ANALYTICS FOR POPULATION HEALTH MANAGEMENT

2015 NCHICA WORKSHOP PREDICTIVE ANALYTICS FOR POPULATION HEALTH MANAGEMENT

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OUTLINE

- **Population Health Management (PHM)**
  - **Definition and areas of importance**
  - **Strategy for modeling PHM data**
- Case Study-1: Risk Segmentation Models for Members with a Chronic Condition
- Case Study-2: Detecting Anomalies in Medicare Claims
- SAS Panel Q/A Session

ISSUES: A POPULATION AND INDUSTRY AT RISK

As noted by IHI, 5% of the patient population accounts for the 50% of total cost across all payers in the US. A small percentage of the population generates this disproportionately large portion of health care costs.

This segment of the population is complex and dynamic…They make frequent use of the health care system and often have poor outcomes.

NHCAA estimates conservatively that 3% of all health care spending—or $70 billion—is lost to health care fraud each year.

Other estimates by government and law enforcement agencies place the loss due to health care fraud as high as 10% of our nation's annual health care expenditure—or a staggering $234 billion—each year.

DEFINITION: TRIPLE AIM AND POPULATION HEALTH MANAGEMENT

- Triple Aim (IHI.org)
  - improve population health
  - reduce per capital health care costs
  - improve the patient care experience

- Population health management
  - intelligent patient **data aggregation** across disparate health information technology resources
  - robust **predictive analytics** performed on actionable patient records
  - strategic **prescriptive analytics** through which care providers can improve both clinical and financial outcomes.

POPULATION HEALTH MODEL: HOW DO I

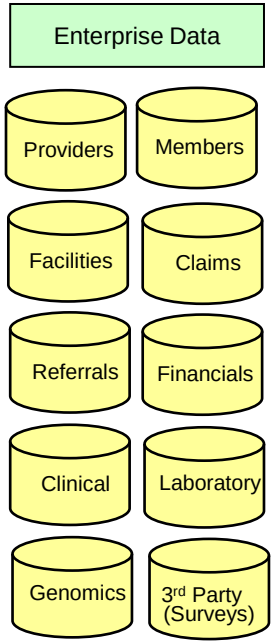
- Q: integrate claims, clinical, survey, and care management data to perform prospective and retrospective analysis on my patient population?
- Q: uncover insights, patterns and determine which episodes are clinically related?
  - **A: Intelligent data aggregation**

- Q: proactively identify high risk members for targeted care outreach?
- Q: predict patients at risk of index- or re-admission based on their clinical profiles?
  - **A:Robust predictive analytics**

- Q: uncover relationships between physician practice patterns and patient quality of care?
- Q: identify gaps in care and minimize adverse outcomes
  - **A: Actionable prescriptive analytics**

DATA BOMBARDMENT

HOW DO I USE ALL THIS DATA TO TACKLE PHM ISSUES



Descriptive Profiling	Epidemiological / Clinical Profiling	Predictive/Precision Profiling	Prescriptive Profiling
Patient-Like-Me/ Similarity Rules	**Clinical Rules/ Anomaly Detection**	**Predictive/Network Modeling**	**Engagement Rules**
For profiling **KNOWN** patterns	For **DIAGNOSTIC and PROGNOSTIC** patterns	For detecting **COMPLEX** and **UNKNOWN** patterns	For evaluating **ACTIONABLE** patterns
• Detect similar clinical/ health care behaviors across a patient population and treatments	• Detect individual and aggregated abnormal patterns vs peer groups	• Predict known and unknown complex cases	• Identify gaps in care
• Profile cost of care for patients with chronic conditions	• Investigate patterns and variations of care	• Hypotheses generation	• Detect non-compliance, and medication non-adherence
	• Compute disease incidence profile	• Root cause/what-if scenario analyses	• Out-of-norm behaviors
	• Stratify patients based on disease risk	• Evaluate treatment patterns and outcomes	• implement patient engagement rules
		• Reduce readmission rates	• Manage healthcare costs

Hybrid Approach

Proactively applies analytics to combined data from all sources across continuum of care: member, provider, facility, and network levels

DATA EXPLORATION

- Data Preprocessing
  - Move small data sets toward large data sets
  - Move code toward large data sets
- Univariate descriptive analysis
  - Determine association of each input feature with the target outcome
  - Pay attention to target and input variables with anomalous distribution
  - Be aware of distributional differences between training and test data
- Identify missing values in the data
  - Variable binning versus imputation
  - Create missing indicators (informative versus non-informative missing values)

DATA REDUCTION AND MODELING

Random projections	Runs directly on data matrix Creates linear, oblique features No one feature is more important than the others Not interpretable
Principal component analysis	Requires a covariance or correlation matrix Creates linear, orthogonal features Limited interpretability
Singular value decomposition	Runs directly on the data matrix Creates linear, orthogonal features Limited interpretability
Non-negative matrix factorization	Suitable for large, sparse, and non-negative data sources Creates linear, oblique features Higher interpretability
Predictive modeling	Decision tree GLM Random forest *k*-means clustering

OUTLINE

- Population Health Management (PHM)

- **Case Study-1: Risk Segmentation Models for Members with a Chronic Condition**
  - **Claims and clinical data-driven “Episode-of-Care (EOC)”**
  - **EOC Cost and Quality Risk Scores**
  - **Propensity to seek care: utilization of recommended preventative core services**
  - **Propensity for potentially avoidable ER utilization**

- Case Study-2: Detecting Anomalies in Medicare Claims

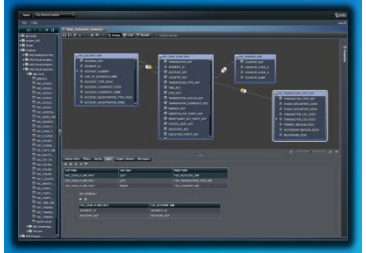
- SAS Panel Q/A Session

SAS® EPISODE ANALYTICS

OPTIMIZED AND FLEXIBLE HEALTHCARE SOLUTION FOR VOLUME-TO-VALUE (V2V) MODEL ANALYTICS

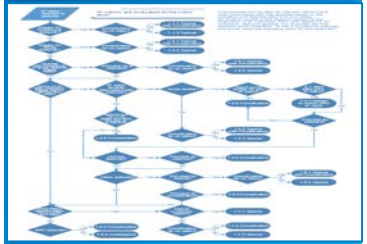
Episode Analytics Entry Point

Episode Analytics Role-Based Views



DATA MAPPING & PREPARATION

- Process user-supplied claims data sets
- Data cleaning and reconciliation
- Map submitted claims to SEA input data sets



EPISODE CONSTRUCTION

- Episode definitions & signal logic
- Service assignment & cost allocation
- Episode association & dependency detection

PROVIDER ATTRIBUTION

- Episode attribution
- Multiple attribution rules
- Provider-level metrics and analyses

RISK ADJUSTMENT

- Construct analytic input data sets
- Create adjusted total episode and PAC costs
- Care variation analysis

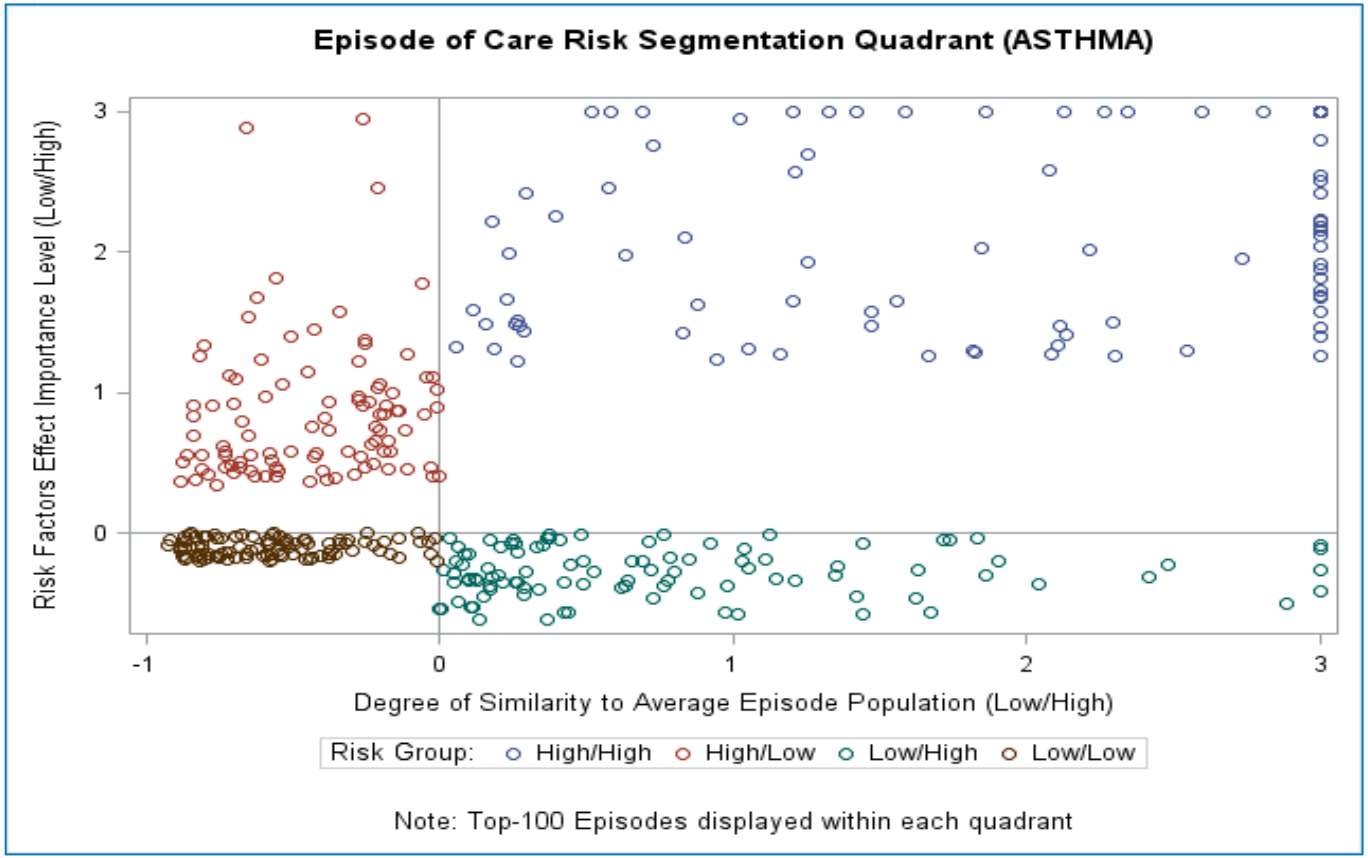
BUDGETING & V-ANALYTICS

- Bundled payments & contracts negotiation
- Service utilization &
- underuse gap analyses
- Population health management models

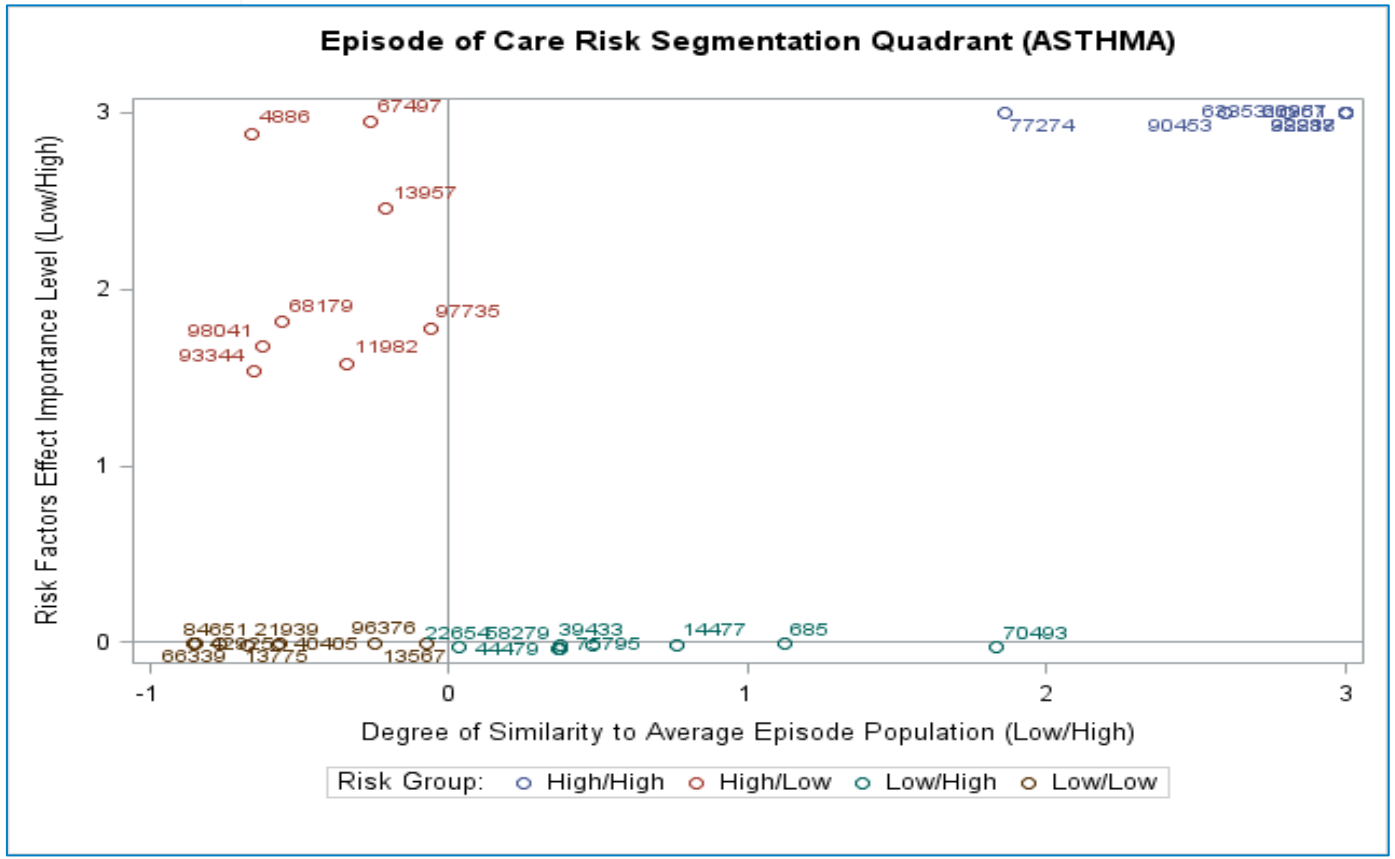
SAS® EPISODE ANALYTICS

PART 1 EOC COST-BASED RISK SCORE QUADRANT

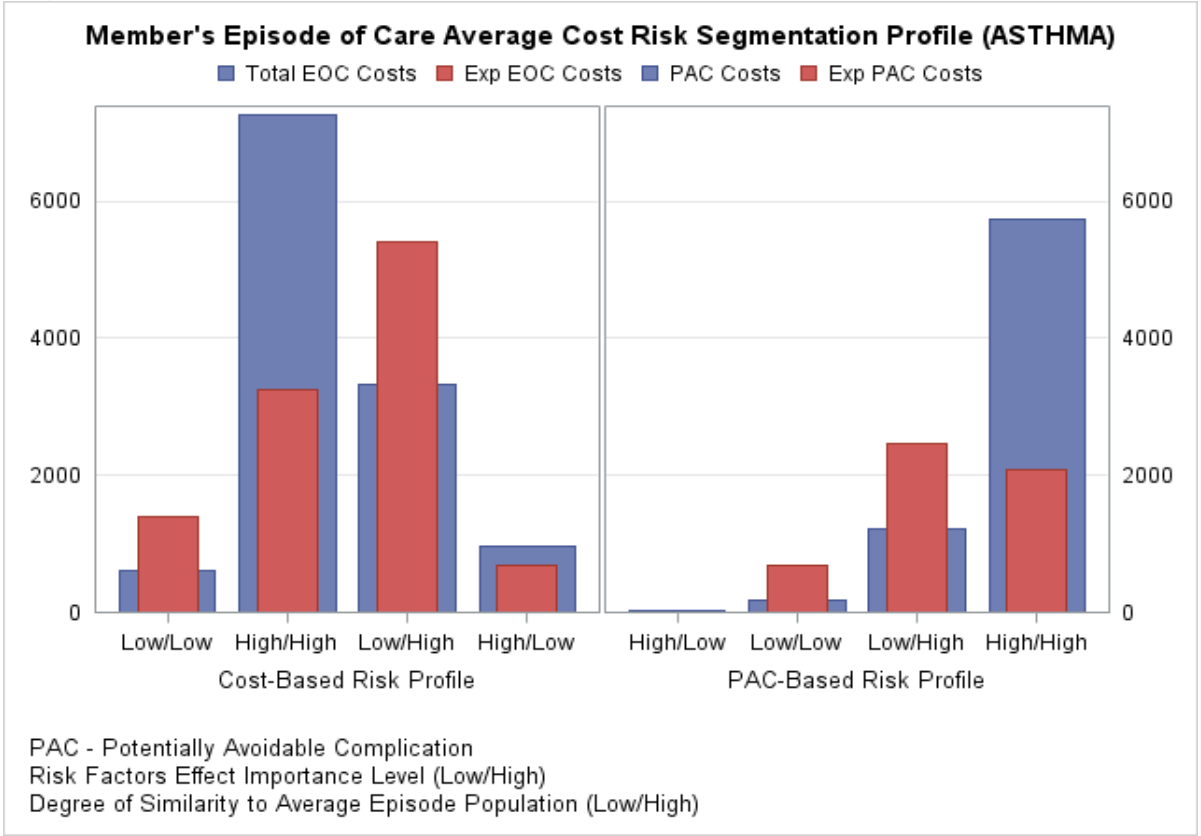
Cost-Based Risk Profile		
epi_pop_cost_riskquadrant	Frequency	Percent
High/High	254	15.64
High/Low	206	12.68
Low/High	116	7.14
Low/Low	1048	64.53



PART 1 EOC COST-BASED RISK SCORE QUADRANT

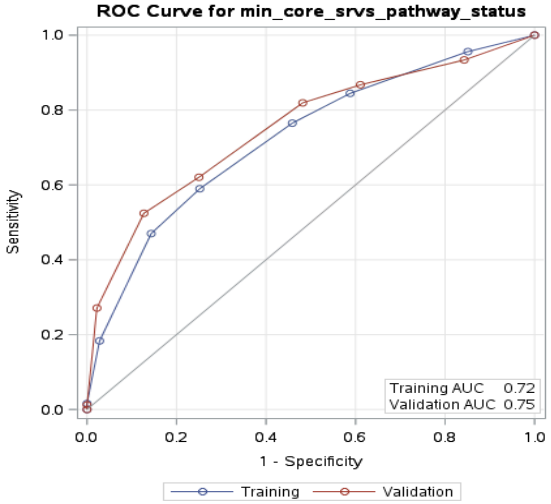


PART 1 EOC COST AND QUALITY RISK SCORES PROFILE



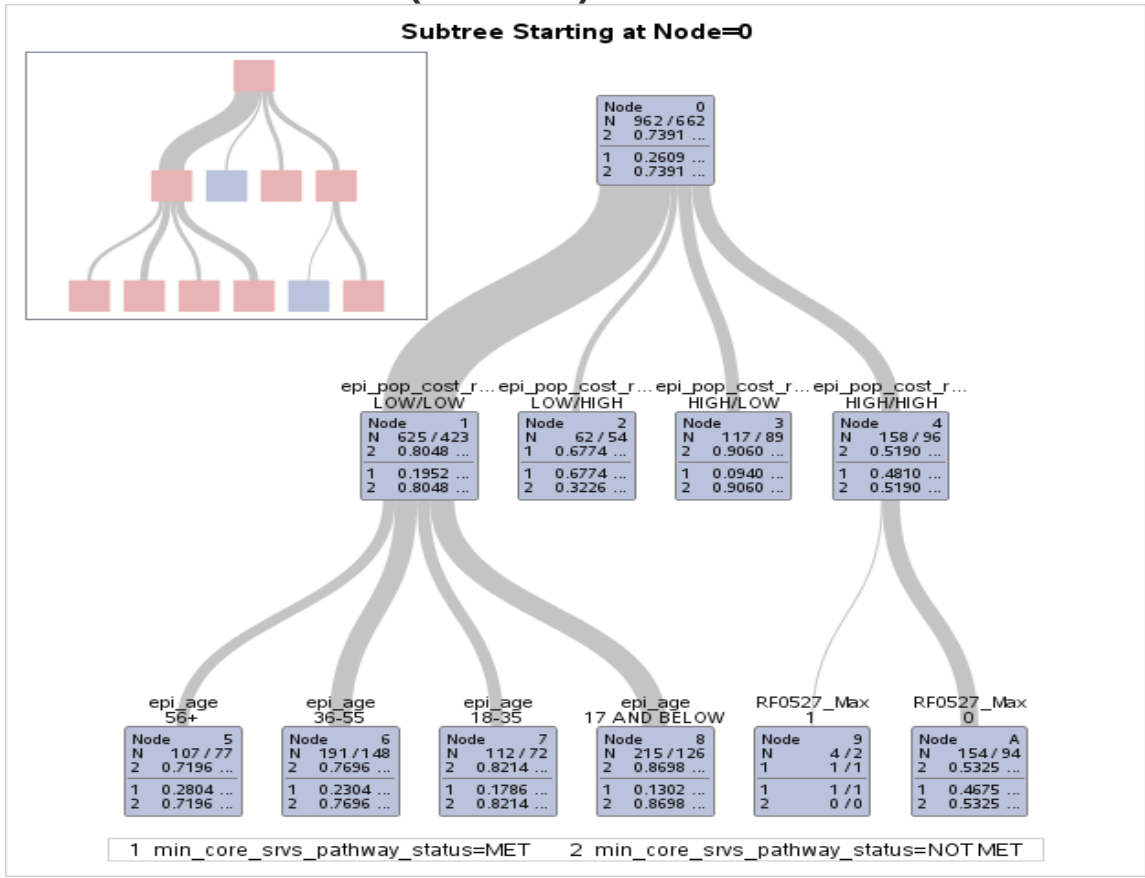
PART 2

PROPENSITY TO SEEK CARE: UTILIZATION OF RECOMMENDED PREVENTATIVE CORE SERVICES (ASTHMA)

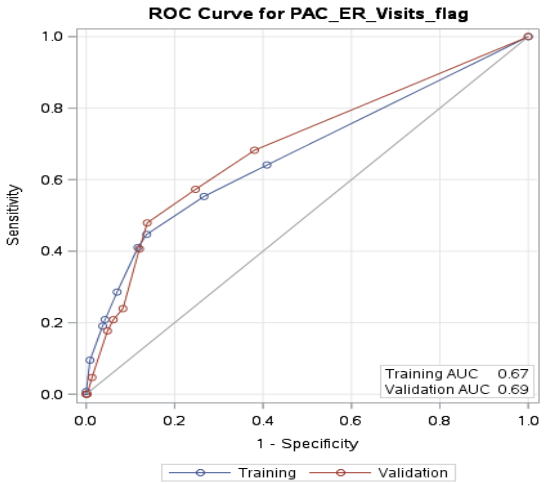


Variable Importance

Variable	Variable Label	Training Relative	Training Importance	Validation Relative	Validation Importance
epi_pop_cost_riskquadrant		1.0000	6.9811	1.0000	6.8919
epi_age		0.2829	1.9753	0.2180	1.5025
RF0527_Max		0.2130	1.4869	0.1600	1.1030

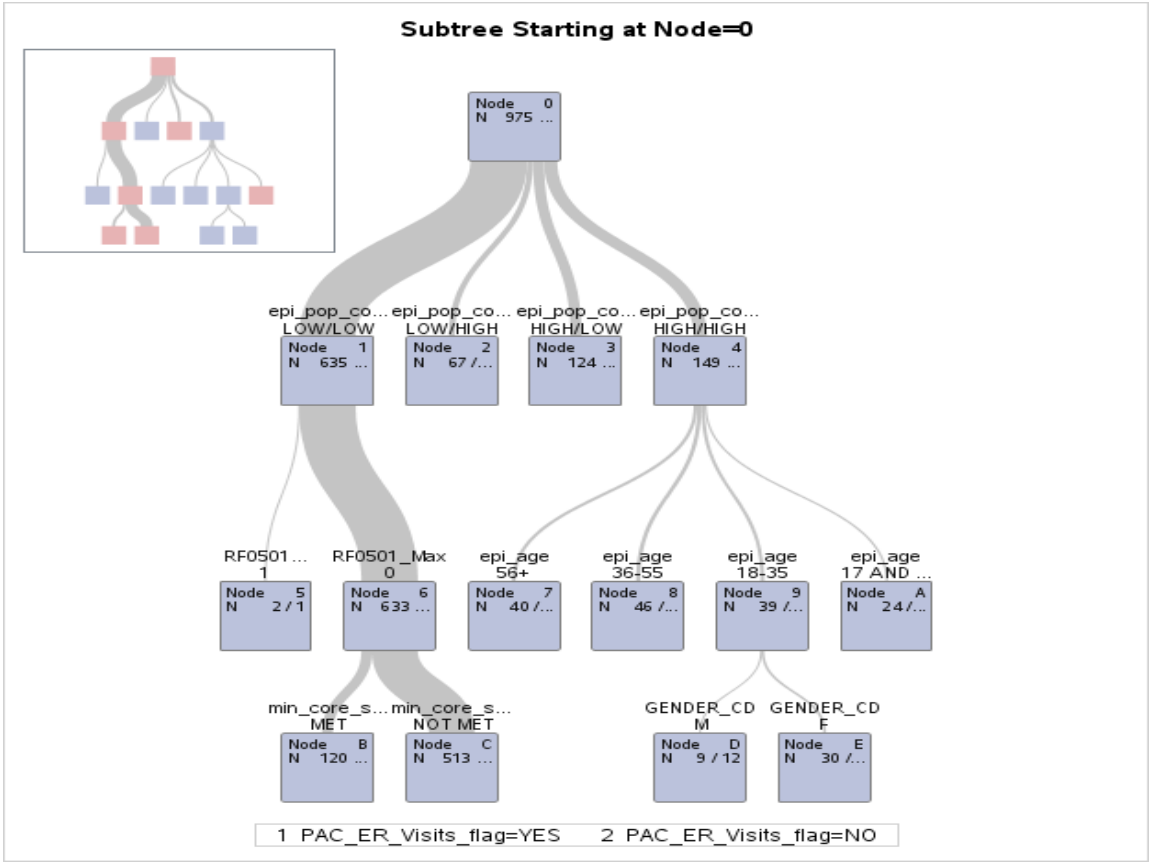


PART 3 | PROPENSITY FOR POTENTIALLY AVOIDABLE ER UTILIZATION (ASTHMA)



Variable Importance

Variable	Variable Label	Training		Validation	
		Relative	Importance	Relative	Importance
epi_pop_cost_riskquadrant		1.0000	6.5273	1.0000	5.9352
GENDER_CD	'	0.1394	0.9096	0.1636	0.9709
min_core_srvs_pathway_status		0.1082	0.7062	0.1440	0.8547
epi_age		0.2918	1.9046	0.0000	0
RF0501_Max		0.2445	1.5962	0.0000	0



OUTLINE

- Population Health Management (PHM)
- Case Study-1: Risk Segmentation Models for Members with a Chronic Condition
- **Case Study-2: Detecting Anomalies in Medicare Claims**
  - **Detecting 10,000 anomalous patients with ‘disproportionately-reported’ claims**
- SAS Panel Q/A Session

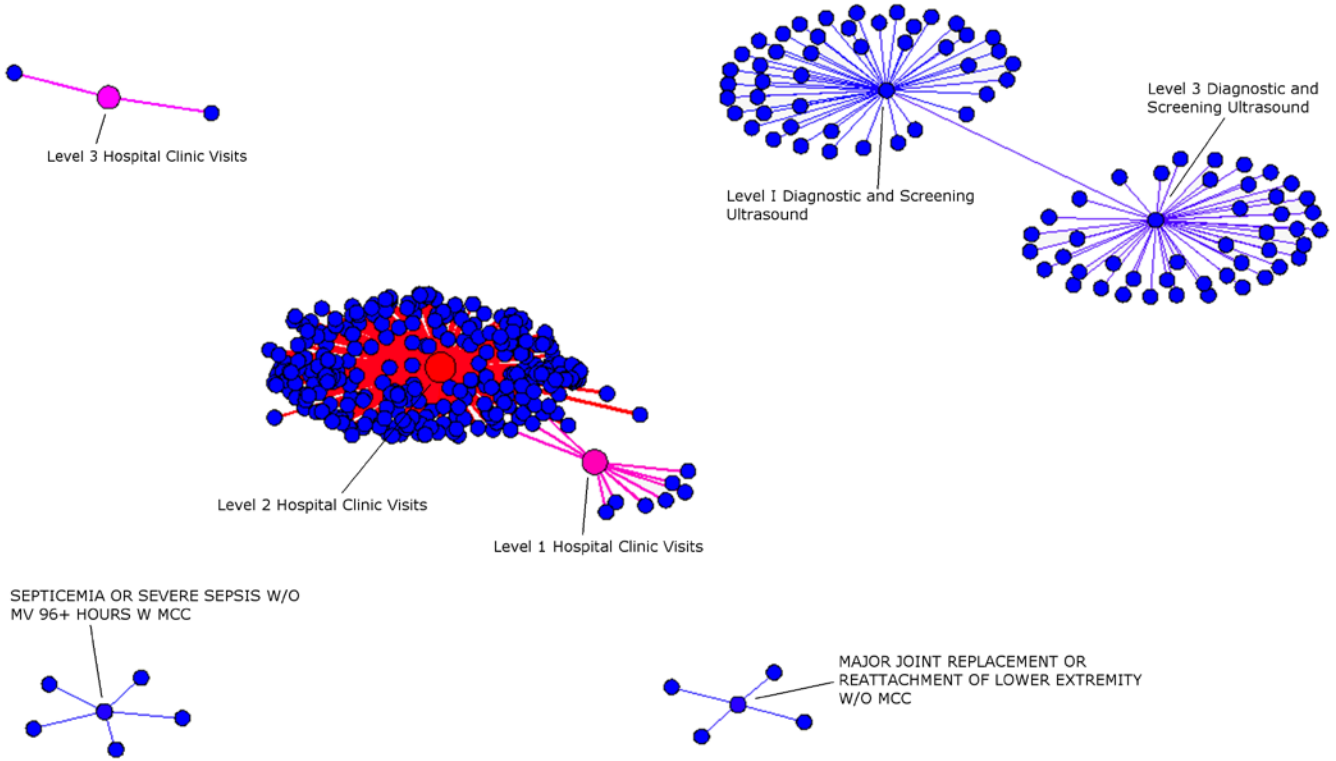
CASE STUDY-2

10,000 ANOMALOUS PATIENTS

Technologies	Analytical Techniques	Visualization Techniques
Base SAS® SAS® Enterprise Miner™ SAS® High-Performance Data Mining SAS® High-Performance Text Mining 24-core server with 128 GB RAM and 300 GB SSD 24-node Teradata appliance	Association analysis *k*-means clustering Singular value decomposition	Constellation plots

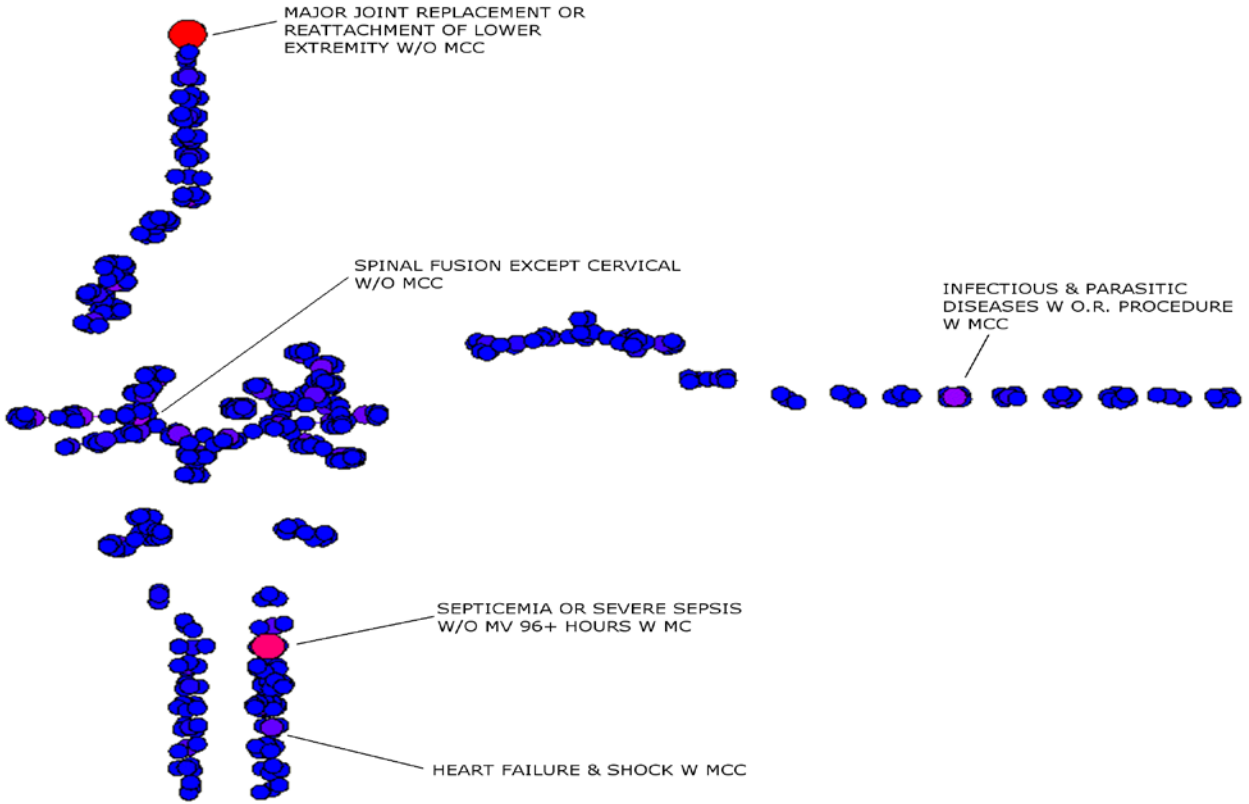
CASE STUDY-2

FREQUENT TRANSACTIONS: GENERAL PATIENT POPULATION



CASE STUDY-2

FREQUENT TRANSACTIONS: REVIEWED PATIENT POPULATION



SAS PANEL Q/A SESSION