

Programmatic Applications for Predictive Modeling of Nursing Home Entry

September, 2008



Overview of JEN Associates, Inc. Products and Services for Medicaid Clients

- JEN Associates Inc. (JAI) has been creating linked national and state-level Medicaid/Medicare analytic databases as well as stand alone state specific Medicaid analytic databases since 1985.
- JAI has supported its Medicaid clients by providing health policy analysis and evaluation as well as econometric and bio-statistical modeling using the linked and state specific databases mentioned above
- JAI has produced national and state level quality, utilization, financial as well as customized benchmarks for state Medicaid agencies
- JAI has completed evaluations of budget neutrality for Medicaid waiver programs during waiver development phases as well as post implementation evaluations under contracts with CMS and states.



Overview of JAI's Risk Identification Projects for Medicaid or State Agencies

- JAI has developed risk identification systems for Medicaid agencies so that program staff can identify and target interventions for those enrollees that may be at “high risk” of having an adverse outcome such as long term care admission, inpatient hospitalization, emergency room use and other adverse events using patterns of diagnoses and utilization from claims data.
- JAI Risk Identification Systems can be customized to address a state program's specific needs. Examples of customized Risk Identification Systems
 - Developed risk identification system requiring only prescription drug data for a state pharmacy assistance plan for the purpose of targeting “high risk” senior plan members for specialized outreach and education by the program's customer service staff during the implementation of Medicare Part D



Overview of JAI's Risk Identification Projects for Medicaid or State Agencies (continued)

- Developed a risk identification system for those Medicaid enrollees who have clinical markers that would indicate that they have a quantifiable risk of having a long-term care admission within a 9 to 12 month time frame. The benefit of this 9 to 12 month risk identification window allows for program staff to implement interventions that would either prevent or delay the LTC admission. A clinical marker associated with an imminent risk window of 1-3 months may not allow enough time for the program staff to affect or prevent the LTC admission (e.g. hip fracture).
- Currently working for one Medicaid Agency with Bull Services to develop a specialized risk identification system for use by Medicaid program staff for targeting “high risk” adults with severe mental illness and children with severe emotional disability who also have chronic diseases for care management interventions to prevent hospitalizations as well as other adverse outcomes



Abstract

The frail elderly in Nursing Homes represent the single most costly group to state Medicaid programs. Many of the efforts to contain costs for this population are focused on identifying Nursing Home Certifiable Medicaid beneficiaries living in the community. The effectiveness of this approach is limited by the frequency of NH residents who are not pre-identified as NHC or are not Medicaid eligible prior to the start of institutional care.

Tools to identify over the horizon risk for NH entry risk are required. The goal is to strategically invest in selected populations before the onset of permanent impairment. Predictive models using diagnostic information that are capable of identifying risk in advance of high cost outcomes can be used to screen individuals for program enrollment, target special financing and design tailored care interventions.



Predictive Model Application

- Current programs:
 - Reactive: highly selected and expensive per beneficiary
 - Proactive: enrollment not sufficiently targeted and too little spent per beneficiary for effective risk reduction
- Challenge:
 - Detecting risk from patterns in the claims data well before targeted outcome
- Programmatic Application:
 - Selective enrollment of true elevated risk population in medical case management and community support programs

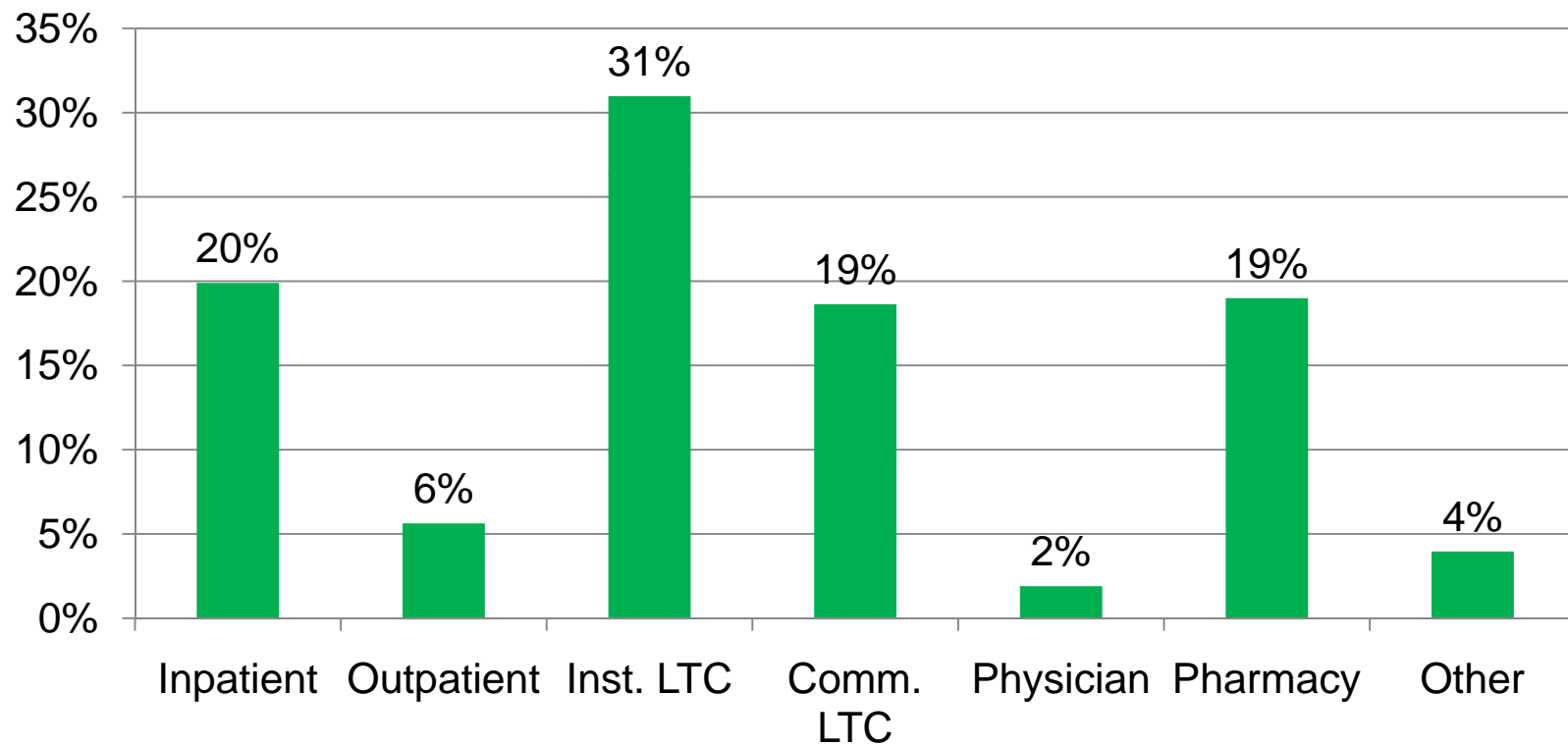


Setting Priorities for Use of Predictive Model

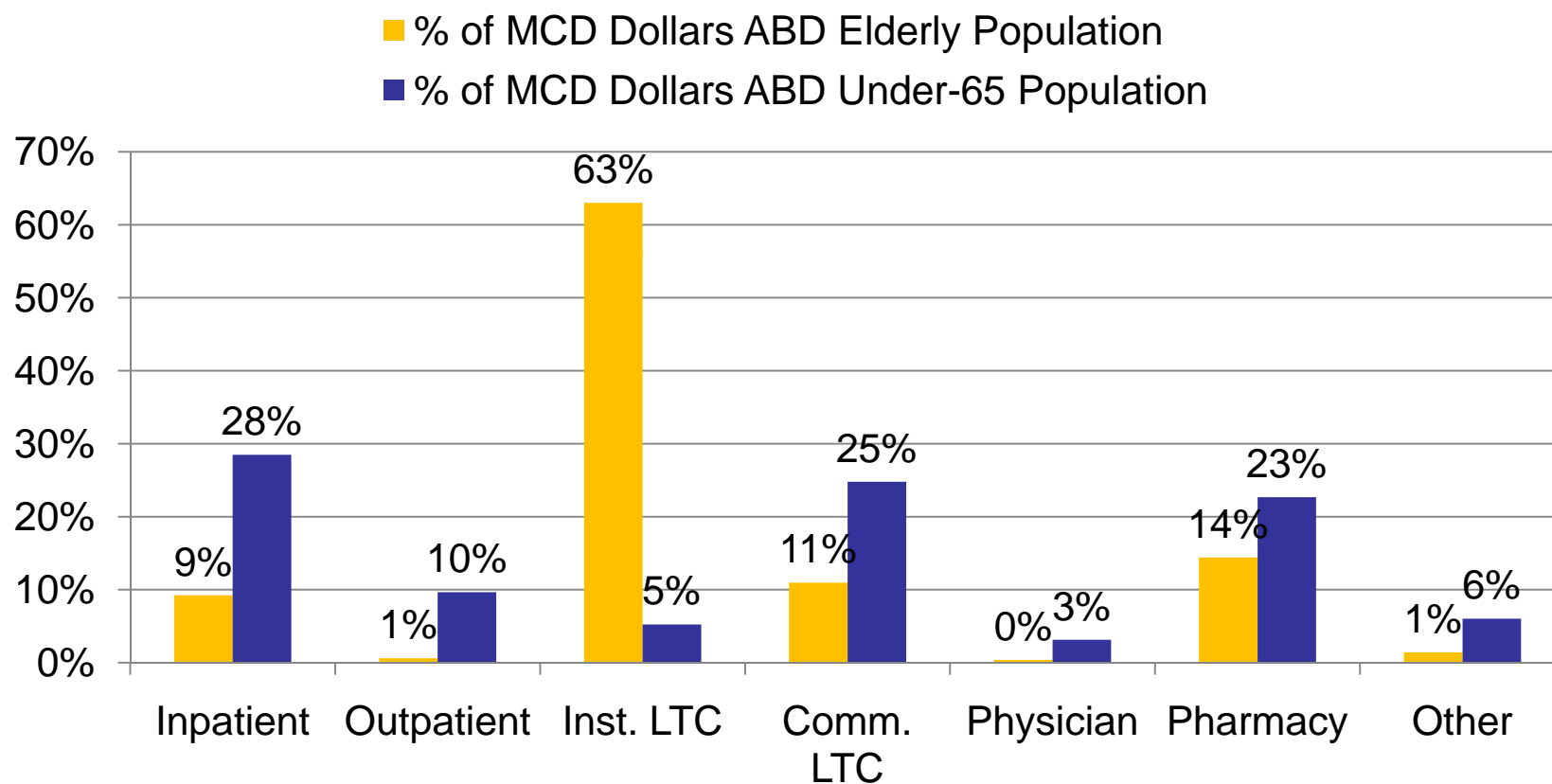
- Significant and Substantial Cost Sector
- Well defined outcome
- Intervention Sensitive Population
- Selective Eligibility Screens
- Small investment yields large returns
- Over 65
 - Long Term NH Placement
- Under 65
 - Preventable Hospitalization



Example Medicaid ABD Service Expenditures



Example Service Utilization Payments by Type within Major Age Group



National Payments from Medicaid and Medicare: Long Stay Elderly NH Residents with Dual Coverage

Count Type	2000	2001	2002
MCR Dollars	\$10,974,446,669	\$12,536,674,419	\$13,889,112,121
MCD Dollars	\$31,522,192,758	\$34,125,134,319	\$36,219,876,866
Total Dollars	\$42,496,639,427	\$46,661,808,739	\$50,108,988,987
Per Capita Eligibles (PCE)	890,402	898,528	896,502
Medicare Dollars PMPM	\$1,017	\$1,156	\$1,289
Medicaid Dollars PMPM	\$2,947	\$3,157	\$3,353



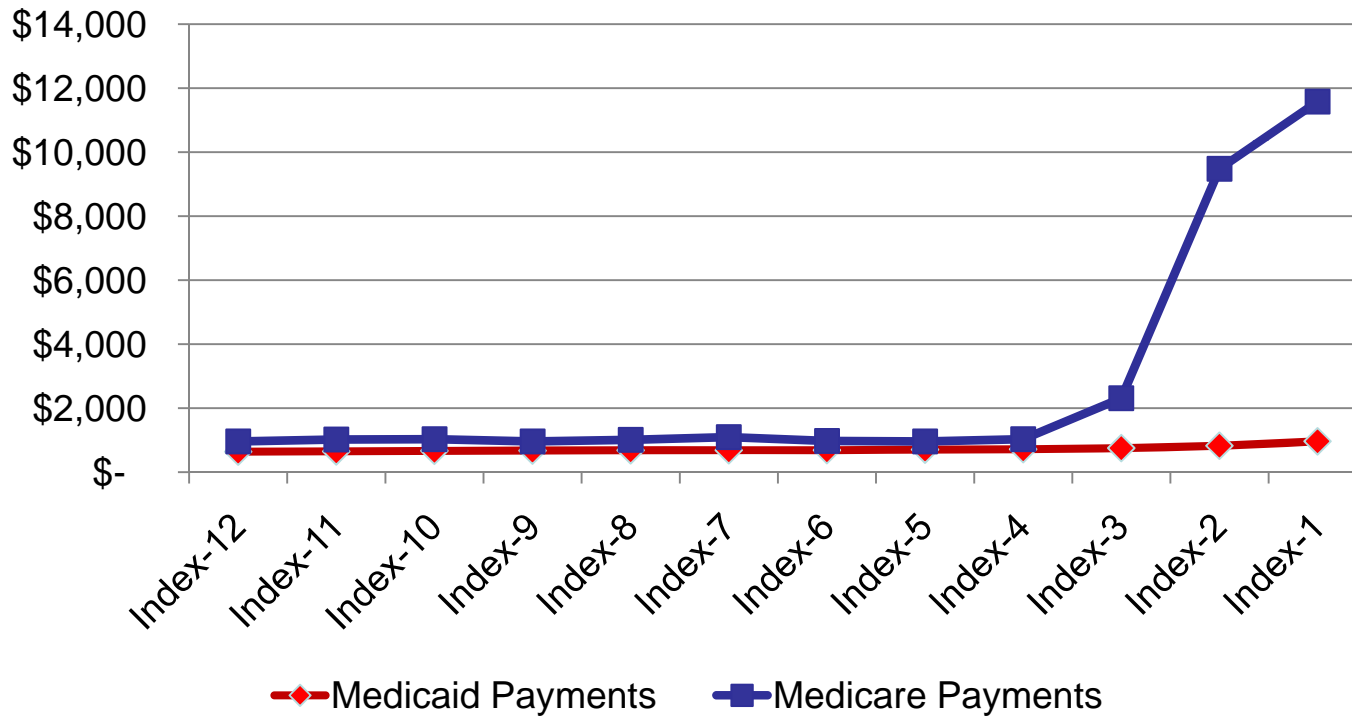
Policy Objective: Reducing Long Term Risk of NH Entry

- Can we identify populations with elevated risk significantly prior to substantial decline in function?
- Examples
 - Cognitive
 - Fall risk
 - Self Care
- Design program to provide sufficient services to reduce long term risk of NH entry in selected population
- Policy can include waived services for Medicaid beneficiaries and/or Medicaid expansion to the high risk Medicare-only



Example Pre Medicaid Financed NH Entry Payments

Medicaid and Medicare Expenditures on Pre NH Entry Population in 12 Months Prior to Index



Time Sensitive Predictive Models

- Imminent Risk
 - Risk apparent directly before the outcome
 - Captures a mix of acute onset of disability and end point of long term decline, highly selective
 - Intervention is focused on high cost stabilization and rehabilitation
 - Direct referral from providers and NHC assessment
- Prevention
 - Risk identifiable significantly before outcome
 - Correlation with outcome lower
 - Lower severity conditions and less selective
 - Intervention focused on reducing long term risks
 - Claims based outreach and recalibrated assessments

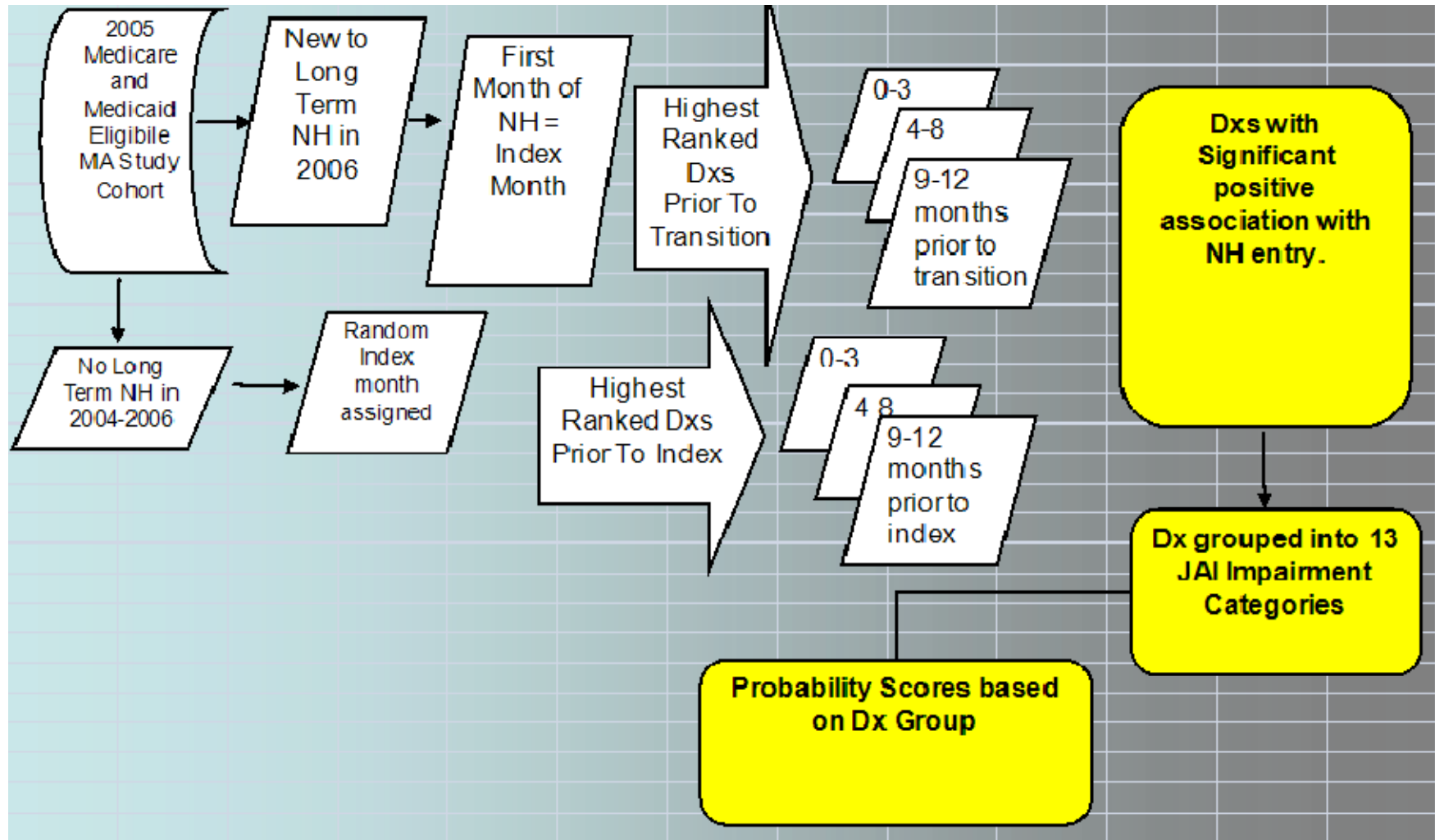


Implementing the Model Using Claims Data

- Identifying diagnoses from claims significantly correlated with NH entry with time sensitive parameters
- Filtering by correlation and measured significance
- Grouping by type and severity hierarchy
- Run the model using patient claim histories
- Calculating individual predictive probability based on model results
- Testing model performance: specificity and sensitivity
 - How well does model select beneficiaries with long term risk
 - How well does the model exclude low risk populations



Predictive Modeling Development Process



Example Imminent Risk Group: Top Correlated Diagnoses 1-3 Months Prior to Index Date

Claim Diagnoses	OR	LCL	UCL
SENILE/PRESENILE PSYCHOS	102.7	89.0	118.5
SUBARACHNOID HEMORRHAGE	95.7	37.0	247.3
TRAUMATIC AMPUTAT FOOT	73.8	15.9	341.6
TRANSIENT ORG MENTAL DIS	68.8	58.4	81.0
OTHER SKULL FRACTURE	65.5	7.3	586.1
INTRACEREBRAL HEMORRHAGE	64.1	40.0	102.6
PELVIC ORGAN INJURY	61.6	20.4	185.7
LOWER LIMB FRACTURE NEC	60.2	16.8	215.7
CEREBRAL LACER/CONTUSION	58.8	25.4	136.1



Example Prevention Group: Top Correlated Diagnoses 9-12 Months Prior to Index Date

Claim Diagnoses	OR	LCL	UCL
CEREBRAL DEGENERATION	9.53	8.46	10.74
PARKINSON'S DISEASE	5.28	4.32	6.47
NERV/MUSCULSKEL SYS SYMP	4.22	3.82	4.66
OTHER BRAIN CONDITIONS	3.34	2.66	4.20
VERTEBRL FX W/O CORD INJ	3.33	2.46	4.52
CHRONIC ULCER OF SKIN	3.18	2.73	3.70
OTH CEREBROVASC DISEASE	3.01	2.53	3.58
HYPOTENSION	3.01	2.46	3.68
CONTUSION FACE/SCALP/NCK	2.99	2.23	4.01



Diagnostic Grouper

- JAI Frailty Index
 - Classifies diagnoses by impact on function and level of correlation with outcome
 - 33 detailed groups
 - 13 Major groups after accounting for interactions and clustering
 - Cognition, example: dementia
 - Ambulation, example: gait abnormality
 - Self-Care, example: nutritional deficiency
 - Each category equally weighted and linear increase in probability of outcome with score increment



Prevention Patient Profile #1

- **Dual Eligible - Male**
- **Age 85+**
- **Pre Index Impairments**
 - Minor Ambulatory
 - Chronic Disease
 - Other Medical Risk
- **Chronic Disease Indicators**
 - Chronic Heart Disease
 - Chronic Heart Failure
- **Pre-Index Diagnoses (9-12 months)**
 - (389) Hearing Loss
 - (410) Acute Myocardial Infarction
 - (414) Other Chronic Ischemic Heart Disease
 - (426) Conduction Disorder
 - (427) Cardiac Dysrhythmia
 - (428) Heart Failure
 - (518) Other Lung Diseases
 - (564) Funct Digestive Dis NEC
 - (599) Other Urinary Tract Disorder
 - (784) Symptoms Involving Head/Neck
 - (786) Resp System/Other Chest Symptoms



Prevention Patient Profile #2

- **Medicare only – Female**
- **Age 85+**
- **Pre-Index Impairment**
 - Dementia
 - Other
- **Chronic Disease**
 - Arthritis
- **Pre-Index Diagnoses (9-12 months)**
 - (331) Cerebral Degeneration
 - (380) Disorder of External Ear
 - (465) AC URI Multiple Sites/NOS
 - (681) Cellulitis, Finger/Toe



Prevention Patient Profile #3

- **Dual – Female**
- **Age 85+**
- **Pre-Index Impairment**
 - Minor Ambulatory
 - Cancer
- **Chronic Disease**
 - Chronic Heart Disease
- **Pre-Index Diagnoses (9-12 months)**
 - (110) Dermatophytosis
 - (174) Malig Neo Female Breast
 - (380) Disorder of Ext Ear
 - (389) Hearing Loss
 - (401) Essential Hypertension
 - (440) Atherosclerosis
 - (724) Back Disorder NEC/NOS
 - (729) Other Soft Tissue Dis
 - (739) Somatic Dysfunction
 - (751) Other Anom Digestive Sys
 - (782) Skin/Oth Integument Symp
 - (786) Resp Sys/Oth Chest Symp
 - (789) Oth Abdom/Pelvis Symp



Example Prevention Model Performance Table

Percentile	Predicted Entry	True Pos.	False Pos.	True Neg.	False Neg.	Sensitivit.	Specificity	False Positive to True Positive Ratio
100	0.3%	0.1%	0.2%	92.3%	7.4%	1.7%	99.8%	1.71
99	0.9%	0.3%	0.6%	91.9%	7.2%	4.2%	99.3%	1.94
98	1.5%	0.5%	1.0%	91.5%	6.9%	7.3%	98.9%	1.78
97	2.7%	1.0%	1.7%	90.8%	6.5%	13.4%	98.2%	1.69
96	3.7%	1.4%	2.3%	90.2%	6.1%	18.1%	97.5%	1.73
95	5.1%	1.7%	3.4%	89.1%	5.8%	22.3%	96.3%	2.03
94	5.1%	1.7%	3.4%	89.1%	5.8%	22.3%	96.3%	2.03
93	5.1%	1.7%	3.4%	89.1%	5.8%	22.3%	96.3%	2.03
92	5.1%	1.7%	3.4%	89.1%	5.8%	22.3%	96.3%	2.03
91	5.1%	1.7%	3.4%	89.1%	5.8%	22.3%	96.3%	2.03
90	9.5%	2.3%	7.2%	85.3%	5.2%	30.4%	92.2%	3.17
89	11.4%	2.5%	8.9%	83.6%	5.0%	33.0%	90.3%	3.61
88	11.8%	2.5%	9.3%	83.2%	5.0%	33.7%	90.0%	3.67
87	12.8%	2.6%	10.2%	82.4%	4.9%	35.0%	89.0%	3.87
86	12.8%	2.6%	10.2%	82.4%	4.9%	35.0%	89.0%	3.87
85	12.8%	2.6%	10.2%	82.4%	4.9%	35.0%	89.0%	3.87



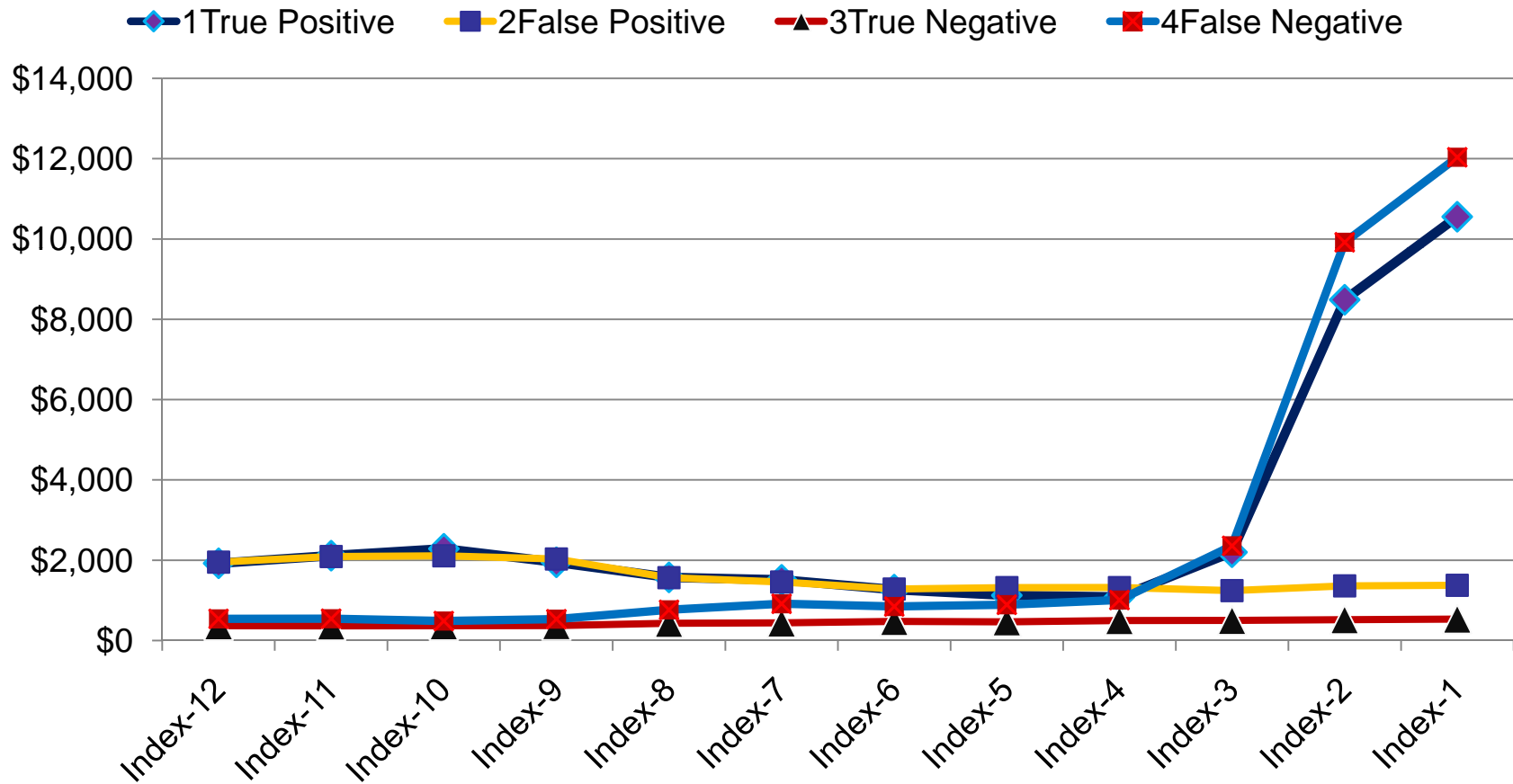
Prevention Model Performance

- Performance Summary at 90th Percentile
 - 10% of population identified as high risk
 - 1 in 4 of predicted high risk group actually enter a NH in 9-12 months
 - 2 in 3 of actual NH entrants not flagged in 9-12 month window
- What characterizes the sub-groups...
 - Is the “false positive” population not high risk?
 - Is the “false negative” population not identifiable?



Example Utilization Rates Over Time

Index= NH Entry Month by Prevention Sub-Group



Prevention Sub-Group Characteristics

- False Positives are an acute event away from NH risk and do show all the characteristics of a high risk population
 - Utilization and risk profiles the parallel to true positives, **except** no acute episode in last 3 months
- False negatives do not exhibit risk until 3-months prior to entry
 - Identifiable as imminent risk-only group with a precipitating acute episode leading to NH care



Practical Application of Measured Prediction Selection in Budget Neutrality

- NH prediction group in top decile of risk has a 30% rate of True Positives
- Pre-Index Medicaid monthly utilization for NH Prediction population is \$650 in 2006
- Post-Index monthly Medicaid costs for NH care in sample state is \$4,500
- Budget Neutrality and Program Budgets follow based on
 - Intervention's clinically validated diversion/deferral success rate



Example Simple Year 1 Budget Neutrality Model

Prevention Group Prediction	10,000
Pre-NH Medicaid	\$650
Post Index Medicaid	\$4,500
True Positive Rate	30%
Intervention Diversion Rate	50%
Base Year Payments	\$78,000,000
Year 1 No Intervention	\$216,600,000
True Positive Population	3,000
Diversion Population	1,500
Year 1 With Diversion	\$147,300,000
Intervention Maximum Allowable Cost	\$69,300,000
Intervention PmPm	\$578



Recalibration of Assessment Tools

- Instruments designed for NHC identification but can be used to detect lower level frailty
- Cross-walk between correlated claim diagnoses and questions in MDS-Home Care assessment instrument
- Reduce model to use only common data
- Implement a scoring system to translate patterns of responses to a predicted probability of over-the-horizon risk
- Select predicted probability thresholds for anticipated size and effectiveness of program



Programmatic Applications of the NH Model

- Program managers have a better handle on the number of ABD enrollees at varying levels of risk for NH entry after the enrollees have been scored by the NH Risk Identification System which supports both budget neutrality and case load analyses.
- Using the NH Risk Identification System, Program Managers can scale up or down the number of ABD enrollees that they want to assess for inclusion in prevention/intervention services based on staffing and budget limitations or requirements
- Program managers can modify their current clinical assessment surveys/tools to include previously unrecognized conditions that may signal long-term risk of NH entry for their specific ABD populations and programs
- Generally, a more targeted and efficient approach to identifying “at risk” enrollees for care management programs geared to preventing or delaying NH entries



Disease Management in Under 65 Population

- Policy:
 - Disease management in disabled populations
- Challenge:
 - What factors can be identified from claim data correlated with future failures in medical management?
 - Preventable Hospitalizations
 - Excessive use of ERs
- Develop Prevention Group identification model for complications of chronic disease care with a co-occurring mental health disability



Medi-Cal Application

- Demonstration of model effectiveness
 - SMI
 - SED
- Implementation in data warehouse operated by Bull Services
 - Claim feed into data warehouse used to update patient longitudinal diagnostic and utilization histories
- Messaging to CalMEND intervention managers as high risk beneficiaries flagged
- Continued monitoring via the data warehouse of high risk beneficiaries and intervention effectiveness



CALMEND-Quality Improvement: Clinically Informed Outcomes Management

CALMEND is a transformed person-centered and recovery-oriented approach to providing and receiving mental health services—largely for adults with severe and persistent mental illness, in effort to guide consistent quality driven practices that truly promote and sustain each person’s individual recovery journey.



Actions

- Identify clients with SMI and SED
- Develop algorithms to predict SMI and SED
 - Develop well targeted intervention and prevention programs

Results

- Identify effective treatment and care practices
- Enhance treatment/service outcomes by supporting the treatment team in identifying clients at risk of unfavorable outcomes
 - Provide support to the treatment team to more effectively support client by prompting consideration of alternative strategies

