

What's New at SAS for Healthcare.

Lina Clover, SAS Institute Inc.

ABSTRACT

This paper highlights the SAS® health care solutions SAS® Real World Evidence and SAS® Episode Analytics. While seamlessly integrated with the SAS Platform and SAS® Visual Analytics, these solutions are designed to help a wide spectrum of health care organizations (providers, payers and insurance companies, pharma, and government agencies) to easily derive health care analytics and insights from administrative claims data and patients' electronic medical records.

For SAS Real World Evidence, this paper covers built-in longitudinal patient views and the interactive cohort discovery tool, which can easily identify cohorts of patients with complex sequences of events and encounters (diagnoses, medical procedures, visits, lab test results, and drug exposures) from a pool of millions of patients with a query response time in seconds; pre-defined analytical models such as Readmission Analysis, Length of Stay Analysis, Risk Scores and Comorbidity Report, and Incidence and Prevalence Analysis; and how to use your own analytical models via the Add-in Builder.

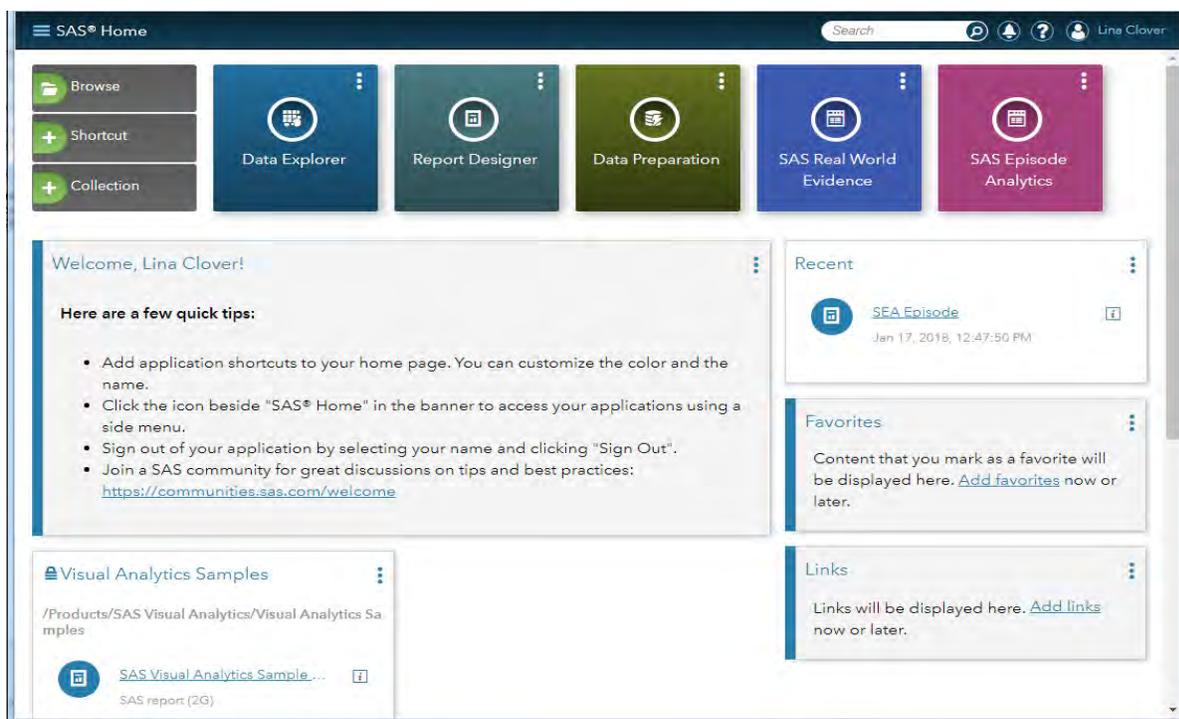
For SAS Episode Analytics, this paper covers chronic condition episodes, reporting per member per month (PMPM) costs, and running prospective costing models that help payers and states predict future cost related to payment contracts and budgets. This paper also provides an understanding of the utilization and treatment pathways needed for population health management, quality metrics, and health outcomes.

INTRODUCTION

SAS Episodes Analytics and SAS Real World Evidence are health care solutions that are integrated with the SAS analytic and visualization platforms. These solutions have features that are specific to health care data and health care analytics, which provide an ideal framework for clinical intelligence. The solutions have the following features that enable them to be quickly adopted by enterprise IT:

- Both solutions are fully configurable and governed by SAS® Metadata Server role-based capabilities, security, and administration.
- Both solutions are seamlessly integrated with the SAS Visual Analytics and are launched from SAS Home (Display 1), seamlessly leveraging interactive visualization and reporting.
- Episodic data and patient cohort data can be made readily available to other SAS products such as SAS® Enterprise Guide, or on the web in SAS® Studio.
- Both solutions provide full logging and audit recordings in accordance with federal regulations and HIPAA rules.

Standardization of health care data is another key benefit provided by the SAS health care solutions. Disparate data sources such as medical claims, electronic medical records, demographics, and other patient data are combined in unified structures to make the data ready for statistical analysis and ad hoc explorations. Most commonly used public domain medical codes such as ICD-9, ICD-10, HCPCS, and DRGs are preloaded into the SAS health care solutions database as a convenience. Other proprietary medical codes can be quickly adapted to the system. The SAS health care solutions were designed for worldwide health care needs; there is support for internationalization, and the solutions are localizable for use in non-U.S. health care systems.



Display 1. Accessing SAS Health Care Solutions from the SAS Home Page

SAS EPISODE ANALYTICS

SAS Episode Analytics calculates the cost of clinically related medical services in inpatient, outpatient, or pharmacy claims as a bundle associated with an episode of care. This process produces several outputs that provide insights beyond the cost analysis. The process identifies medical services against predefined treatment pathways, which enables the analyst to discover and examine overutilization or underutilization of services performed. The process also enables analysts to examine certain outcomes by capturing complications and negative outcomes such as readmissions or hospital-acquired infections. SAS Episode Analytics can also be used to run prospective costing models that help payers, states, and governments predict future costs related to payments, health care expenses, and budgets. Understanding utilization and treatment pathways is essential for population health management, quality metrics, and health outcomes studies.

SAS Episode Analytics offers several standard interactive reports that enable users to examine data and services at various levels of detail and from different perspectives: the patient's perspective, the provider's perspective, and the payer's perspective.

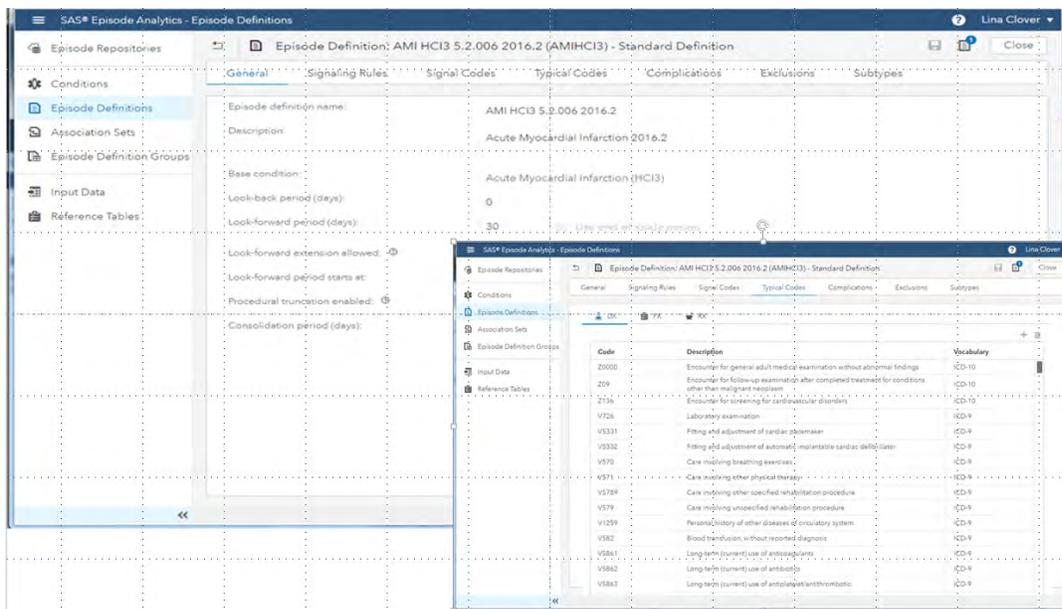
USING EPISODES OF CARE

The user interface enables analysts to create and modify episode definitions; the demonstration will explain how to use episode-based methodology to capture medical services for purposes other than bundled payments. The user interface for episode definitions (Display 2) are organized into the following components:

- **Signaling Rules:** The circumstances of episode discovery and start.
- **Signal Codes:** The medical codes found in claims that specify the anchor diagnosis, the anchor procedures, or a drug exposure that signals an episode.

- **Typical Codes:** The medical diagnoses, procedures, and prescription drugs that make up a typical treatment of the conditions of the episode.
- **Complications:** Outcomes such as complications or hospitalization.
- **Exclusions:** Filters that enable the exclusion of certain patients.
- **Subtypes:** The risk factors that the Risk Adjustment and Analytical Models step uses for the episode condition.

The ability to customize and define episode definitions is a key feature not available in other “black box” closed episode systems. This ability is useful for health care analysts and actuaries who need to understand the impact of variation of services mix on cost and outcome. It also enables analysts and US States to evaluate new payment proposals by CMS (Center for Medicare and Medicaid Services) while they are in review, giving the states the ability to comment on proposed new bundles.



Display 2. Episode Definition Editor

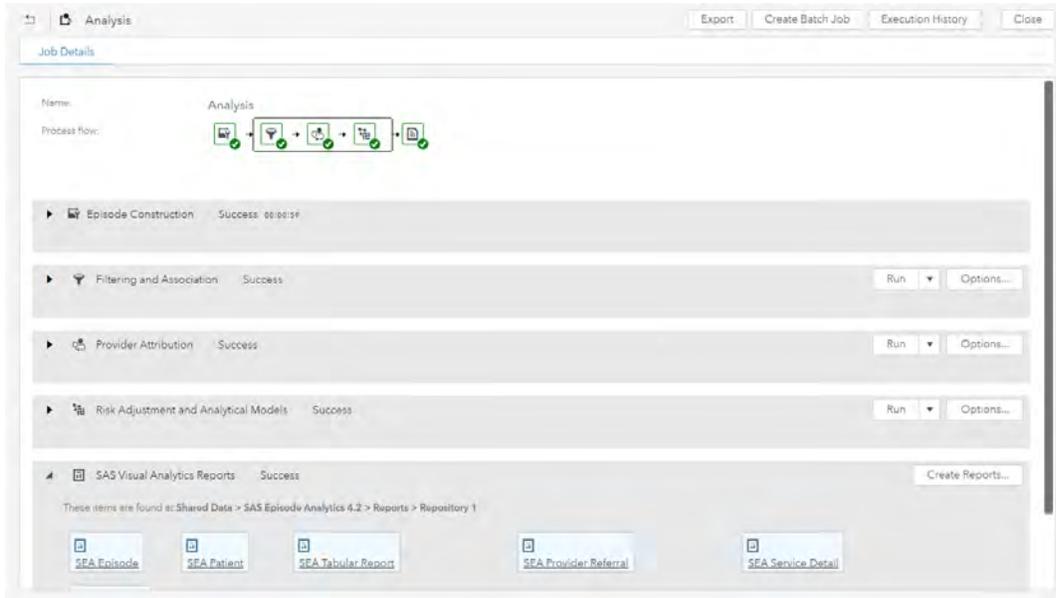
PROCESSING EPISODES OF CARE

Episodes are processed using multiple steps, which produce data output that can be used for analytics (Display 3). A key feature in SAS Episodes Analytics is the “Leveling and Associations” step, which enables analysts to associate clinically related conditions, while “leveling” provides a breakdown of chronic, acute, or system-related failure episodes into predetermined cost categories. SAS Episode Analytics is comprised of the following steps:

- **Episode Construction:** Examines longitudinal patient records with all services and creates episode records based on episode criteria. This data helps analysts examine the patient’s journey.
- **Filtering and Association:** Allocates service costs to episodes and associates episodes to each other, based on defined clinical and business rules.
- **Provider Attribution:** Assigns costs based on the following options: primary care provider (PCP), attending physician, specialist, or a provider group.

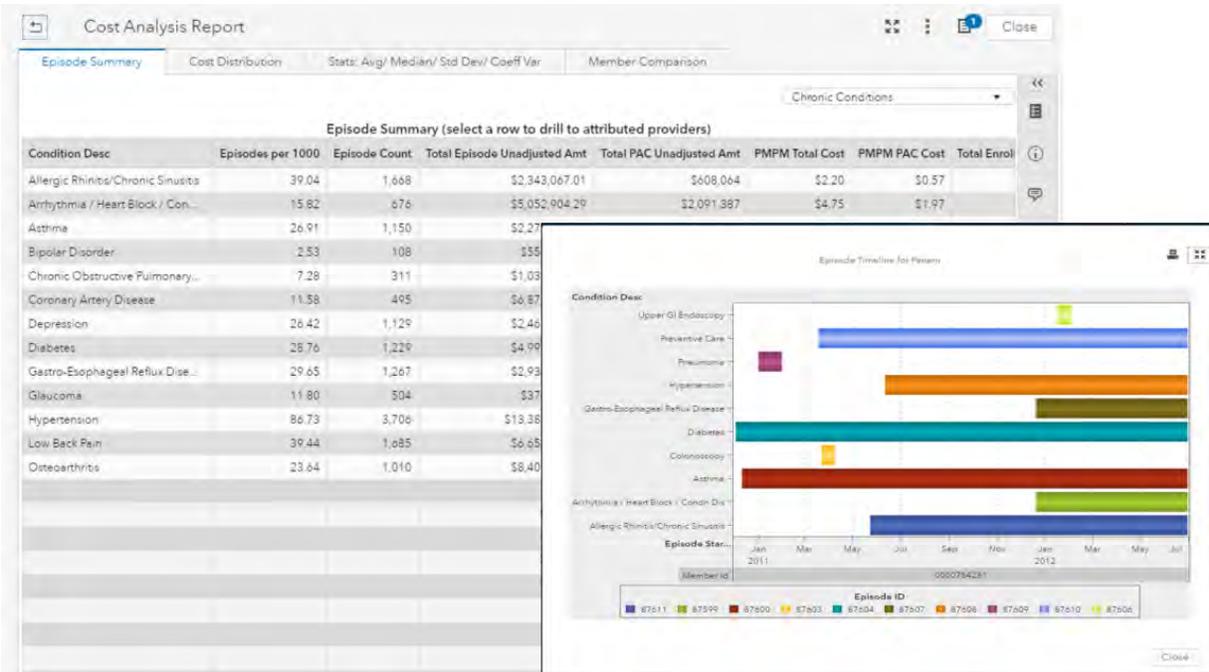
- **Risk Adjustment and Analytical Models:** Adjusts cost based on the severity of conditions and patient risk factors. Predictive models for readmission, length of stay (LOS) and cost prediction are available for budgeting and planning.
- **Standard Reports:** Enables visualization of outputs from episodes in several interactive SAS Visual Analytics reports, such as the Patient's Journey report and the Cost Analysis Report (Display 4)

Collectively, these steps not only process the data for cost bundles, but also provide insights with analysis-ready outputs, in a manner that is critical to understanding health cost and outcomes.



Display 3. Processing Episodes

The following display shows per member per month (PMPM) normal costs and complication costs (PAC), which are calculated as part of the standard Cost Analysis Report. This report is available in SAS Episode Analytics 4.2. The standard SAS Episode Analytics Patient Report offers a patient journey perspective.

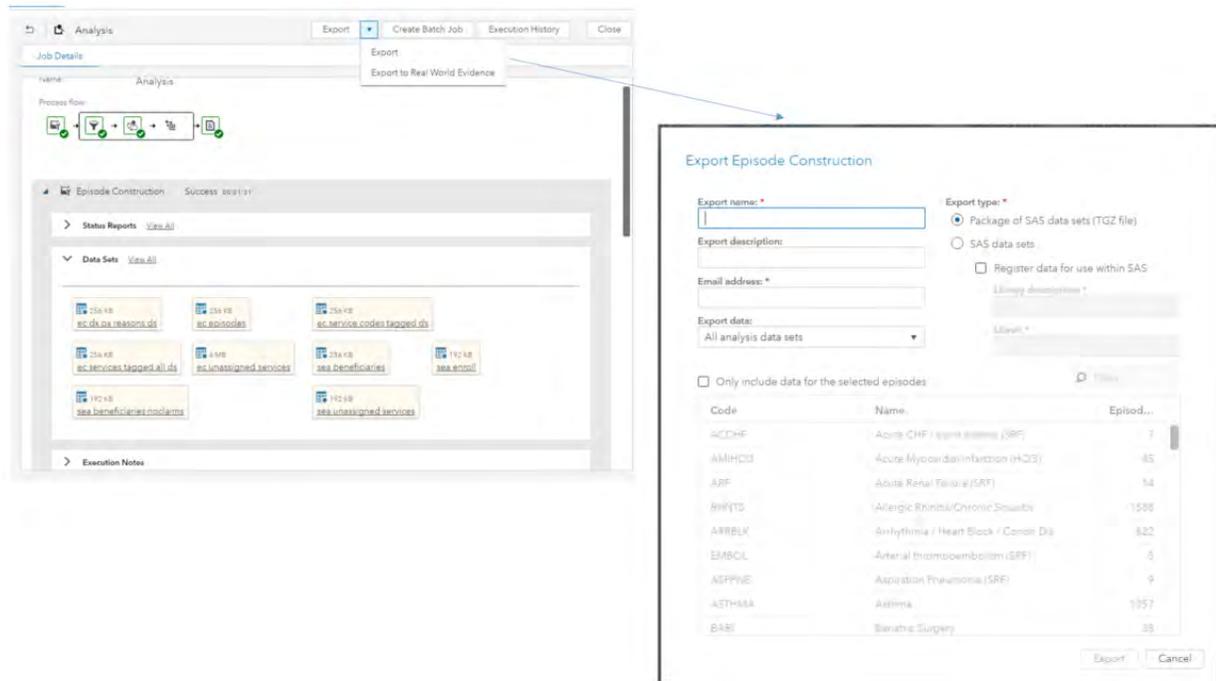


Display 4. Standard Analysis Reports

USING EPISODE DATA FOR ANALYTICS

After each step in the process, SAS Episode Analytics allows users to export the underlying detailed data output tables that are produced for that step. The output tables provide details per patient, per episode, or per provider; the tables can be linked to service records (claim lines) and can be joined to provide a complete breakdown of medical services.

Data can be exported to an external location as a zipped package, exported to a folder location, or registered as a SAS library in the SAS Metadata Server, which makes the data available for immediate use in other SAS applications. Exporting data to SAS Real World Evidence enables user to export episodes costs for HEOR (Health Economics and Outcomes Research) type of studies (Display 5).



Display 5. Exporting Episodes Data

SAS REAL WORLD EVIDENCE

Health care data volumes, disparity, and inconsistency are some of the biggest challenges facing health care researchers; medical claims, electronic medical records, lab results, Immunizations, registries, and IOT devices are just a few of the incoming data sources. This data is complex, disconnected, and exists in different forms and standards. Collectively, this data makes up Real World Data (RWD); SAS Real World Evidence combines these data sources with data merges and transformations to allow the use of RWD from different vendors and sources for statistical analysis. Mining RWD to identify patient cohorts of interest is one of the main purposes of SAS Real World Evidence. Cohort identification is fundamental to many health care research areas, such as:

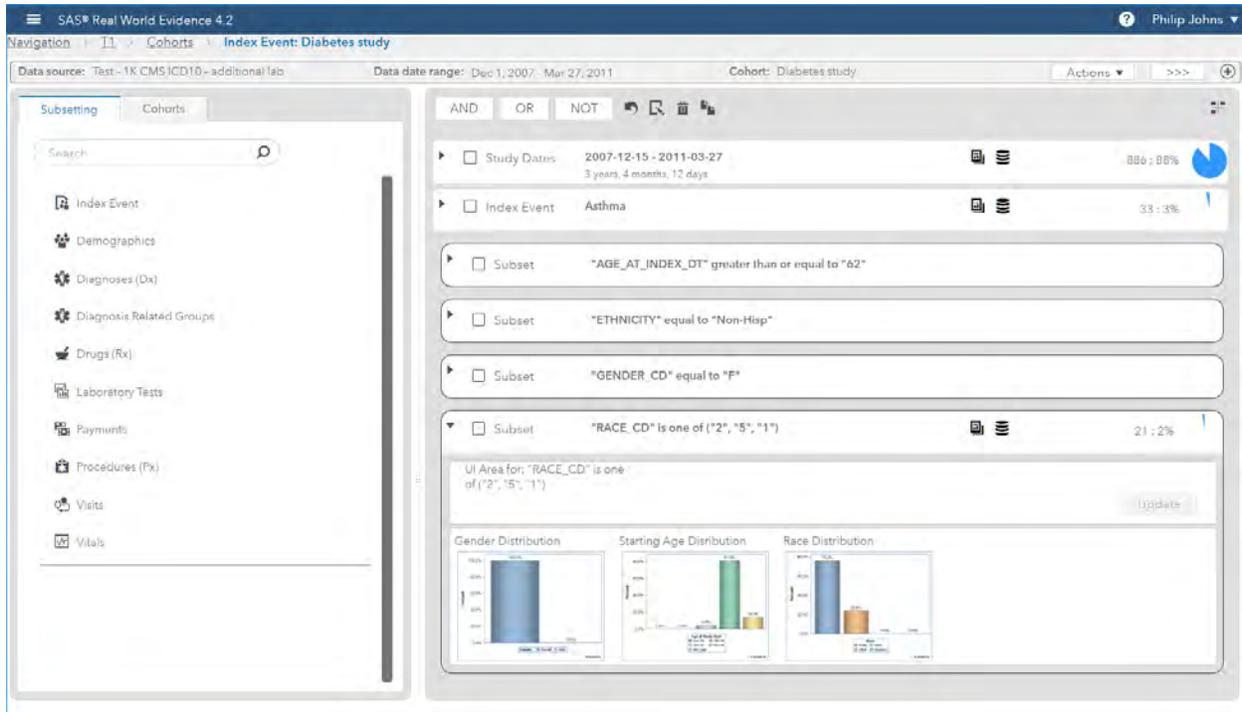
- Health Economics and Outcomes Research (HEOR): market access studies, comparative effectiveness, and patient journeys
- Pharmacovigilance and safety surveillance: adverse events, signal detections, and drug safety and utilization
- Clinical research and development: trial design optimization, patient recruitment, new indications.

COHORT DISCOVERY

Identifying cohorts for health care studies requires both clinical domain and data manipulation expertise. The process of obtaining the final cohort list along with associated outcome variables and relevant patient characteristics can be very complicated and often takes several days to several weeks to complete.

SAS Real World Evidence offers an ideal framework for researchers with a robust, high-performance cohort query and discovery tool that can query large health care data in just seconds. Users can interactively define complex criteria for events and encounters based on diagnosis, procedures, visits, lab

results, drug exposures, and temporal restrictions, with instant cohort counts and graphical representation of resulting cohorts' demographic composition.



Display 6. SAS Real World Evidence, Cohort Discovery

Index event cohorts and population cohorts, available in SAS Real World Evidence, are two methods of evaluating cohort criteria.

Index Event Cohorts

Within the research study period, events are identified using criteria based on an index (anchor) diagnosis, encounter, or exposure to a drug. All subsequent inclusion and exclusion criteria are evaluated based on a specified time distance before or after the date of the index event. These types of cohorts are ideal for drug efficacy studies, outcome studies, and many other pharmacovigilance research studies.

Population Cohorts

Population cohort inclusion and exclusion criteria are evaluated within the research study period that is specified for the cohort. These types of cohorts are ideal for HEOR, population health studies, or quality measure gap analysis.

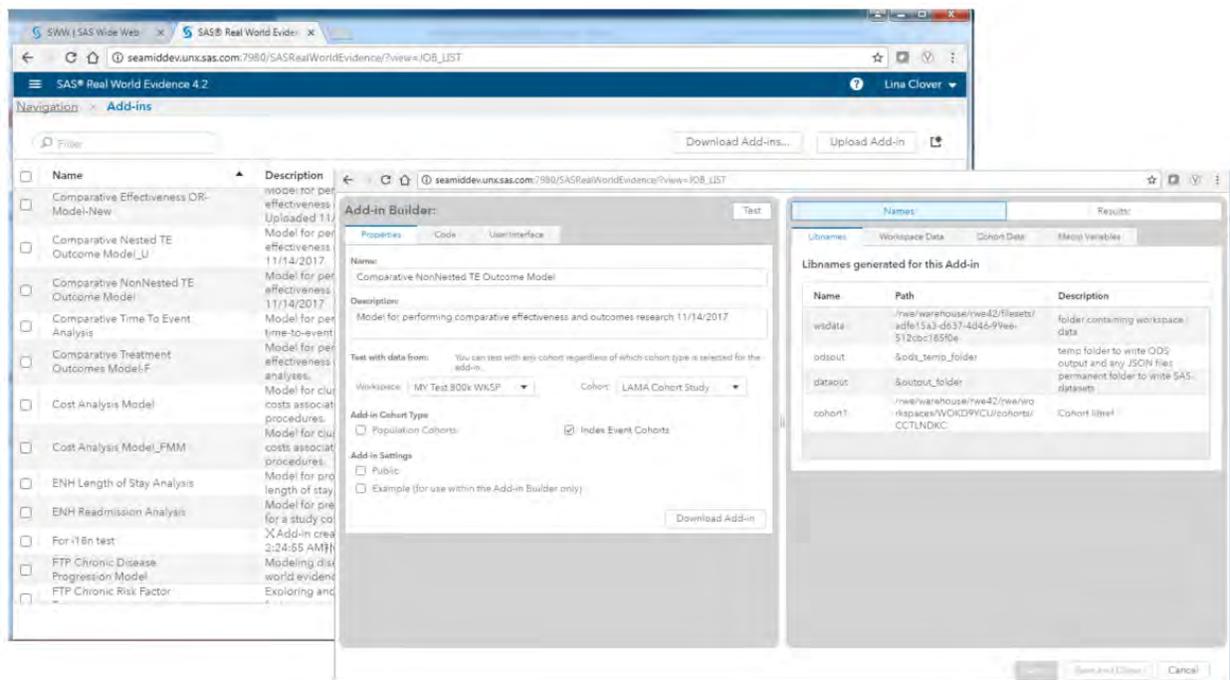
ANALYTICAL MODELS

SAS Real World Evidence includes several analytical models with comprehensive choices for risk adjustment methodologies. It is well-recognized that in health care analytics one model does not fit all! Models provided with SAS Real World Evidence can be used as is, or they can be customized by the user via the Add-in Builder (Display 7), which is available in the product. The following list contains a few of the analytical models that are available in SAS Real World Evidence:

- **Incidence and Prevalence Analysis:** This model computes the incidence and prevalence rate for an index event. The user can optionally perform a 'point prevalence' calculation for a specific date as well.
- **Cohort Characterization:** This report shows the data profile for a cohort with regard to enrollment information; most frequently reported diagnoses, procedures, and drug codes; as well as the demographic breakdown of the cohorts.
- **Readmission Analysis:** This model examines patients that have an elevated risk of readmission and identifies factors associated with the risk of readmission. The model enables users to evaluate the risk for different readmission days, and generates a readmission risk profile for cohort members.
- **Length of Stay Analysis:** This model predicts the length of stay for cohorts. The following options are provided: a selection of risk factors, log-transform of skewed data, quantile regression model, and forecasting.
- **Risk Score and Comorbidity Profile:** This model produces a detailed profile report for different comorbidity factors, as well as a risk score that can be used for modeling and analytical reporting. Six common risk/comorbidity factors (Standard, CMS-HCC, AHRQ-CCS, Charlson, Elixhauser, and LACE) are available as options.

ADD-IN BUILDER

SAS Real World Evidence is extensible, which enables analysts to create their own analytical models, or to customize models that are included with the software. Models can execute against the entire population in the data source, or execute against the cohort population of the study.



Display 7. SAS Real World Evidence, Add-in Builder

DEMONSTRATION CASE STUDY

Demonstration of SAS Episode Analytics evaluation of the COPD, Asthma chronic condition using the new 2018 proposed CMS BPCI-Advanced model, contrasted with the Prometheus (HCI3 5.2) Asthma model. The output is examined for cost and service allocation differences in each of these models. Patients identified in the Asthma episodes are further examined in SAS Real World Evidence for quality measure gap analysis, and profiled with the risk score and co-morbidity profile model.

CONCLUSION

Improving health care outcomes and reducing health care costs are universal goals in most health care systems. Many recent health care technology improvements and ongoing debates about value of care, accessibility, fairness, efficacy, cost, choice, quality, and outcomes have increased the need for analytical, health care-focused tools and solutions.

SAS Episode Analytics and SAS Real World Evidence provide functionality that is critical to health care analytics and many of its domains. They address many of the data challenges, provide a breadth of health care-specific analysis, and provide features with enterprise-ready capabilities that are ideal for clinical intelligence. Statistical modeling and visualization of outcomes are tightly interwoven with the SAS platform, providing best-of-breed, one-of-a-kind health care system offerings.

REFERENCES

Dickstein, Craig, and Renu Gehring. 2014. *Administrative Healthcare Data: A Guide to Its Origin Content, and Application Using SAS*. Cary, NC: SAS Institute Inc.

CMS.gov Centers for Medicaid and Medicaid Services. "BPCI Advanced." Available: <https://innovation.cms.gov/initiatives/bpci-advanced>. Accessed February 20, 2018.

U.S. Food and Drug Administration. "Real World Evidence." Available: <https://www.fda.gov/ScienceResearch/SpecialTopics/RealWorldEvidence/default.htm>. Accessed February 20, 2018.

RECOMMENDED READING

- *Administrative Healthcare Data: A Guide to Its Origin Content, and Application Using SAS*

CONTACT INFORMATION

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

Lina Clover
SAS Institute, Inc.
Lina.Clover@sas.com

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.