

## Pay Less but Get More, Analyze Medicare Claims Data using SAS® Episode Analytics

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### ABSTRACT

The healthcare system in the United States has adopted new healthcare reimbursement models rapidly after Patient Protection and Affordable Care Act (ACA) has been signed. The most popular new models are Episode-based payment models (also known as bundled payment models). The Episode-based payment models have been tested and approved which can improve care, lower costs, and better align payment systems to support patient-centered practices. But what kind of tools or solutions to help to perform the models? How to analyze Medicare claims data to solve real-world health care questions? SAS® Episode Analytics (SEA) is such a solution, it is an enterprise-level, episode-bundling solution for payers and providers and enables health care organizations to construct and analyze episodes derived from electronic health records or insurance claims data to solve health care questions. This paper explains the concepts of episode and episode relevant topics, how SEA encourages coordination of patient care and quality improvement by holding multiple providers jointly accountable for the outcome and the total cost of care for a given episode of care.

### INTRODUCTION

Traditionally, Medicare makes separate payments to providers for each of the individual services they furnish to beneficiaries for a single illness or course of treatment. This is called fee-for-services (FFS) model. In health care, it gives an incentive for physicians to provide more treatments because payment is dependent on the quantity of care, rather than quality of care. In contrast, the fee-for-value (F4V) model offers a bundled episode-of-care approach that enables care coordination amongst several entities (hospital, physicians, laboratory, and so on) all working together to achieve common goals: cost reduction, higher quality care, and a better experience for the patient. (See Figure 1) Under these models, the patient becomes the center of care and providers are held accountable for the care provided. There are many researches by health care organizations in United States have approved the benefits of bundled payment models. For example, Horizon Blue Cross reported that its episodes program reduced the hospital readmission rate after hip replacement by 37% and the rate of C-sections among pregnant women by 32%. (American Journal of Managed Care blog, February 18, 2016.)

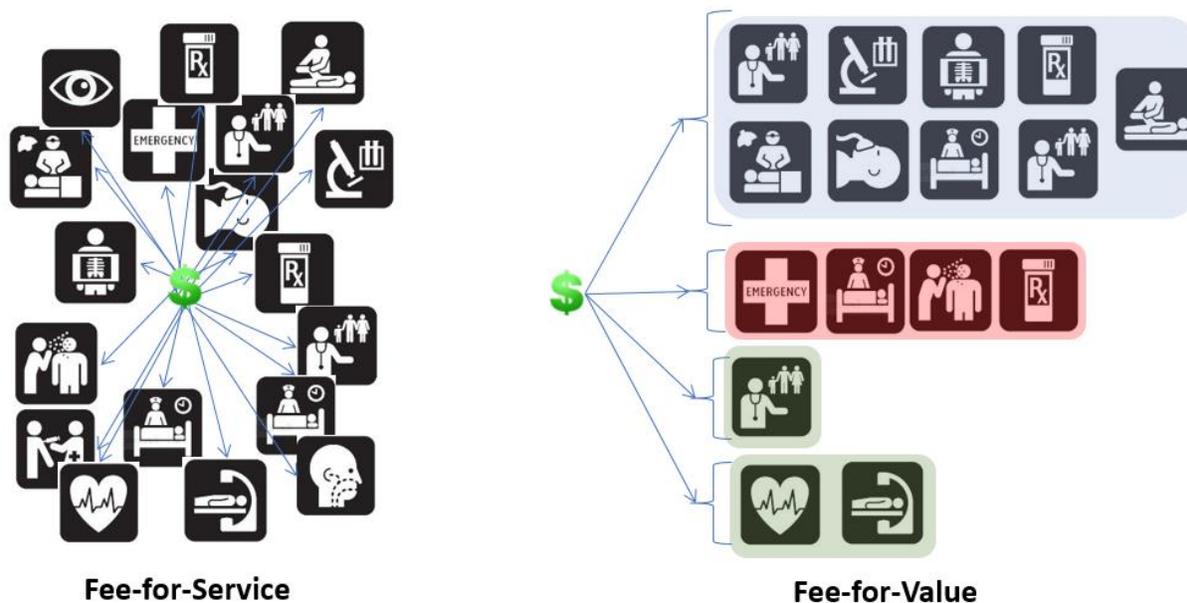


Figure 1: Traditional Payment Model vs Episode-based Payment Model

Centers for Medicare & Medicaid Services (CMS) is one of the proponents and early adopters of the bundled payment models. They have tested different episode-of-care based bundles that represent a mix of chronic, acute, surgical, and medical conditions, with the goals to curtail cost, optimize provider efficiency, and achieve better patient

health outcomes. Other health care organizations in USA also defined episode-based payment models which are not referenced in this paper.

For meeting the business requirements on performing episode-based payments models, SAS Episode Analytics was generated. SEA is modeled on Centers for Medicare and Medicaid Services bundle definitions. In addition, the solution supports custom bundle development. Base on the episodes established by certain rules, deeper analysis are applied in SEA to solve real word healthcare problems.

## BACKGROUD ON EPISODE-BASED PAYMENT INITIATIVES

### WHAT IS AN EPISODE?

An Episode of Care definition includes all covered services across all providers that would typically treat a patient for a single illness or condition (hospital, physicians, laboratory, pharmacy, rehabilitation facility, etc.). Definitions are comprised of diagnosis, procedure and pharmacy code tables, which establish the episode’s triggers and boundaries.

Each episode in CMS episode-based payments models has certain rules to start and end it. For example, in Bundled Payments for Care Improvement initiative(BPCI) Model 2, episode begins with an acute inpatient hospital admission for an included MS-DRG and ends either 30, 60, or 90 days after hospital discharge. All related items and services paid under Medicare Part A and Part B for all Medicare fee-for-services beneficiaries are included in this episode of care.

Currently, there are 5 episode-based payment models are active according to CMS website, they are listed in Table 1. The detailed information for each models, please find in CMS website.

	BPCI Model 2	BPCI Model 3	BPCI Model 4	Oncology Care Model	Comprehensive Care for Joint Replacement Model
Episode	Selected MS-DRGs; hospital plus post-acute period	Selected MS-DRGs; post-acute period only	Selected MS-DRGs; hospital plus readmissions	Selected MS-DRGs; Covers nearly all cancer types	MS-DRG 469 or 470; ends 90 days post-discharge
Services included in the bundle	All Medicare Part A and Part B services during the initial inpatient stay, post-acute period and readmissions	All Medicare Part A and Part B services during the post-acute period and readmissions	All Medicare Part A and Part B services (including the hospital and physician) during initial inpatient stay and readmissions	All Medicare Part A and Part B services; certain Part D expenditures are also included.	All Medicare Part A and Part B services, with the exception of certain exclusion
Payment	Retrospective	Retrospective	Prospective	Performance-based	Prospective
Stage	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

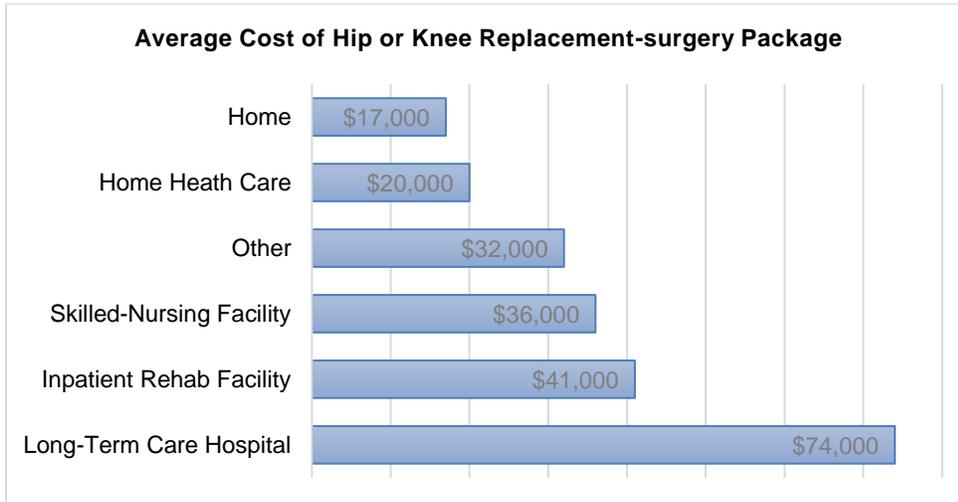
**Table 1. Episode-based Payment Models Developed by CMS**

### AN EXAMPLE OF EPISODE-BASED PAYMENT MODEL

A digitized example published to THE WALL STREET JOURNAL can be used to explain the benefits of Comprehensive Care for Joint Replacement (CJR) Model. Hip and knee replacements are the most common inpatient surgery for Medicare beneficiaries and can require lengthy recovery and rehabilitation periods. In 2014, there were more than 400,000 procedures, costing more than \$7 billion for the hospitalizations alone. Despite the high volume of these surgeries, quality and costs of care for these hip and knee replacement surgeries still vary greatly among providers. For instance, the rate of complications like infections or implant failures after surgery can be more than three times higher at some facilities than others, increasing the chances that the patient may be readmitted to the hospital.

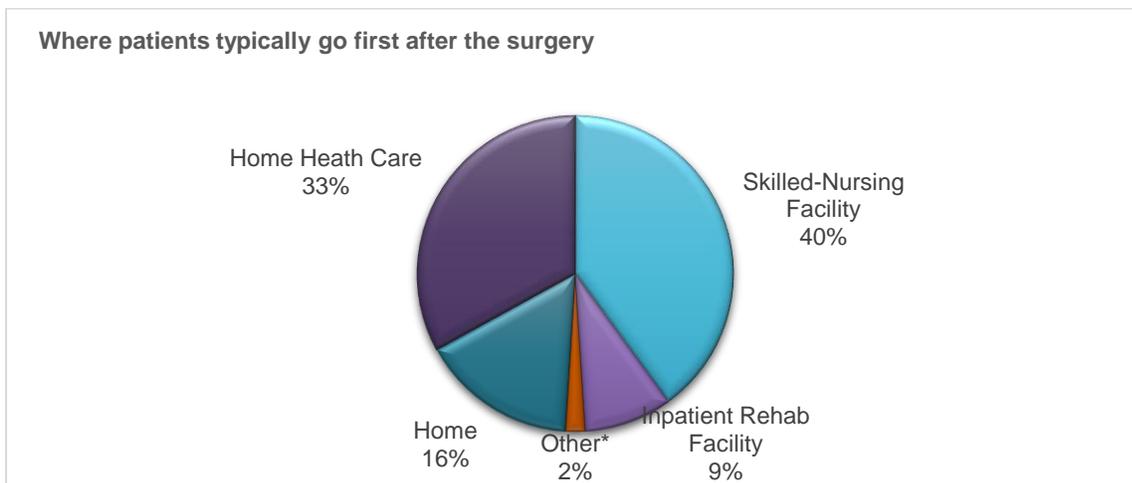
The Medicare rules in CJR model will hold some hospitals accountable for the bundled cost of hip and knee replacements for 90 days. With a typical bundled payment of \$27,870, hospitals would lose money if patients go anywhere but home. In Figure2, the average cost of hip or knee replacement-surgery package are listed. In Figure 3, the percentage of where patients typically go first after the surgery are also shown. So the hospitals must improve

care, reduce infection, avoid complications happened on patients, then they could get profits from the surgeries for the 51% patients. (Melinda Beck, 2016. Source: Remedy Partners)



Note: All costs include \$12,267 for surgery and inpatient hospital stay

**Figure 2. Average Cost of Hip or Knee Replacement-surgery Package**

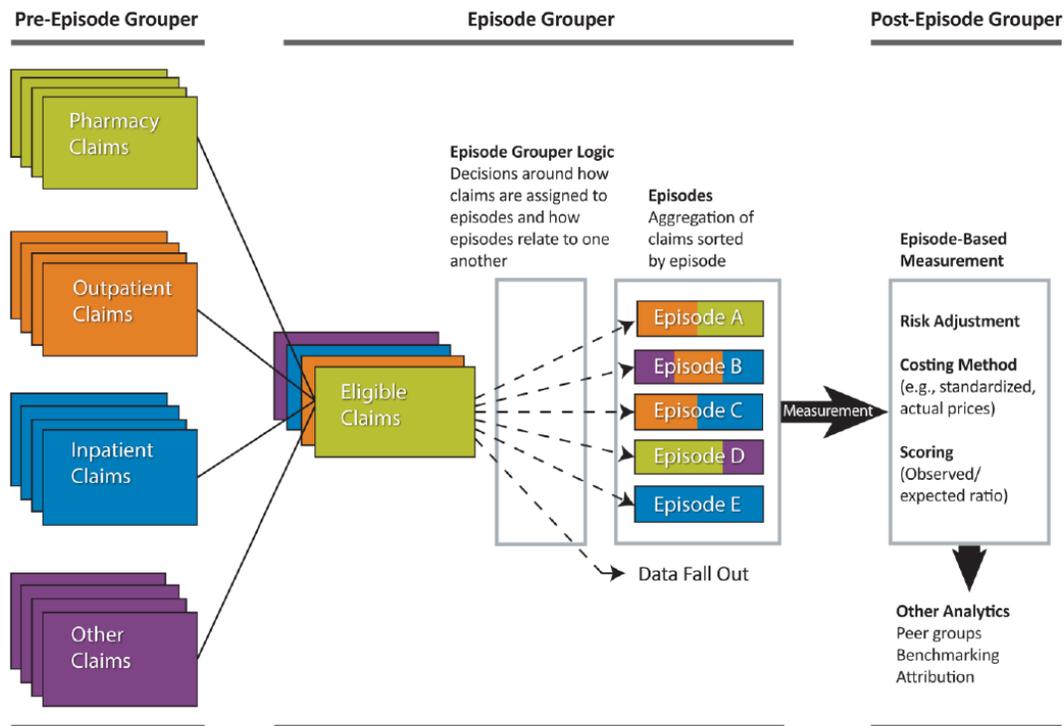


\* includes Long-Term Care Hospital

**Figure 3: Where Patients Typically Go First After the Surgery**

### EPISODE GROUPER

To generate episodes from thousands of or even millions of claims data, a tool or software must be used. CMS commissioned the National Quality Forum (NQF) to explore and recommend best practices for the construction of an episode grouper, define its key characteristics, and issue recommendations for evaluation and endorsement of episode groupers. The NQF issued a final report which defined an episode grouper as “the software and logic that assign patient claims representing their utilization of healthcare services to clinically relevant episodes of care.” (CMS Episode Groups)



SOURCE: Evaluating Episode Groupers: A Report from the National Quality Forum, 2014.

**Figure 4: Illustrating Episode Groups**

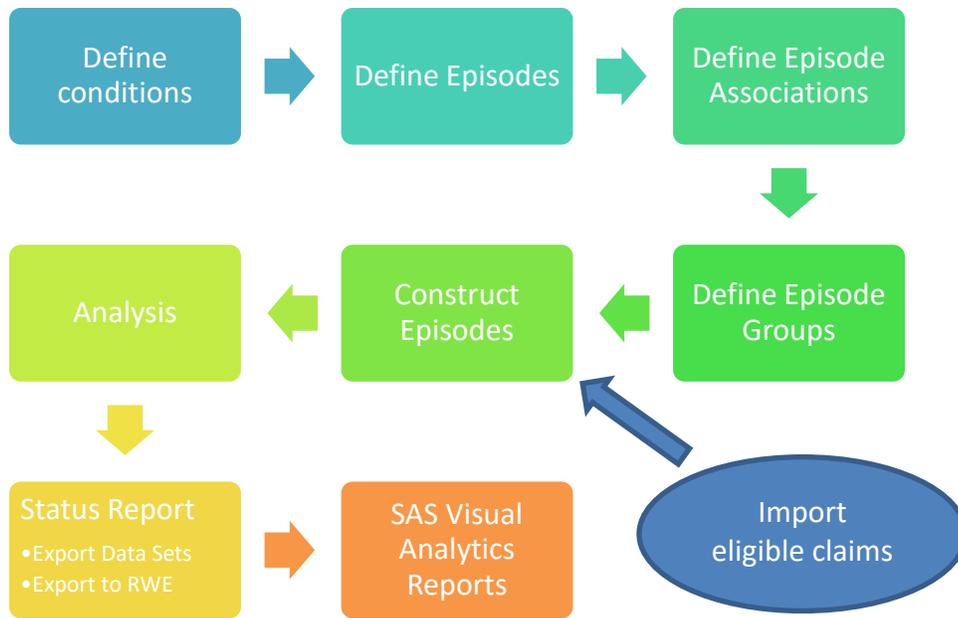
Figure 4 illustrates the basic function of an episode grouper, showing the flow of patient-level administrative claims data into the grouper, the grouper functions, and the resulting output. SAS Episode Analytics is just a qualified episode grouper.

## SAS EPISODE ANALYTICS

SAS Episode Analytics is an enterprise-level, episode-bundling solution for payers and providers, enables you to build retrospective and prospective bundled payments, to identify savings, to identify financial and clinical risk, and to expose potentially avoidable complications (PAC). The application goes through all the professional, outpatient, inpatient, and pharmacy claims provided for each patient during the study period, to construct episodes according to the rules defined. The benefits and components of SAS Episode Analytics include:

- an episode definition manager that provides flexibility in defining episodes based on customized rules and logic
- rapid construction of episodes, including episode association across multiple conditions, and identification of potentially avoidable complications
- cost allocation logic, which assigns money based on a claim or service to one or more episodes and then determines how the money should be distributed if the services are assigned to more than one episode
- episode filtering logic that enables users to define criteria and scenarios for including or excluding members or episodes for further analysis
- creation of physician accountability metrics for patient care with options to use different provider attribution rules
- calculation of expected episode costs and budget allocation based on flexible risk adjustment models
- comparison of providers' performance and efficiency on similar episode types

Figure 4 shows the general workflow in SEA, once the definitions works are done, they can be used to analyze different inputs. SEA provides the abilities to customize definitions, also primed in the standards of definitions by CMS.



**Figure 4: The General Workflow in SAS Episode Analytics**

Display 1 shows the UI for episodes creation and analysis process workflow. Besides definition works, only 5 steps are needed for a whole analysis job. Filtering and Association is required step, provider attribution and Risk Adjustment and Analytical Models are option steps.

**Display 1: SAS Episode Analytics for Episodes Creation and Processing Workflow**

## EPISODE ASSOCIATION

Episodes are constructed individually and independently, based on the specific rules for each condition. After all episodes have been constructed for each patient, there is a leveling process for all episodes to build hierarchical relationships between those that are either typical or complication sub-episodes. The leveling process enables users to understand which episodes likely exist because of another episode, such as one with a complication. The rules around what episodes are associated with other episodes, at what level, and of what type of association (complication vs typical) are specified in the episode definitions. SEA uses industry-standard episode-of-care or user-customized definitions to categorize all provided services as typical or complication for each episode.

The different types of associations include the following:

- procedural episodes that are children of related acute medical episodes.
- acute and procedural episodes that are children of related chronic episodes.
- procedural or acute episodes that signal during an open episode of the same type and are children of the existing open episode. These episodes are usually considered complications.

There are five possible hierarchy levels, with rules on when each episode can be subsumed by another, and at what level the episode is considered complete. An episode is considered complete when all possible child episodes have been associated with the episode. Procedural episodes are complete at level 3, acute episodes are complete at level 4, and chronic and other episodes are complete at level 5. System-related failure (SRF) episodes are complete at level 2.

### A PATIENT'S EPISODE-OF-CARE JOURNEY

To understand the Episode association concept better, and show the value of analyzing base on it, let's see a simulated diabetic patient one year journey. Over the course of the year, the patient had 2 acute events of AMI and PNEUMONIA, 3 procedures PCI, CABG, and knee replacement, along with some routine preventives episodes. Using the leveling concept learned from the previous section, let's walk through the year of this patient and determine the cost breakdown of typical vs PAC for each episode as well as determine if any of these episodes were related to each other.

At level 1, the most detailed level, all Medicare claims for the diabetic patient among this year have been categorized to 7 episodes – diabetic, AMI, PCI, CABG, Knee replacement, Pneumonia, and Preventive. For FFS payment models, the cost for all services no matter typical or complications were all pay by payers. For F4V payment models, the cost was breakdown to independent episodes and broken into Typical and PAC. (See Figure 5)

At level 2, typical associations are made. The PCI and CABG procedures are combined into a single episode from a cost perspective. This is because both episodes are in the same category of procedure and related clinically with being heart procedures.

At level 3, the procedure level, the PNEUMONIA episode is identified as potentially avoidable complication to the knee replacement episode and the 2 episodes are combined.

At level 4, the acute level, the PCI/CABG episodes are identified as procedures related to the acute AMI event and the episodes are combined.

At level 5, the chronic level, the AMI episode is identified as a PAC to the patient being diabetic and the 2 episodes are combined. (See Figure 6)

Before episode association, the total Medicare cost for this diabetic patient is \$80,000 (simulated number, not real). Only \$6,000 in the total cost is for PAC. But after applying episode association, the PAC cost is increased to \$40,000, 50% of total cost. The payers could use this analysis result to challenge providers.

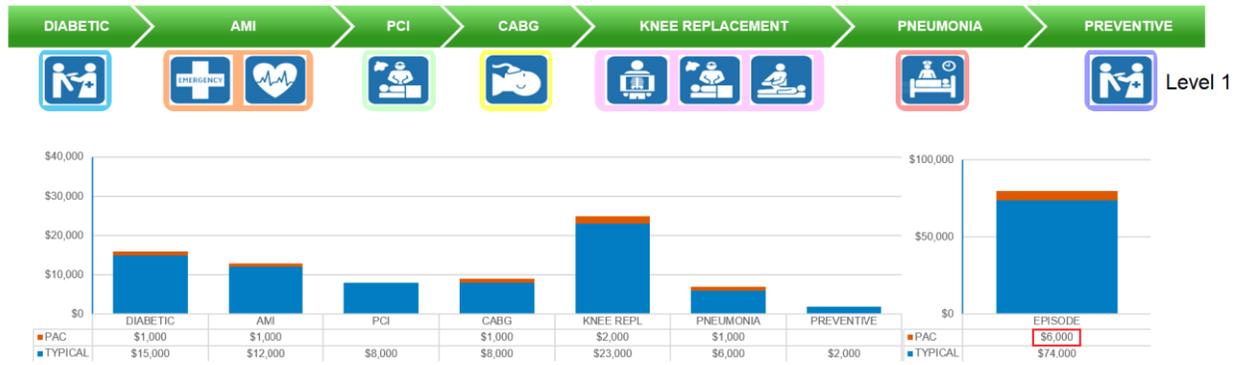


Figure 5: Episodes Cost at First Level

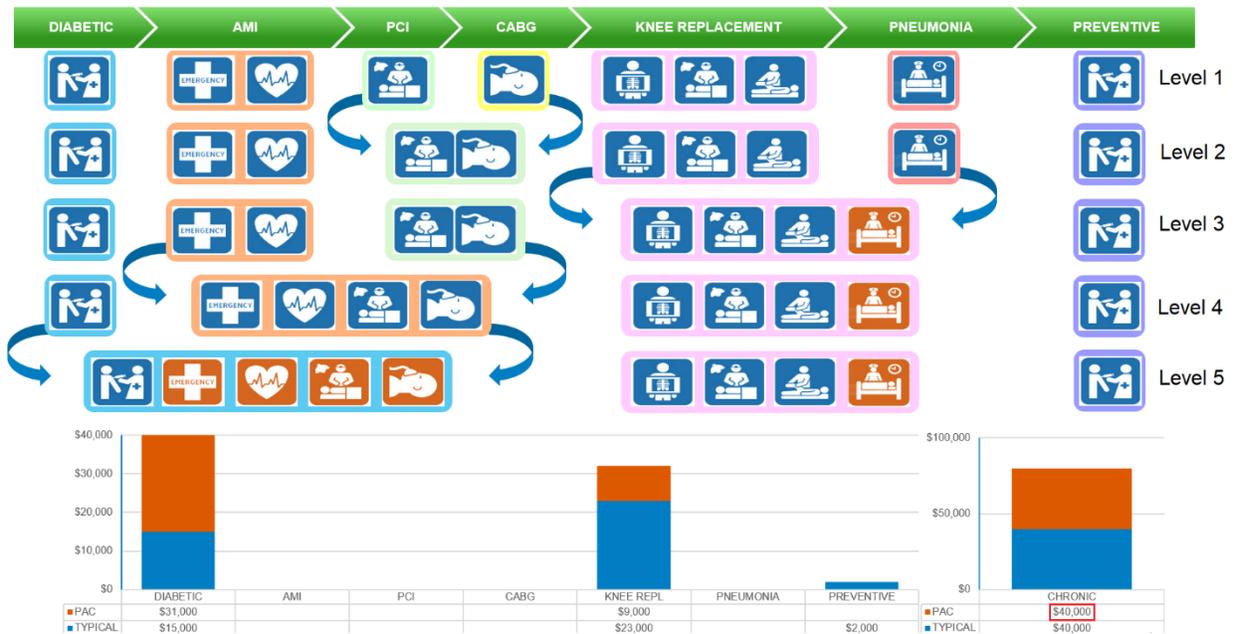
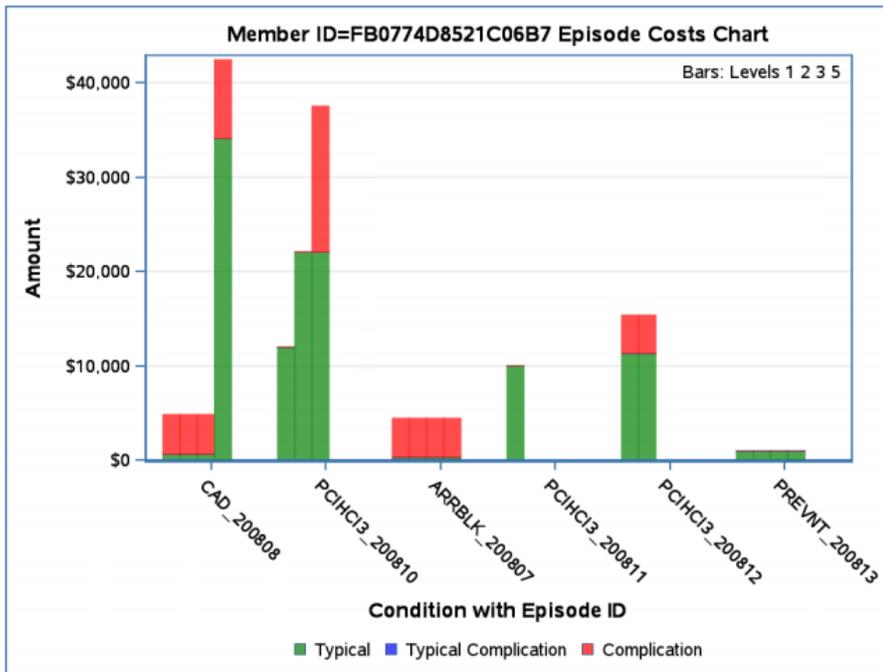


Figure 6: Episodes Cost after Episode Association

**OUTPUTS FOR FILTER AND ASSOCIATION STEP IN SAS EPISODE ANALYTICS**

In SEA, after running filter and association step, graphs, output tables and data sets are generated. They provide more information about the claims. For example, output 1, shows a random member's episode cost chart. Output 2, shows the summary of episodes by condition for Level 5, the summarized for other levels are also provided. There will be 5 PDF files and 7 data sets created after running filter and association step. The data sets can be exported to localized place or Real World Evidence (another SAS product) for further analysis.

Member ID=FB0774D8521C06B7 Episode Costs Chart



Output 1: Episode Cost Chart

Summary of Episodes by Condition for Level 5 (Leveled on Filtered Episodes)

Condition	Number of Members	Number of Episodes	Mean Cost per Episode	Standard Deviation of Cost per Episode	Min Cost per Episode	Max Cost per Episode	Total Cost
Upper GI Endoscopy	138	142	\$1,152.58	\$2,371.85	\$0.00	\$22,594.00	\$163,666.05
Arterial thromboembolism (SRF)	3	3	\$7,030.67	\$6,265.56	\$0.00	\$12,024.00	\$21,092.00
Gall Bladder Surgery	30	31	\$13,357.54	\$6,137.18	\$5,222.33	\$31,656.00	\$414,083.63
Gastro-Esophageal Reflux Disease	529	529	\$1,512.94	\$3,790.60	\$120.00	\$37,328.00	\$800,345.87
GI Bleed (SRF)	15	15	\$10,227.47	\$18,365.30	\$0.00	\$74,000.00	\$153,412.00
Glaucoma	670	670	\$544.84	\$452.27	\$118.57	\$5,360.00	\$365,040.56
Hip/Pelvic Fracture	91	92	\$13,341.67	\$6,621.31	\$1,024.00	\$42,073.00	\$1,227,433.43
Hip Replacement & Hip Revision	19	19	\$4,956.31	\$9,133.05	\$0.00	\$26,068.00	\$94,169.83
Hypertension	4,609	4,609	\$2,449.63	\$4,006.65	\$118.24	\$91,990.00	\$11,290,350.44
Hypotension / Syncope (SRF)	9	9	\$5,374.44	\$4,343.61	\$0.00	\$16,068.00	\$48,370.00
Hysterectomy	19	20	\$7,987.01	\$4,401.30	\$1,220.00	\$19,167.33	\$159,740.17
Fluid Electrolyte Imbalance (SRF)	8	8	\$5,152.50	\$3,016.97	\$0.00	\$8,100.00	\$41,220.00
Intestinal Obstruction (SRF)	10	10	\$11,318.80	\$13,108.67	\$0.00	\$37,068.00	\$113,188.00

Output 2: Summary of Episodes by Condition

### PROVIDER ATTRIBUTION

To compare or monitor providers' performance, provider attribution step must be run. Customers can use the system default rules by condition class or customize provider attribution methods for specific conditions to attribute episodes to providers (see Display 2). For example, for Acute Trigger method, acute episodes are attributed to the provider ID from the signaling claim, which is typically the facility where the inpatient stay occurred. After this step, we can know

how many episodes that a certain provider have provided services for, the total PAC cost, typical cost that the certain provider has spent, etc. The result can be found in the 2 PDFs and 3 data sets after running this step (see Output 3). Provider attribution is useful in creating metrics for provider-level quality, potentially avoidable complications comparisons, and costs of care in SAS Visual Analytics Reports.

Provider Attribution Parameters

Summary Acute Procedural **Chronic** Other SRF

Default method: Minimum Visits Professional Modify All...

Method Override	Condition Code	Condition	Attribution Method	Attribution Rule	Minimum Visits	Minimum %
	RHNTS	Allergic Rhinitis/Chronic Sinusitis	Minimum Visits Professional	Plurality Rule	1	
	ARRBLK	Arrhythmia / Heart Block / Condn Dis	Minimum Visits Professional	Plurality Rule	1	
	ASTHMA	Asthma	Minimum Visits Professional	Plurality Rule	1	
	BIPLR	Bipolar Disorder	Minimum Visits Professional	Plurality Rule	1	
	COPD	Chronic Obstructive Pulmonary Disease	Minimum Visits Professional	Plurality Rule	1	
	CHF	Congestive Heart Failure	Minimum Visits Professional	Plurality Rule	1	
	CAD	Coronary Artery Disease	Minimum Visits Professional	Plurality Rule	1	

Save Cancel

Display 2: Settings of Provider Attribution Parameters

Obs	Provider ID	N Episodes	N Members	Provider Attributed PAC Cost	Provider Attributed Typical Cost	Provider Attributed Total Cost
1	01006V	1	1	\$0.00	\$16,024.00	\$16,024.00
2	01008A	1	1	\$1,007.50	\$680.00	\$1,687.50
3	01008J	12	9	\$3,990.42	\$16,408.69	\$20,397.11
4	0100DN	2	2	\$313.33	\$880.00	\$1,193.33
5	0100GP	1	1	\$827.33	\$1,410.33	\$2,237.67
6	0100GU	2	2	\$654.82	\$550.67	\$1,205.49
7	0100HQ	3	2	\$331.67	\$1,240.00	\$1,571.67
8	0100JS	1	1	\$2,988.00	\$447.00	\$3,433.00
9	0100KT	1	1	\$10,100.00	\$0.00	\$10,100.00
10	0100MD	4	2	\$135.33	\$58,702.33	\$58,837.67
11	0100NV	3	3	\$312.00	\$3,088.67	\$3,398.67
12	0100PH	12	5	\$2,095.33	\$9,690.00	\$11,785.33
13	0100PQ	1	1	\$0.00	\$10,098.00	\$10,098.00
14	0100QJ	2	1	\$110.00	\$220.00	\$330.00

Output 3: Provider Summary

### RISK ADJUSTMENT AND ANALYTICAL MODELS

The Risk Adjustment and Analytical Models step in SAS Episode Analytics enables users to build a cost prediction model that allows control of the different levels of medical risk that are presented by the population case-mix. Risk adjustment refers to a statistical process used to estimate episode-of-care costs or the propensity for resource use within a patient population (such as health plan members), after adjusting for their current health status and known clinical risk factors (such as age, gender, and comorbidities). This methodology is used by insurance companies and managed care organizations to set capitation payments for health plans and to capture the expected costs of providing health care to their insured members.

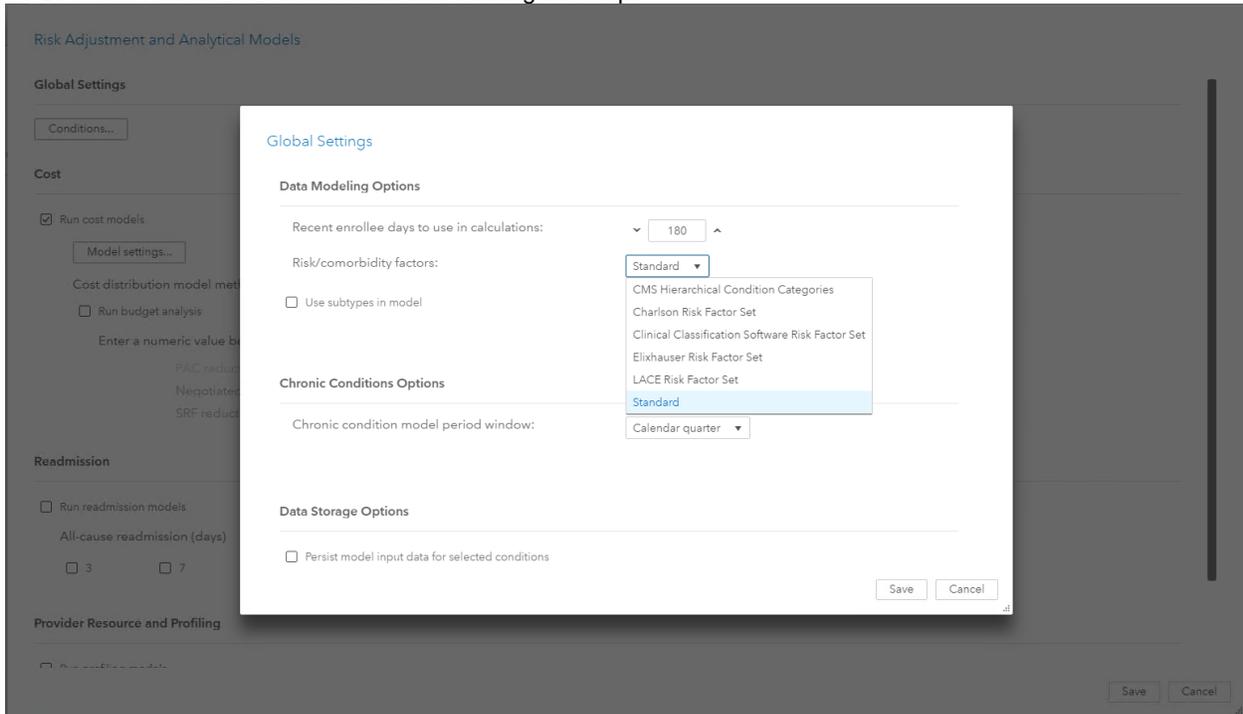
Risk adjustment on claims data-based episodes of care and associated services enables fair comparison of providers with a heterogeneous patient population. Adjusting for the different levels of medical risk present in the case-mix of population can reduce the incentive for health plans to enroll healthier members or to avoid more costly patients. It also levels the playing field for fair performance comparison of providers when episode payments are tied to performance.

Important features of the risk adjustment modeling component include (see Display 4):

- a parallel-processing analytic data preparation and model plug-in engine for rapid processing of episode data sets to create analytical-ready data sets

- choice of comorbidity risk factor set – including the standard risk factor set, CMS-hierarchical condition categories, Charlson, Elixhauser, and LACE
- flexibility in the type of cost prediction models - from level 1 cost modeling (baseline costs) for all conditions to level 3 for procedural conditions, level 4 for acute conditions, and level 5 for chronic conditions
- flexibility in the choice of modeling technique (one-part versus two-part model) and statistical method (normal, gamma, or Tweedie)
- population health focused models that include readmissions and provider cost profiling

9 PDFs and 16 data sets are created after running this step.

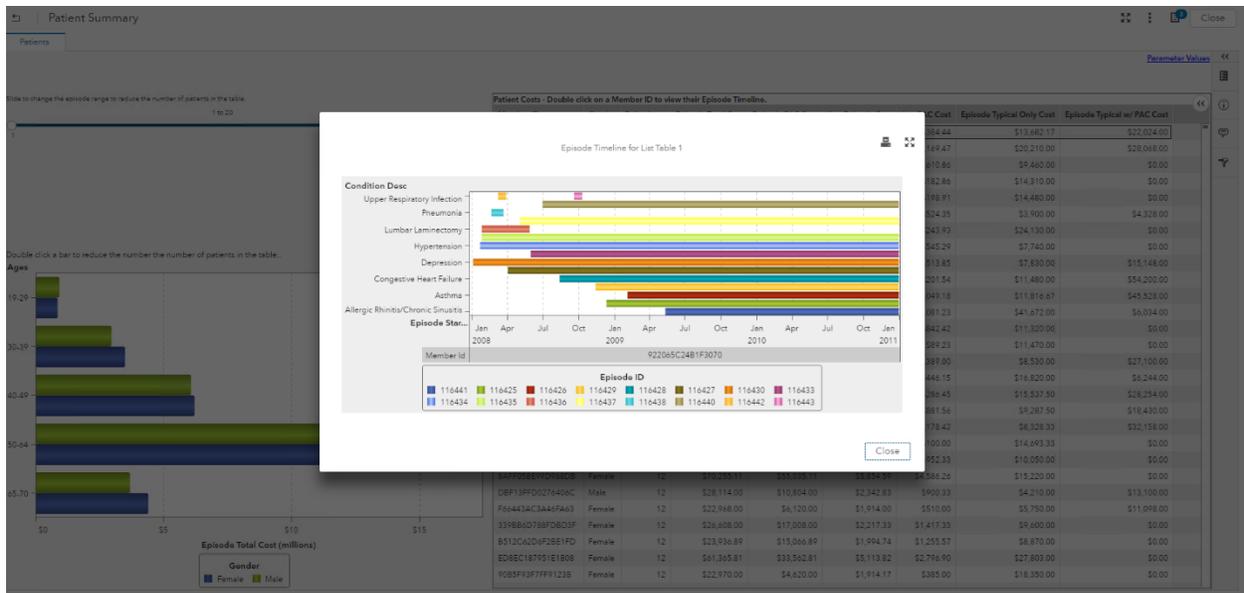


**Display 4: Settings of Risk Adjustment and Analytical Models**

## SAS VISUAL ANALYTICS REPORTS

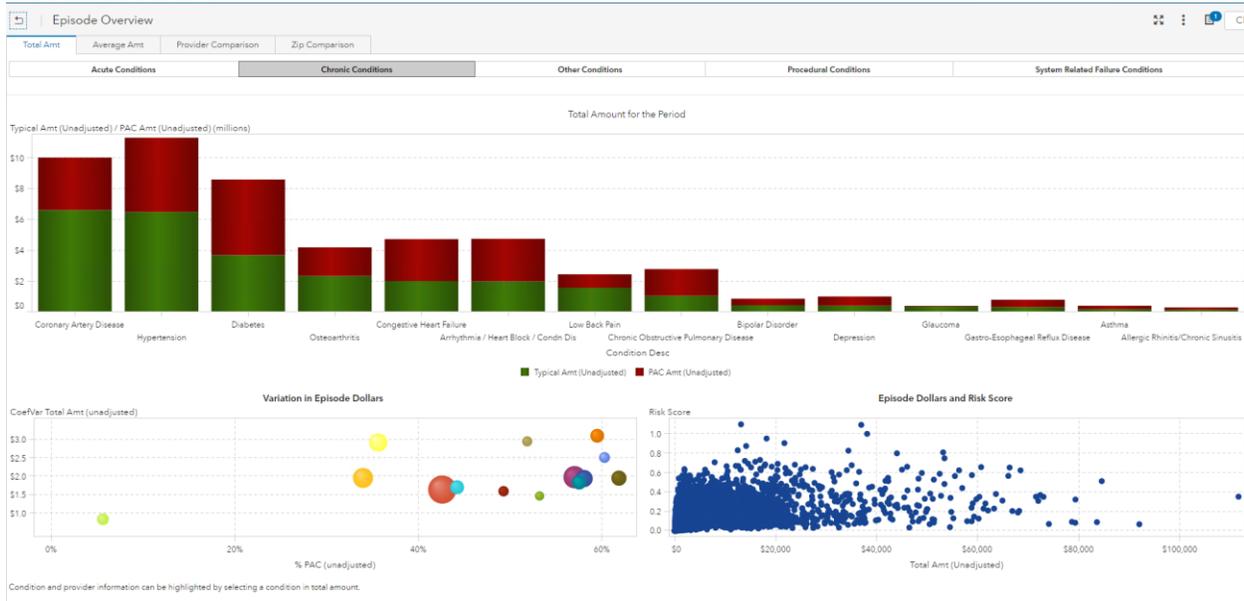
We can also get more intuitive and interactive user interface from SAS Visual analytics. For example, we can get reports in different perspectives like: Episode Summary, Patient Summary, Condition Financial Summary, Provider Referral, Episode Service Detail, and Episode Overview. The reports give visualized result for an analysis job. Let's see what we can get from the powerful feature

From Patient Summary report, Double-click a patient to display the Episode Timeline window. The timeline shows which episodes happen concurrently and the conditions that are associated with the episode. This window graphically displays the duration and condition associated with each patient episode.



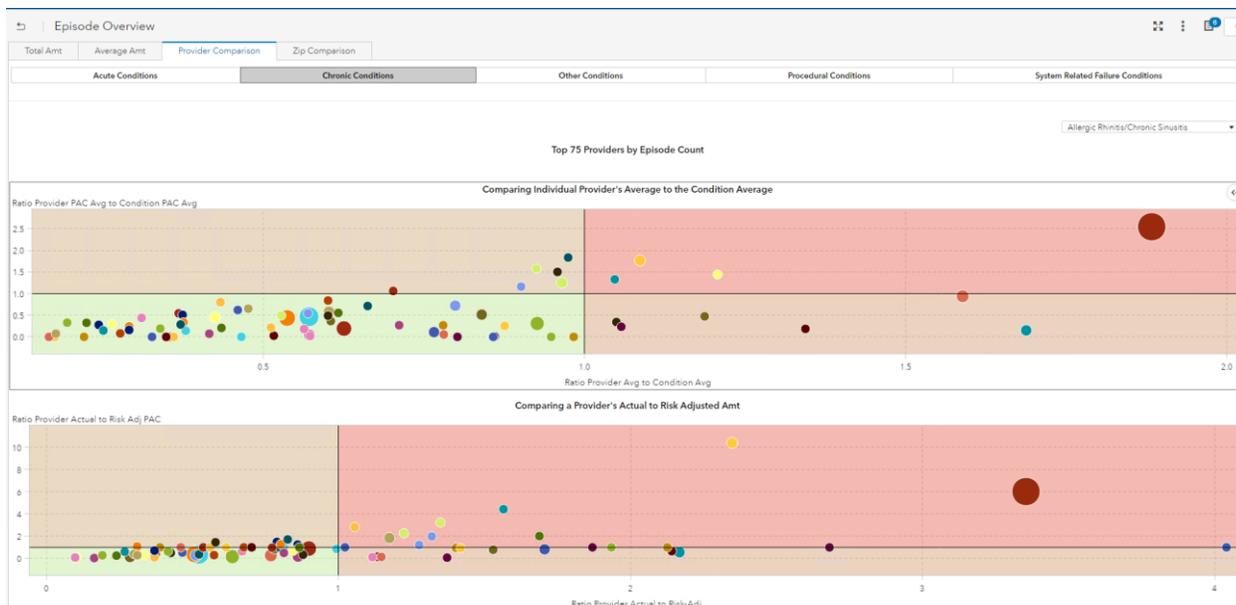
**Display 5: Episodes Timeline for a Patient**

The Total Amt section in Episode Overview report displays the total unadjusted allocated amounts for conditions within the selected condition class. The bar chart displays the total typical and PAC unadjusted allocated dollars for each condition within a condition class. Customer can use this report to find opportunities to reduce cost.



**Display 6: Total Amt for Conditions**

The Provider Comparison section in Episode Overview report enables to compare the top 75 providers within a specific condition by the provider's average to the condition average or risk adjustment. Each bubble represents a provider. More close to left bottom corner means the provider spends less money and less PAC for treating the same condition. In contrast, close to the top upper corner, might mean the provider's performance is not very good. This is helpful in planning provider networks or targeting providers that warrant further investigation.



Display 7: Provider Comparison

## CONCLUSION

SAS Episode Analytics is a qualified episode grouper, it enables payers and providers to garner insights from episode-of-care profiles that describe the holistic view of each patient. It provides multiple perspectives and dimensions to analyze Medicare claims data. It helps to monitor providers' performances, provides clues and evidences to increase the possibility of reducing cost and improving health care quality. With Episode-based payment reimbursement models, SAS Episode Analytics is a necessary product.

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SAS Episode Analytics 4.2: Usage

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