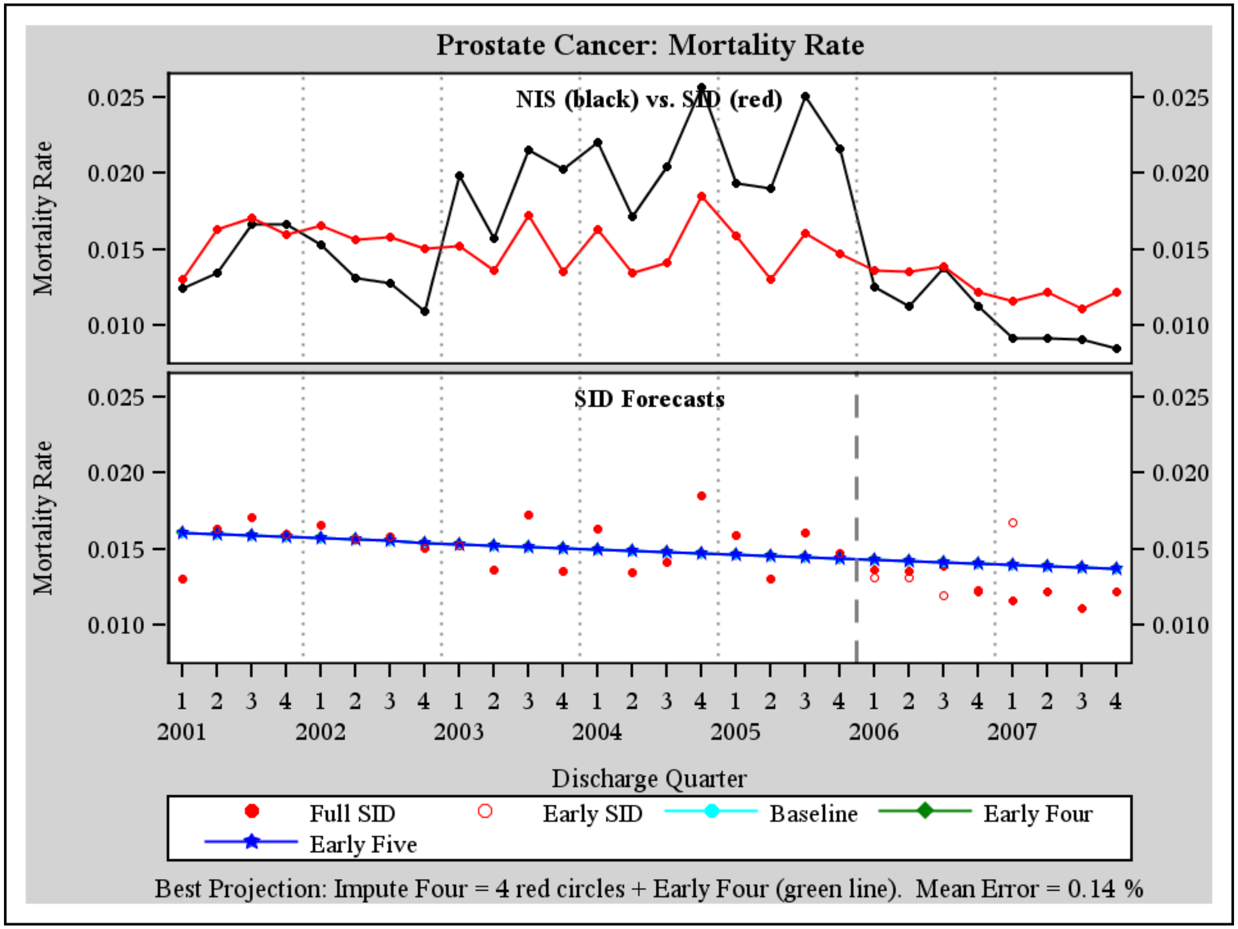


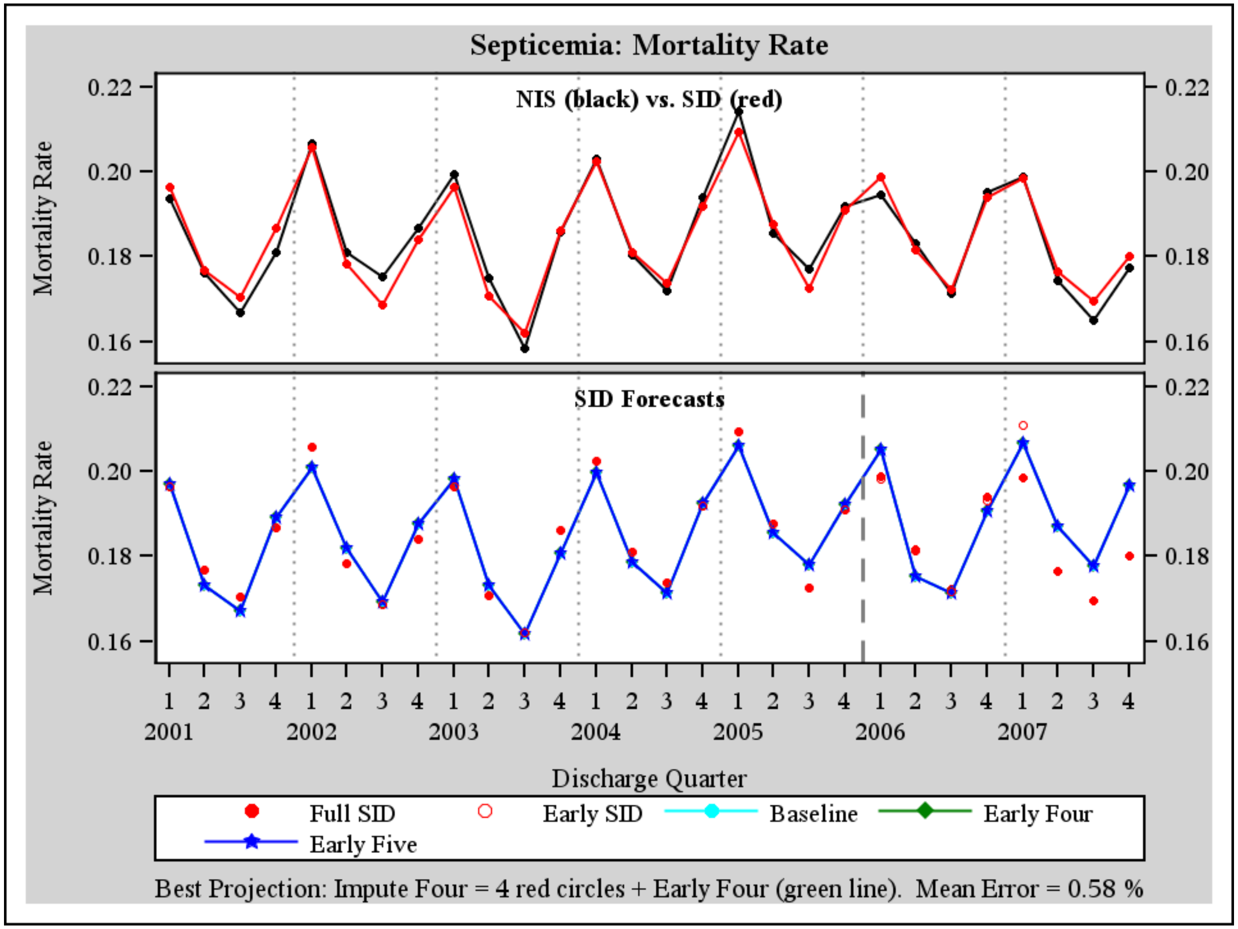
MRSA: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.18
0.16
0.14
0.12
0.10
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 0.37 %

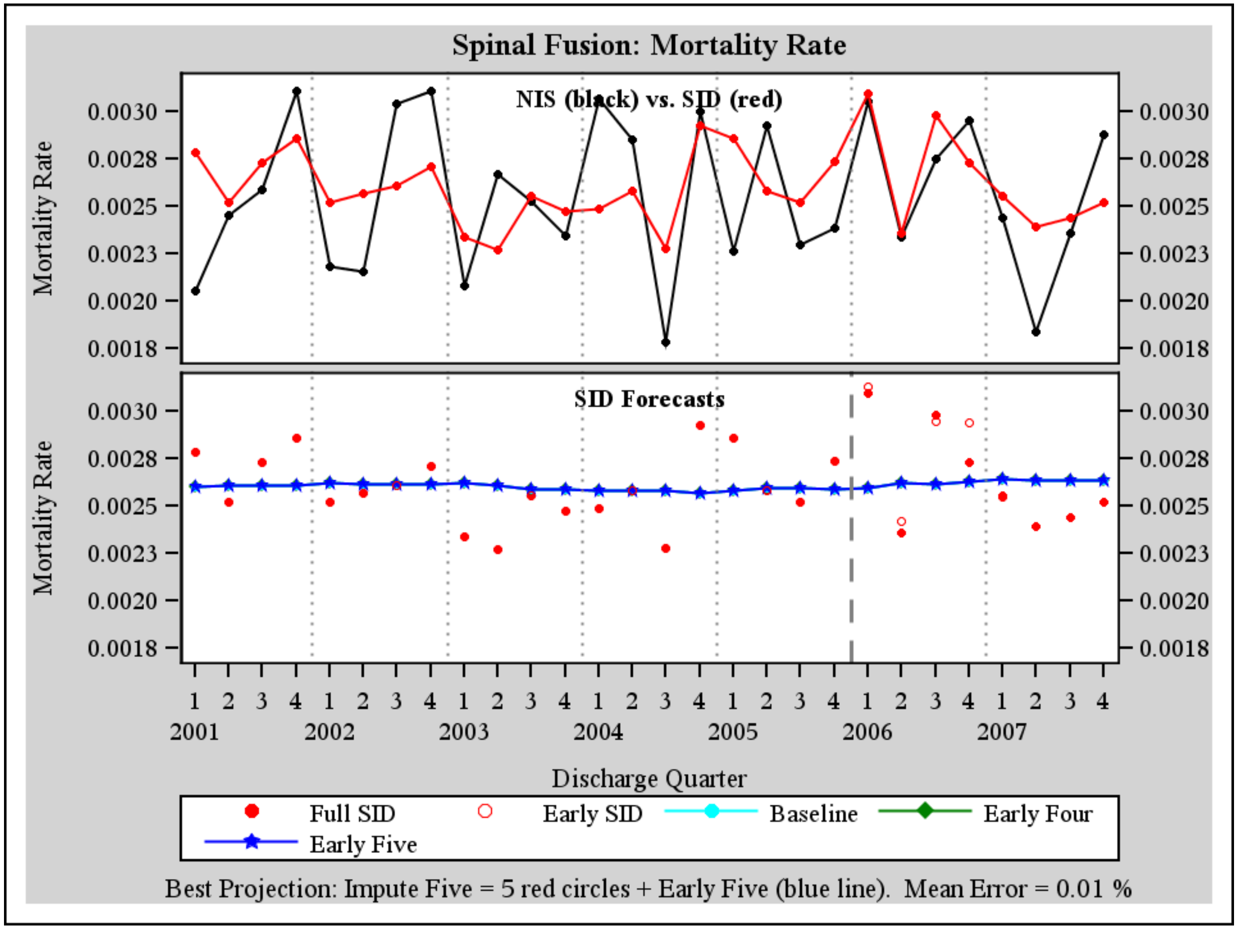

PTCA: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.0090
0.0085
0.0080
0.0075
0.0070
1 2 3 4
2001
2002
2003
2004
2005
2006
2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.02 %

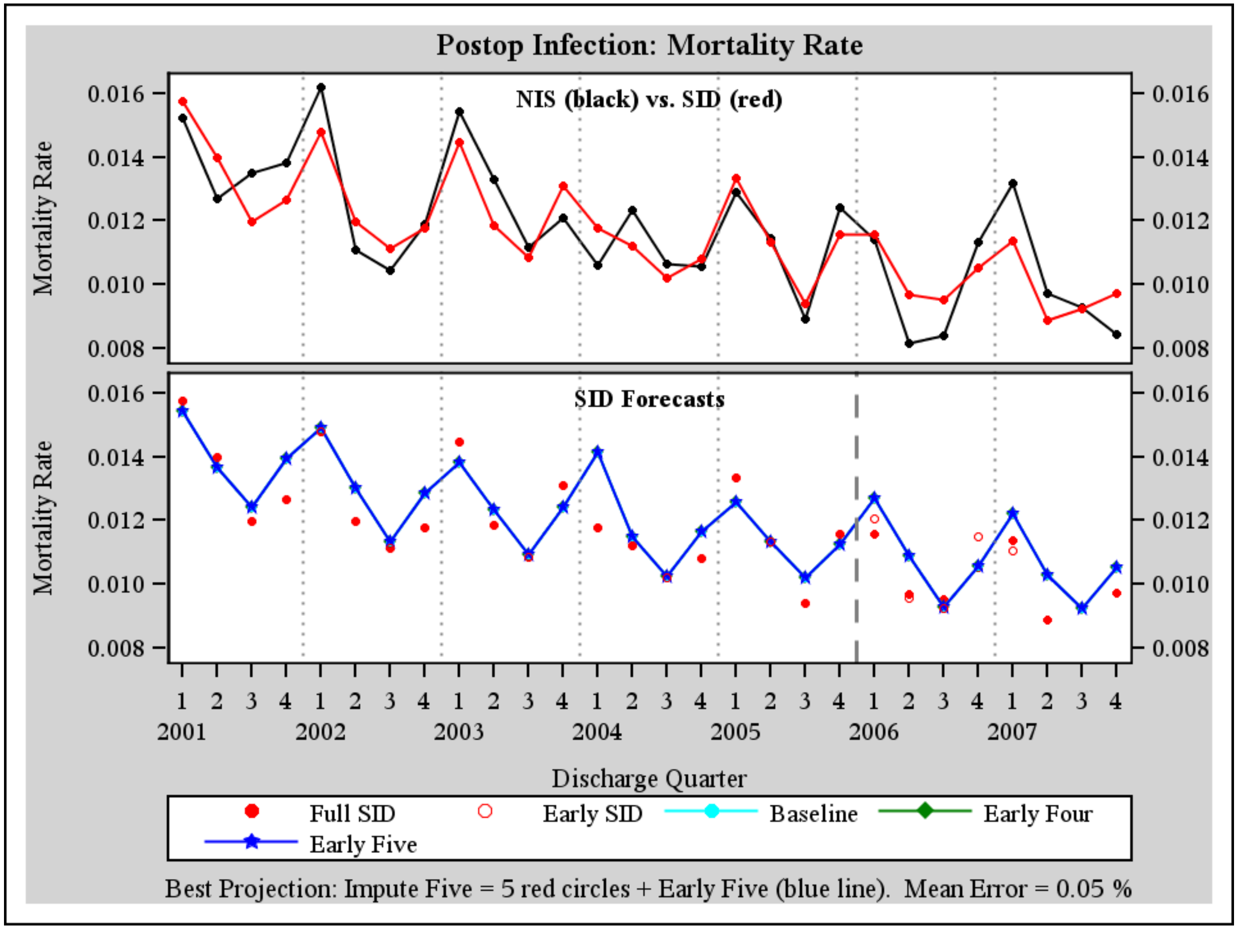

Peptic Ulcer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.035
0.030
0.025
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Five (blue line). Mean Error = 0.07 %


Pneumonia: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.06
0.05
0.04
0.03
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.16 %

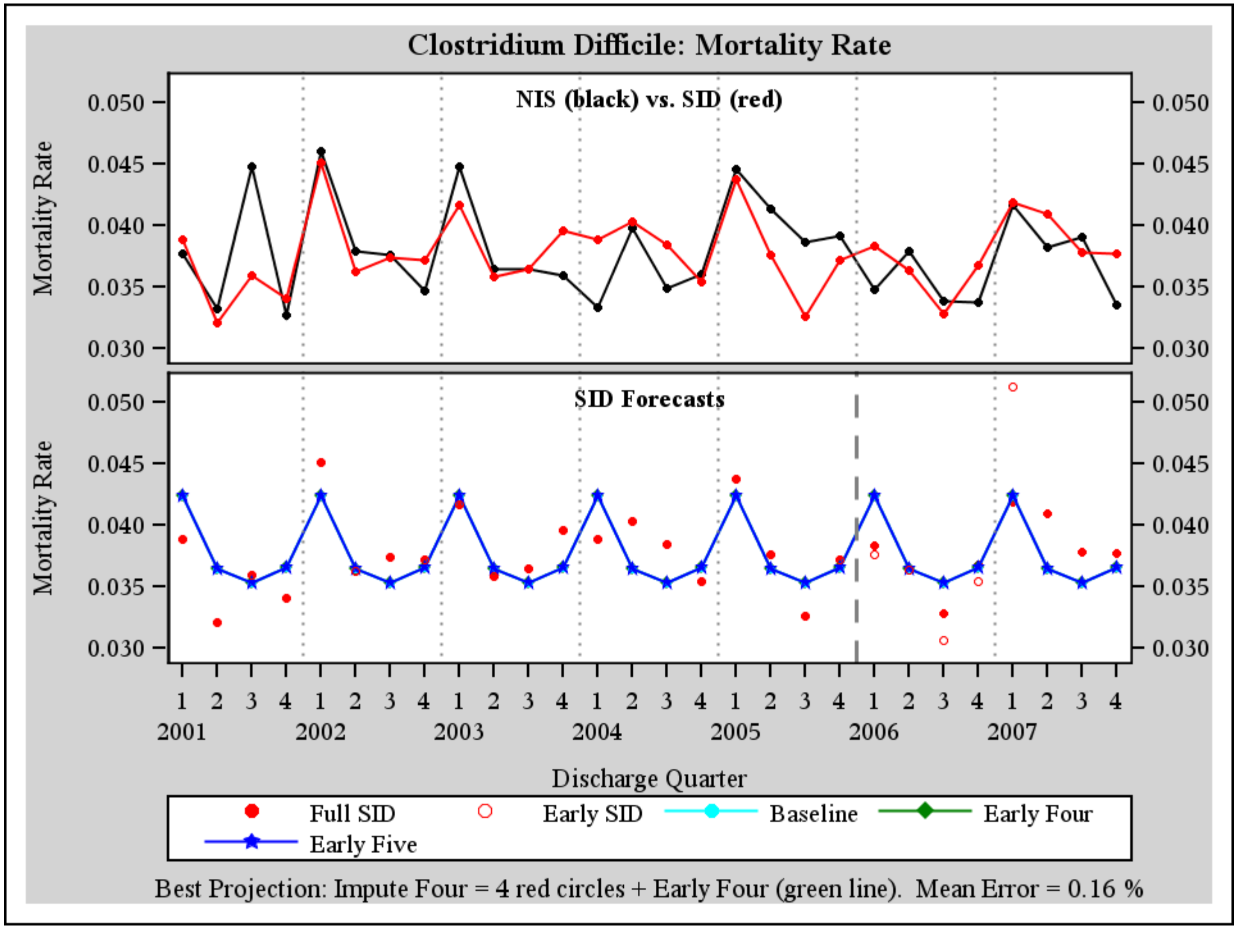

Prostate Cancer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.025
0.020
0.015
0.010
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.14 %

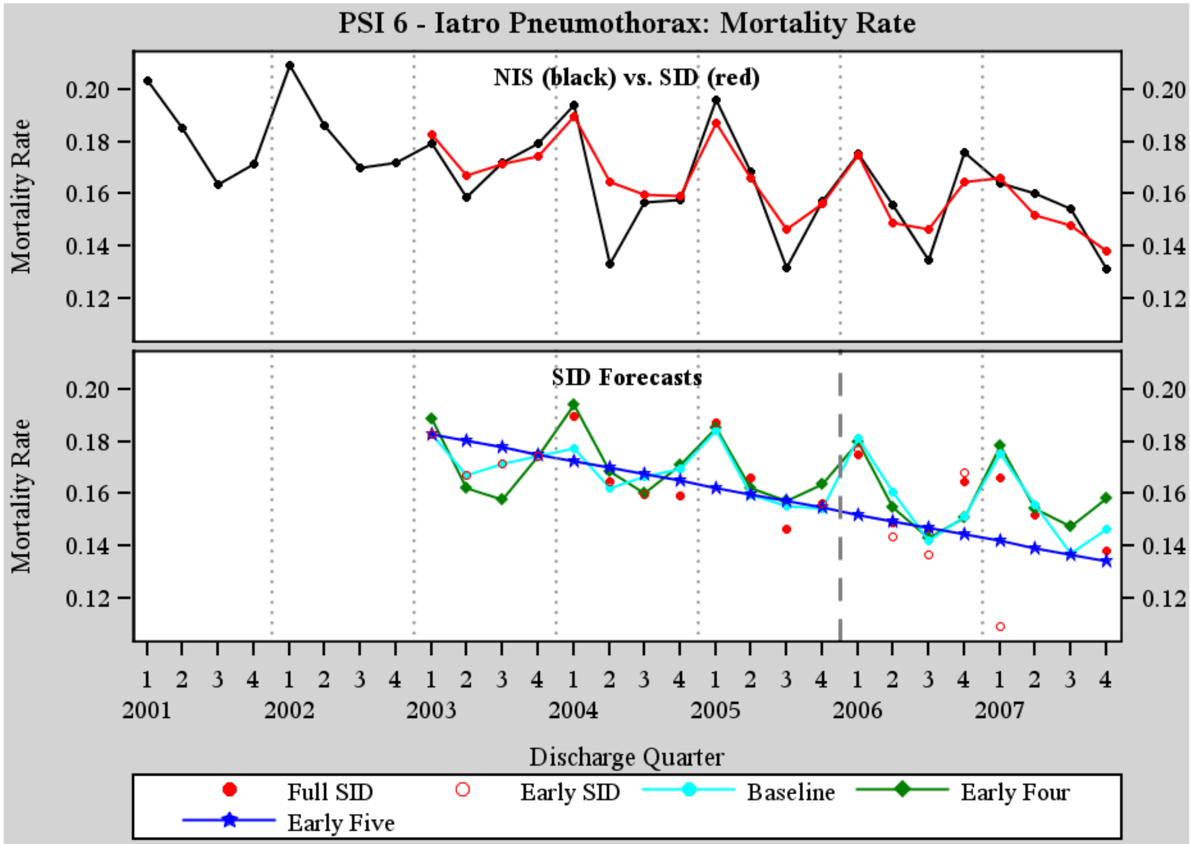

Septicemia: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.22
0.20
0.18
0.16
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.58 %


Spinal Fusion: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.0030
0.0028
0.0025
0.0023
0.0020
0.0018
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.01 %

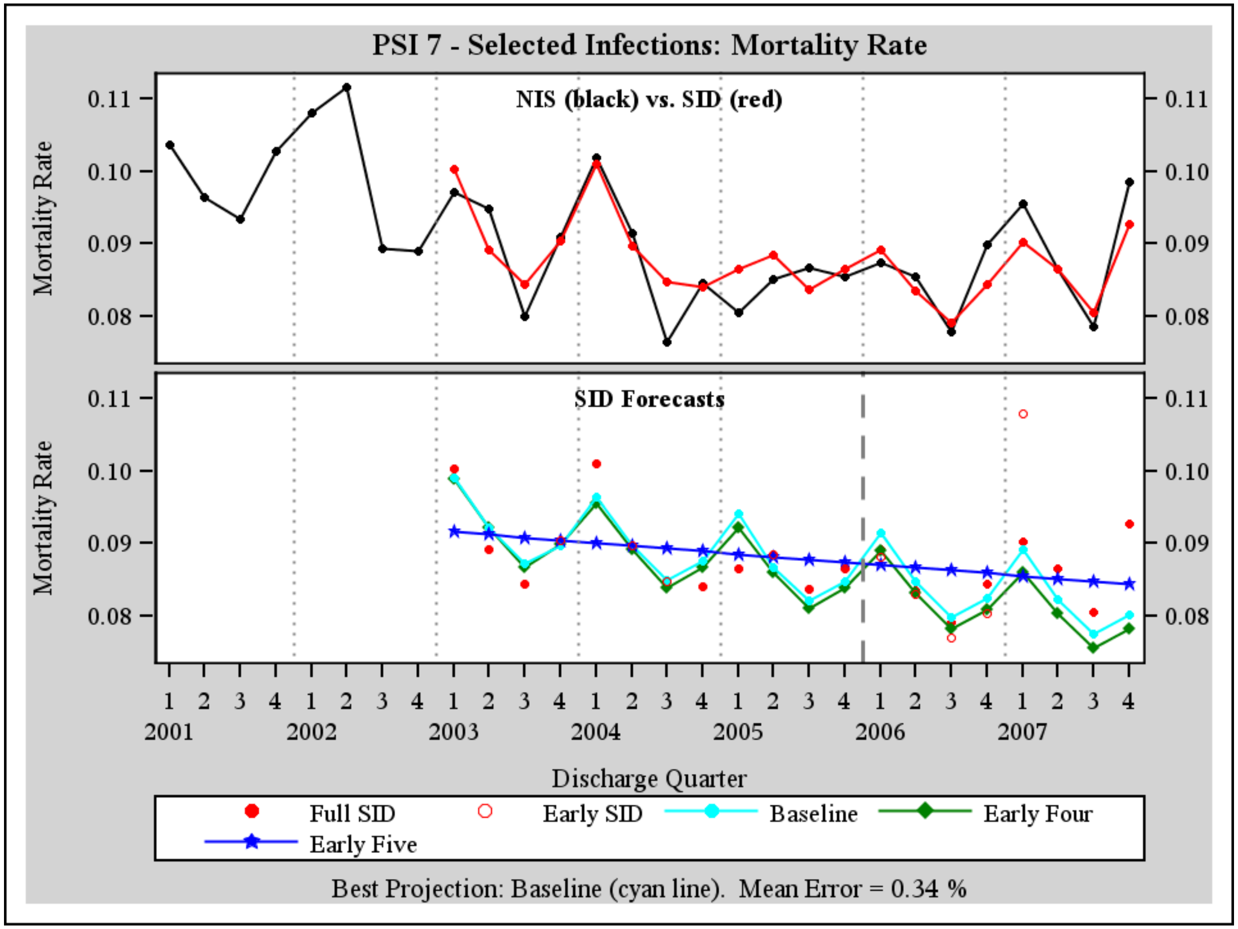


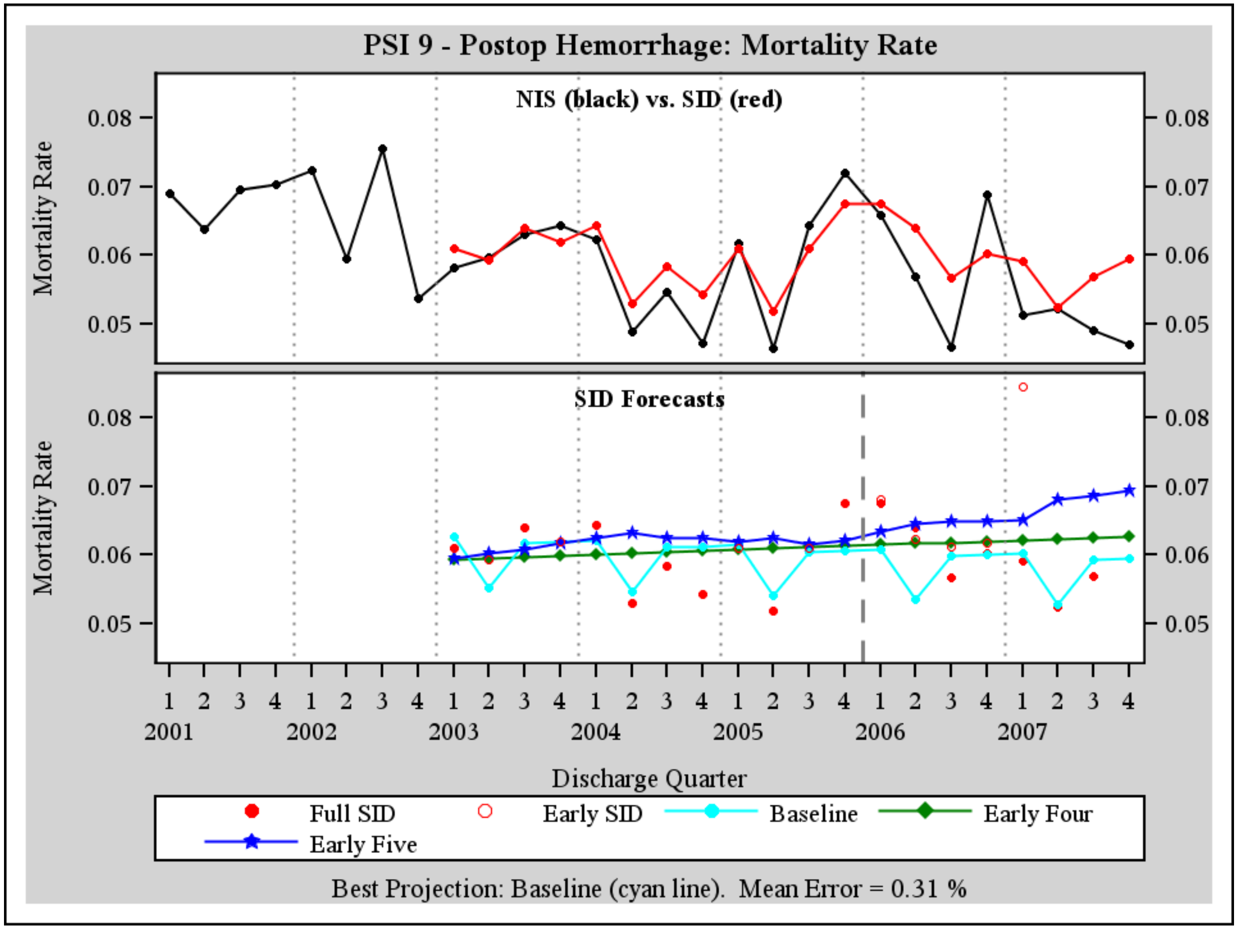
Postop Infection: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.016
0.014
0.012
0.010
0.008
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 0.05 %


Clostridium Difficile: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.050
0.045
0.040
0.035
0.030
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.16 %

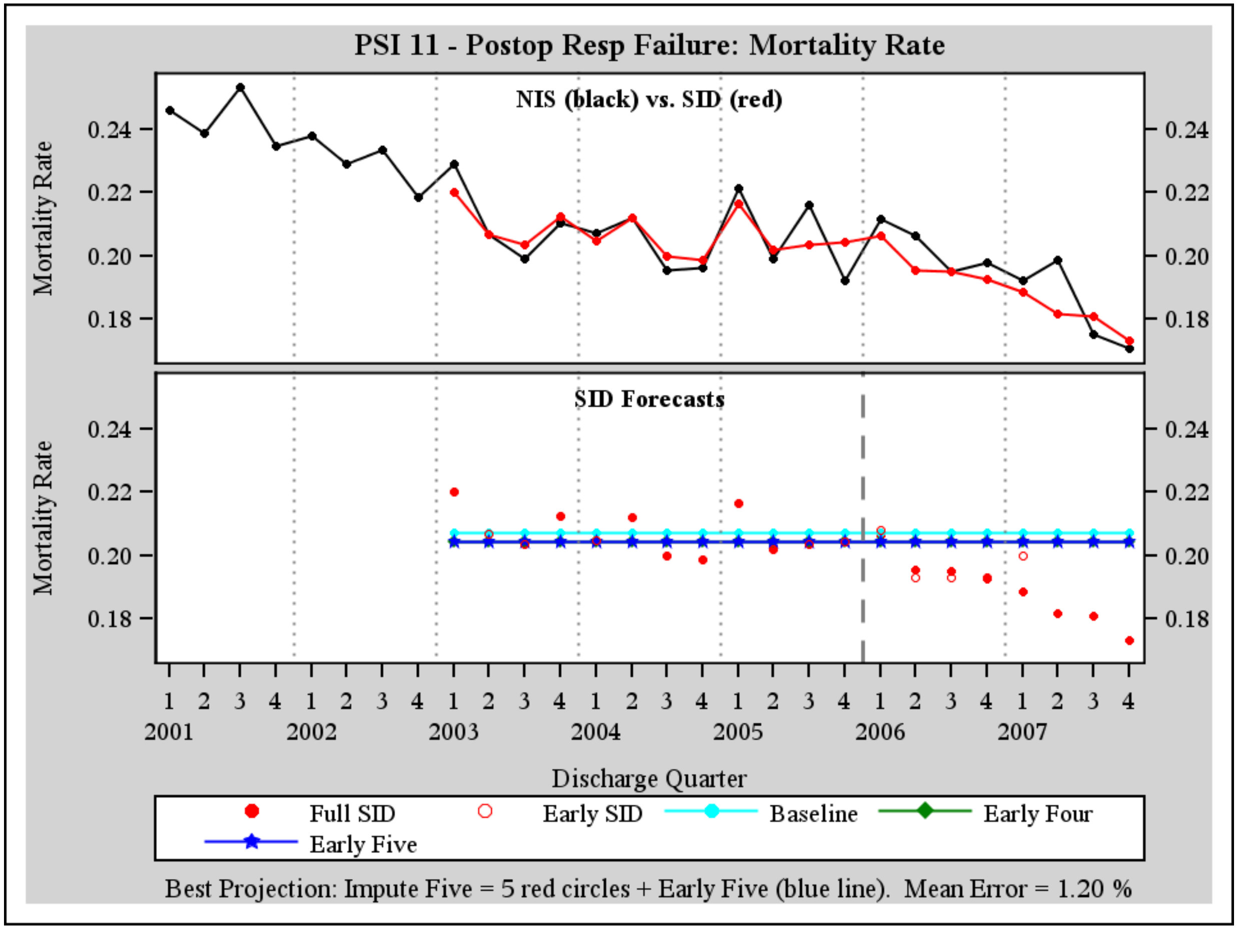


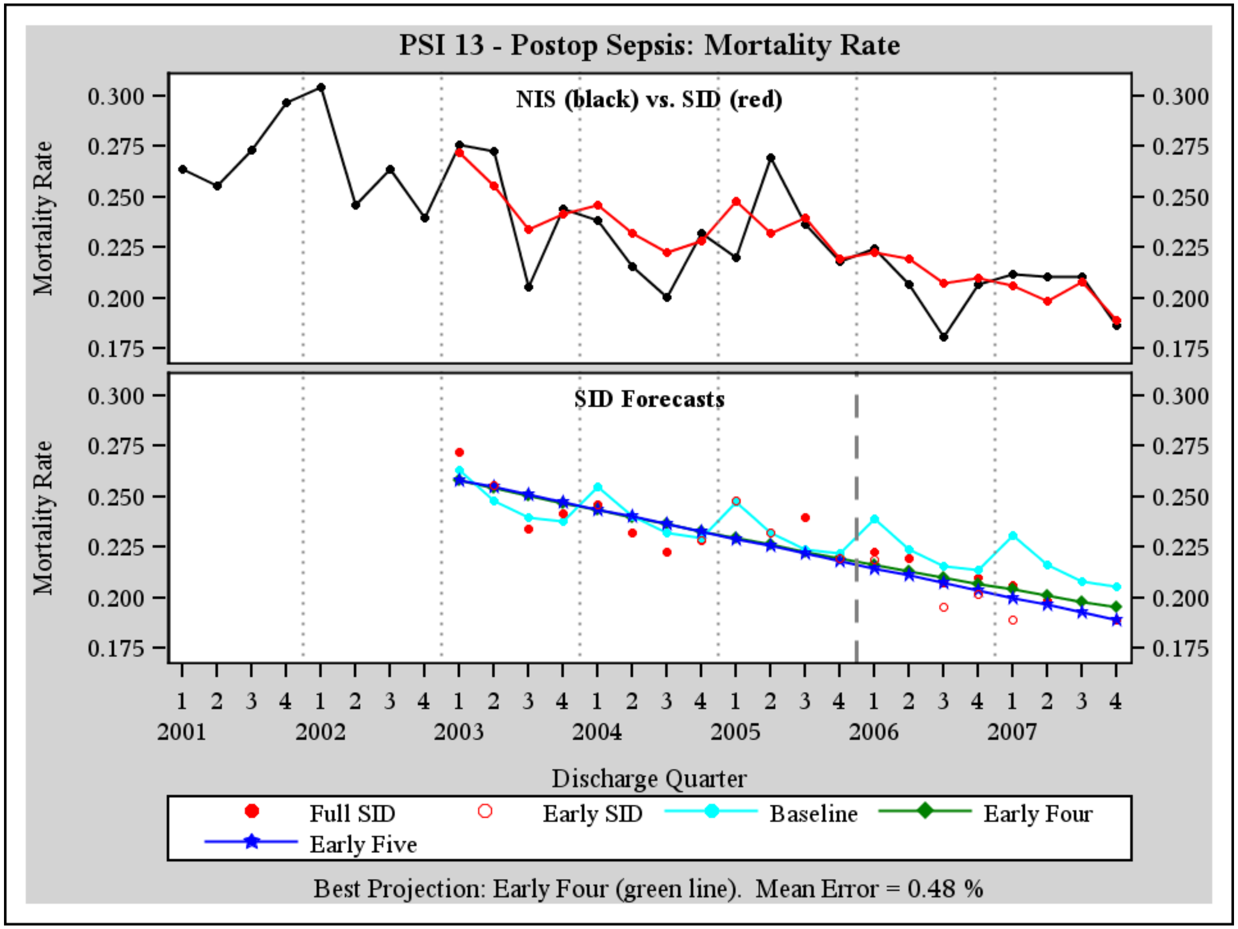
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.69 %

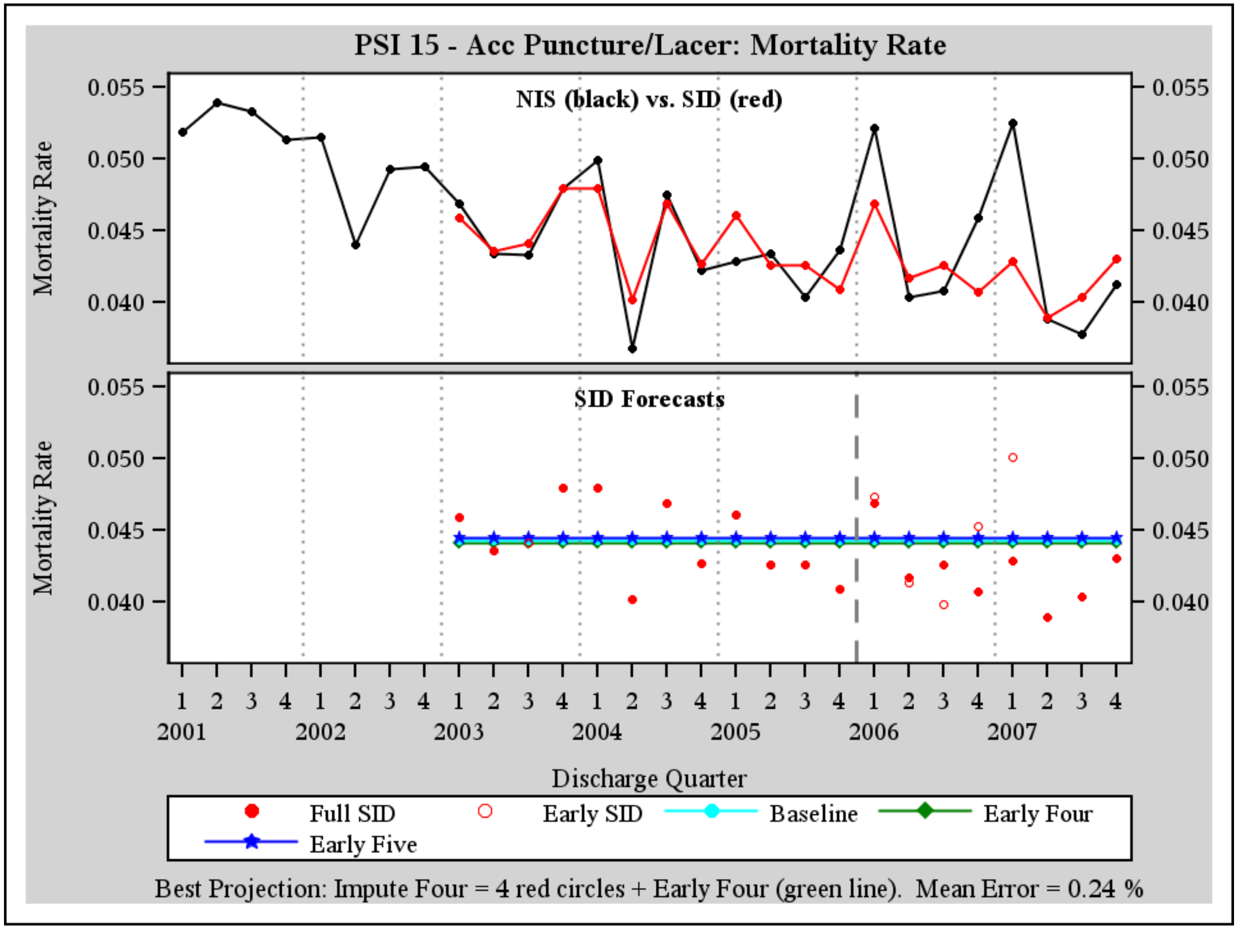

PSI 7 - Selected Infections: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.11
0.10
0.09
0.08
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.34 %



PSI 9 - Postop Hemorrhage: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.08
0.07
0.06
0.05
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Baseline (cyan line). Mean Error = 0.31 %


PSI 11 - Postop Resp Failure: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.24
0.22
0.20
0.18
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Five = 5 red circles + Early Five (blue line). Mean Error = 1.20 %


PSI 13 - Postop Sepsis: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.300
0.275
0.250
0.225
0.200
0.175
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Early Four (green line). Mean Error = 0.48 %



PSI 15 - Acc Puncture/Lacer: Mortality Rate
NIS (black) vs. SID (red)
SID Forecasts
Mortality Rate
0.055
0.050
0.045
0.040
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
2001 2002 2003 2004 2005 2006 2007
Discharge Quarter
Full SID
Early SID
Baseline
Early Four
Early Five
Best Projection: Impute Four = 4 red circles + Early Four (green line). Mean Error = 0.24 %