Identification of Potential Care Management Savings Using Chronic and Acute Impact Indices

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Patent pending for Acute and Chronic Impact Indices

MEDai
accurate impactable solutions

AGENDA

- Problem /Solution /Methodology
- Health Cost Components
- Evidence Based Guideline Gaps
- ROI Methods
- Chronic Impact Index
- Acute Impact Index

Problem

- Problem
  - Identifying members for Care Management
- Create solution for Care Management that
  - Identifies Impactable Members
  - Easy to Rank/prioritize members
  - Forecast Resources separately
  - Provides followup actions
  - Integrates Members information
  - Integrates into CM workflow
  - Results in ROI

Solution

- High-risk Identification
  - Only Step 1
  - Catastrophic Members often not impactable
- Forecasting Inpatient Stays, ER visits, Rx$
  - Individualized action plans per member
- Forecasting Acute Care Cost
  - Identifies members with potential for high acute-cost
- Forecasting Savings
  - Identifies members with the greatest opportunity for chronic savings
  - Highest Impactability & ROI
- Implementing Forecast via Impact Index
  - Acute & Chronic Index
  - Easily Ranks Members
- Implement into Care Management tool
  - detailed Member Profiles & data mining integrated

Study Methodology - Overview

- Acute Index
  - Create Model to forecast acute-cost
- Chronic Index
  - Create Model to forecast Savings based on Yr2 Chronic Cost – Yr1 Chronic Cost
  - Evaluates members following guidelines vs those not
  - Applies weights to gaps & diseases in order to forecast savings opportunity
  - Forecasted Savings based on member's
    - Disease
    - Severity
    - Compliance to evidence based guidelines

HEALTH COST COMPONENTS

Health Cost Components

Total $

Acute $ - Nonrepeatable $ - 20%

Chronic $ - Repeatable $ - 80%

Misc Preventive$

- For 70% of members, the difference between Yr1 & Yr2 chronic cost is < $500
- 15% of members, hospitalized during Yr1 also Yr2 ;
- 27% of members with ER Yr1 also Yr2;
- 30% of members with IP/ER visits during Yr1 also Yr2

Health Cost Components

- Acute $
  - Inpatient Care
    - facility charges
    - professional services related to facility care
  - Emergency Room Services
  - Facility Based Outpatient Care
    - ambulance
    - ambulatory surgery
    - observation and treatment room charges
    - costly radiology and nuclear medicine
    - CT and MRIs

Health Cost Components

- Misc Preventive $
  - Non-routine preventive services
  - Immunizations - long immunity periods
    - Hepatitis vaccine / Tetanus booster
  - Sports insurance / Physicals / Drug testing
  - Antigen testing
    - Detecting hereditary cancer
  - Colonoscopy
- Chronic $
  - All $ besides acute and above preventive

Diseases and Guidelines

Diseases

Diseases In Current Chronic Impact Index

- **Diabetes**
- **CAD**
- **CHF**
- **Hyperlipidemia**
- **CVA/TIA**
- **Asthma**
- **COPD**
- **Depression**

Potential Diseases for future Chronic Impact Index

- Preventative
- Osteoporosis
- Schizophrenia
- HIV/Aids
- Rheumatoid Arthritis
- Migraine
- Multiple Sclerosis
- Chronic Renal Failure
- High Risk Pregnancy

Diabetes Guidelines

- Diabetes with eye exam
- Diabetes with HGBA1C testing
- Diabetes with microalbuminuria testing
- Diabetes with ACE inhibitor
- Diabetes with LDL testing
- Diabetes w/hypertension used appropriate Rx
- Diabetes missing multiple guidelines

CHF Guidelines

- CHF w/ hypertension & using appropriate Rx
- CHF with hypertension and received ECG
- CHF and received ACE, ARB or beta blockers
- CHF on digoxin and received a digoxin level
- Inpatient for CHF and received ECG
- CHF and received appropriate medications
- CHF with hypertension and received ACE/ARB
- CHF with diuretics and received a chemistry panel
- CHF with atrial Fib on coumadin

CVA/TIA Guidelines

- CVA with atrial fib on Coumadin
- CVA on coumadin or clot inhibitor
- CVA and received lipid lab testing
- CVA w/ hypertension & using appropriate Rx
- CVA on Coumadin and received a protime test

GAPS - Statistics

Disease	Count	%	Y1$	Y2$
CHF	4,498	0.5	9.45	6.54
CVA	3,625	0.4	8.00	4.89
CAD	19,334	2	5.82	4.05
COPD	13,225	2	4.79	3.76
Diabetes	41,111	5	3.38	3.15
Depression	27,544	3	2.89	2.54
Asthma	28,777	3	2.58	2.25
HyperLipidemia	126,846	14	2.45	2.29
Total Diseases	183,128	**20**	2.49	2.28
Gaps=0 compliant	63,933	7	2.26	2.13
Gaps>0 noncompliant	119,234	13	2.61	2.35
Total	892,577	100%	$2,282	$2,616

Disease Management ROI Methodologies

Calculation of Cost Savings - ROI

- Choosing Disease Management programs based on ROI
- Two Calculation Approaches
  - Direct Approach

    Total cost for disease-specific member
  - Indirect Approach

    Utilization measures like admits, ER visits, procedures

ROI Methods

- Pretest–posttest design
  - before & after DM implementation
  - most common method
  - no control group for outcome comparisons
  - several sources of bias
  - competing extraneous confounding factors
  - difficult to conclude difference due to program intervention
- Randomized Control Trial
  - ideal for overcoming above issues
  - not practical
    - DM already underway
    - time and effort
    - control group ethical/legal considerations

ROI Methods

- Comparison Study vs Control Group
  - reliable
  - control & study group may be reasonably similar, but not identical/randomized-selection as in randomized control
- Propensity Score
  - Study/managed group vs control/non-managed group
    - with differences on their covariates
    - leads to biased estimates of cost savings
  - Propensity Score - the conditional probability of being managed given the covariates
    - Used to balance covariates in the two groups & reduce bias
    - To create this balancing PS uses:

      matching, stratification, regression adjustment or combination

ROI Methods

Predictive Model Adjustment – MEDai's approach

- Instead of comparing 2 groups
- Build predictive model that accounts for differences between them
- Control group data used to develop model that calculates expected-costs for study group
- Predictive model avoids differences between both groups.
- Predictive model blind to differences because
  - We build expected costs model using the control group and apply it on the study group

Savings for study group = Actual$ - Expected$

Predictive Model Approach – Chronic Impact Index

Predictive Model – Chronic Impact Index

- **Problem**:
  - 8 diseases with 42 gaps
  - decision support system that identifies compliance to guidelines using
    - Medical/ Rx claims/ lab results
  - Create model to calculate
    - member-level savings for any combination of gaps and diseases.
  - Savings based on:
    - gap disease(s)
    - gaps' count
    - severity of the member's health status
    - demographics (sex, age)

Predictive Model – Chronic Impact Index

- Dependent Variable – Chronic Savings

-1
- Does not have one of the chronic diseases/conditions Indicates NA

0$
- No savings opportunity
- Has disease but is following all recommended guidelines

>0$
- Has savings opportunities
- Patients with one of the chronic diseases
- Not following guidelines
- Patients with catastrophic disease or outlier-cost are weighted down

Predictive Model – Chronic Impact Index

- No strict separation of members into study vs control
  - Diabetic Member
  - Compliant with guidelines 3 thru 7
    - part of the control group
  - Noncompliant with guidelines 1&2
    - part of the study group for calculation of the cost savings for guidelines 1&2
  - Members participated in different DM programs. Therefore we have to reduce the bias at the individual level, not only at group level

Predictive Model – Chronic Impact Index

- To create generalizable model across 8 diseases:
  - Requires many disease/gap combinations
  - Large number of members with gaps and without gaps

- Working Hypothesis:
  - The 8 diseases/gaps have different influences on cost components according to forecast period
    - Short Forecast Period (1-2 yrs)

      Gaps main influence are on chronic cost
    - Longer forecast (4+ yrs)

      Gaps lead to more severe diseases / much higher cost - acute cost

Chronic Impact Index – The Model

Overall Study Group Savings =

- **Actual$ - Expected$**

- Future Actual Chronic$
  - is not only the result of guideline compliance
  - Other factors
  - therefore can't use Chronic$ of non-compliant members but instead must smooth this cost to avoid uncertainty/bias thru modeling
- Model should use
  - expected Cost if member 100% compliant
  - gap diseases/gaps/Chronic$/demographics if pt noncompliant

Individual Savings =

- **Expected$(non-compliant) - Expected$(compliant)**

Chronic Impact Index – Data

- Data
  - 2 years claims data
    - 671,513 members at least one disease
      - Compliant Members - 210,472
      - Non compliant - 461,041

        Randomly Split into two datasets A&B
      - Many cost savings studies use only a few hundred - few thousands members (max <50k)

- Training Set
  - Compliant Member Dataset
  - Noncompliant dataset A
- Validation Set
  - Noncompliant dataset B

Chronic Impact Index – Modeling Steps

- **Step1**
  - Use Compliant Member dataset to develop model to calculate Compliant-Expected-Chronic$
  - non-linear model many clusters
    interactions/transformations of the predictors
    mini-models for more than 18 different body systems
- **Step2**
  - Apply Step1 model on Noncompliant members Data Set A to calculate their Compliant-Expected-Chronic$
    as if they had no gaps

Chronic Impact Index – Modeling Steps

- Step3
  - Use NonCompliant Dataset A to develop model to calculate NonCompliant-Expected-Chronic$
  - Basically adjust Compliant-Expected-Chronic$ for the non-compliant members using predictors that describe gaps/diseases/severity
- Step4:
  - Apply Step3 model on NonCompliant DataSet B Validation Set
- Individual Savings =

  Non-CompliantExpectedChronic$ - CompliantExpectedChronic$

Chronic Impact Index – Modeling Steps

- Step5: Adjustment based on
  - Catastrophic disease presence
  - Severity according to year1 chronic cost
- Parameters
  - Catastrophic & chronicyr1 $\geq$ \$25k
  - Catastrophic & chronicyr1 \$5-\$25k
  - No catastrophic but chronicyr1 $\geq$ \$50k
  - No catastrophic but chronicyr1 \$35-50k

Chronic Impact Index – Formulate the Index

- Create Easy to use **Index**
  - Convert $ Savings to percentile ranking
  - Percentile Ranges:

0	• Does not have one of the 8 diseases Indicates NA
10	• No savings opportunity • Has disease but is following all recommended guidelines
70-100	• Has savings opportunities • Patients with one of the chronic diseases • Not following guidelines • Range typically around 70-100 but can be 66-100 or 93-100 etc. depending on your plan's percentage of noncompliant patients.

Results – from Chronic Impact Model

Results

- Validation set
  - Truncation - $50k
  - Forecasting Year2 Chronic $

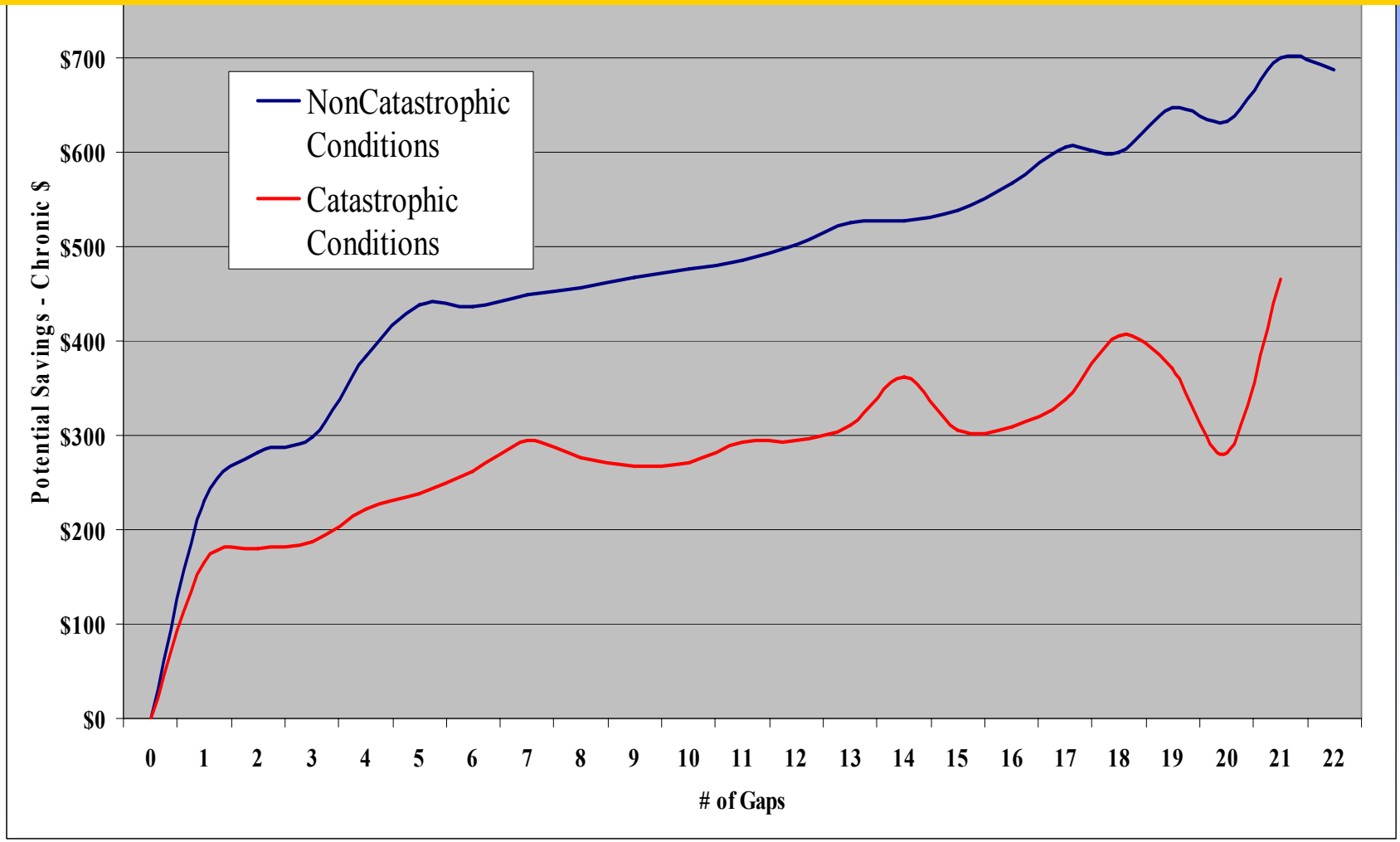
Model	Corr	R2	Sn(10%)
Chronic1$	.611	.301	50.16%
CompliantChronic$	.643	.407	53.34%
Non-CompliantChronic$	.644	.414	53.76%

Results

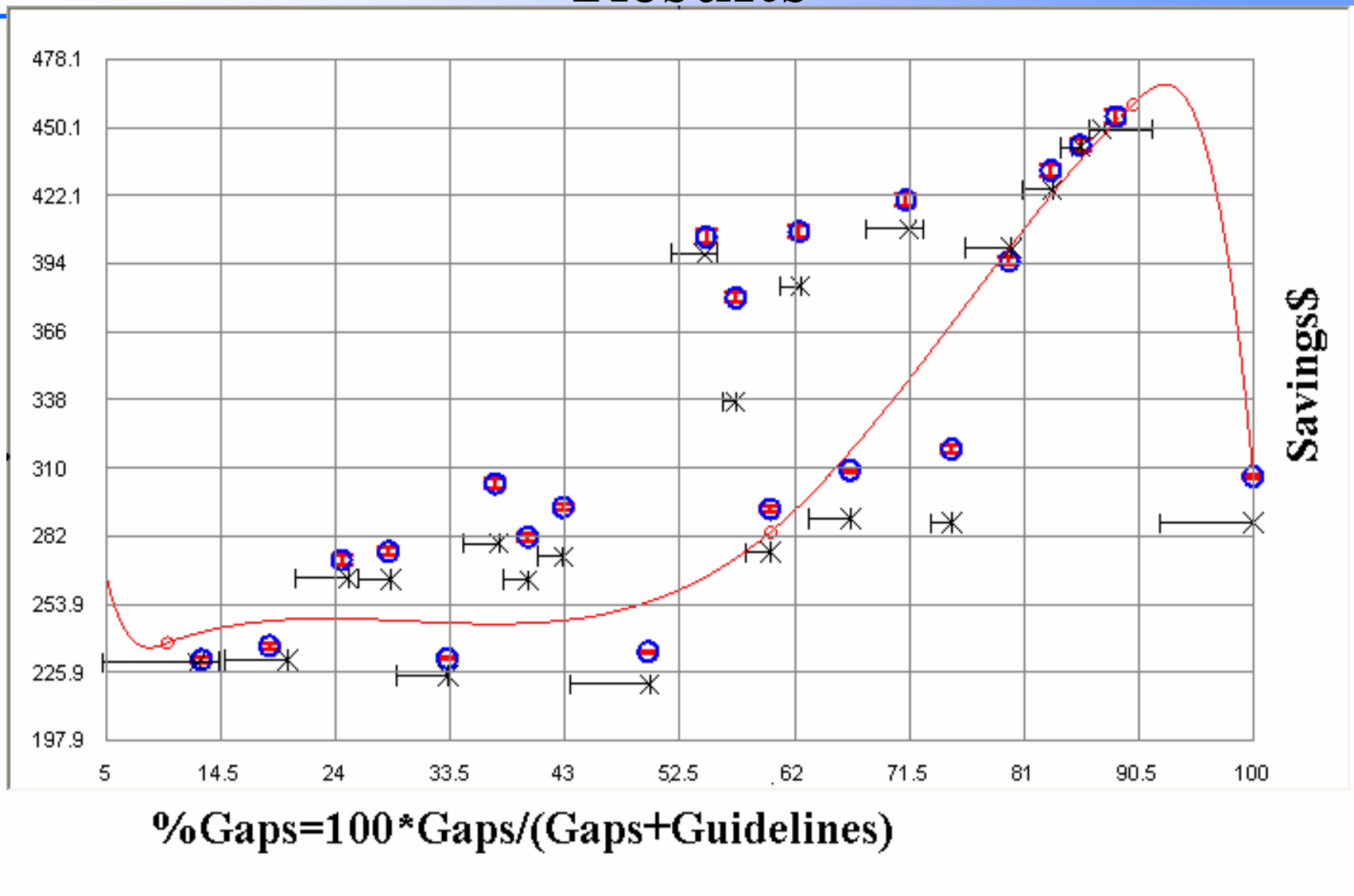
Gaps	Count	Chr1$	Chronic Savings$	Guide lines	Diseases	Claims#	Body System
1	114102	1851	**214**	1.58	1.08	15.50	5.04
2	84243	1977	**270**	1.45	1.19	16.17	4.99
3	63171	2076	**282**	1.83	1.34	17.38	4.91
4	33626	2745	**374**	2.57	1.61	20.70	5.50
5	26962	2664	**429**	1.88	1.64	19.46	5.18
6	11865	3201	**426**	2.69	2.12	24.79	6.06
7	7315	3352	**435**	2.81	2.41	27.92	6.32
8	3856	4003	**438**	3.26	2.67	32.89	6.85
9	2158	4399	**441**	3.93	3.07	39.45	7.40
10	3438	4621	**464**	3.53	3.35	46.48	7.72
Total	350,736	2213	289	1.83	1.36	18.02	5.18

Chronic Impact Index:

- Higher potential savings when you can close the gap on patients with numerous noncompliant guidelines.
- Weights vary among diseases & guidelines.
- Catastrophic conditions show less savings potential

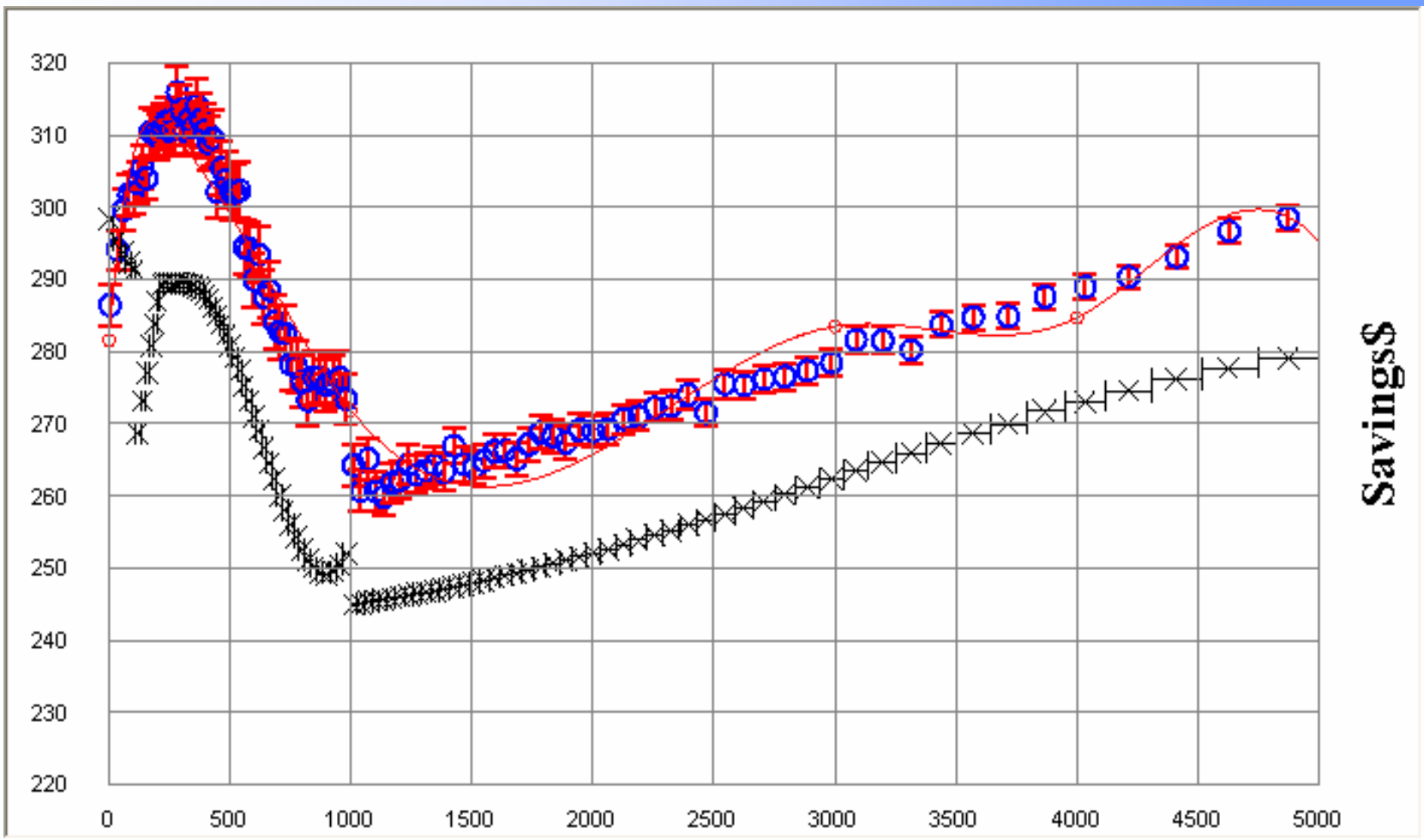


Results



Potential savings generally increases with noncompliance

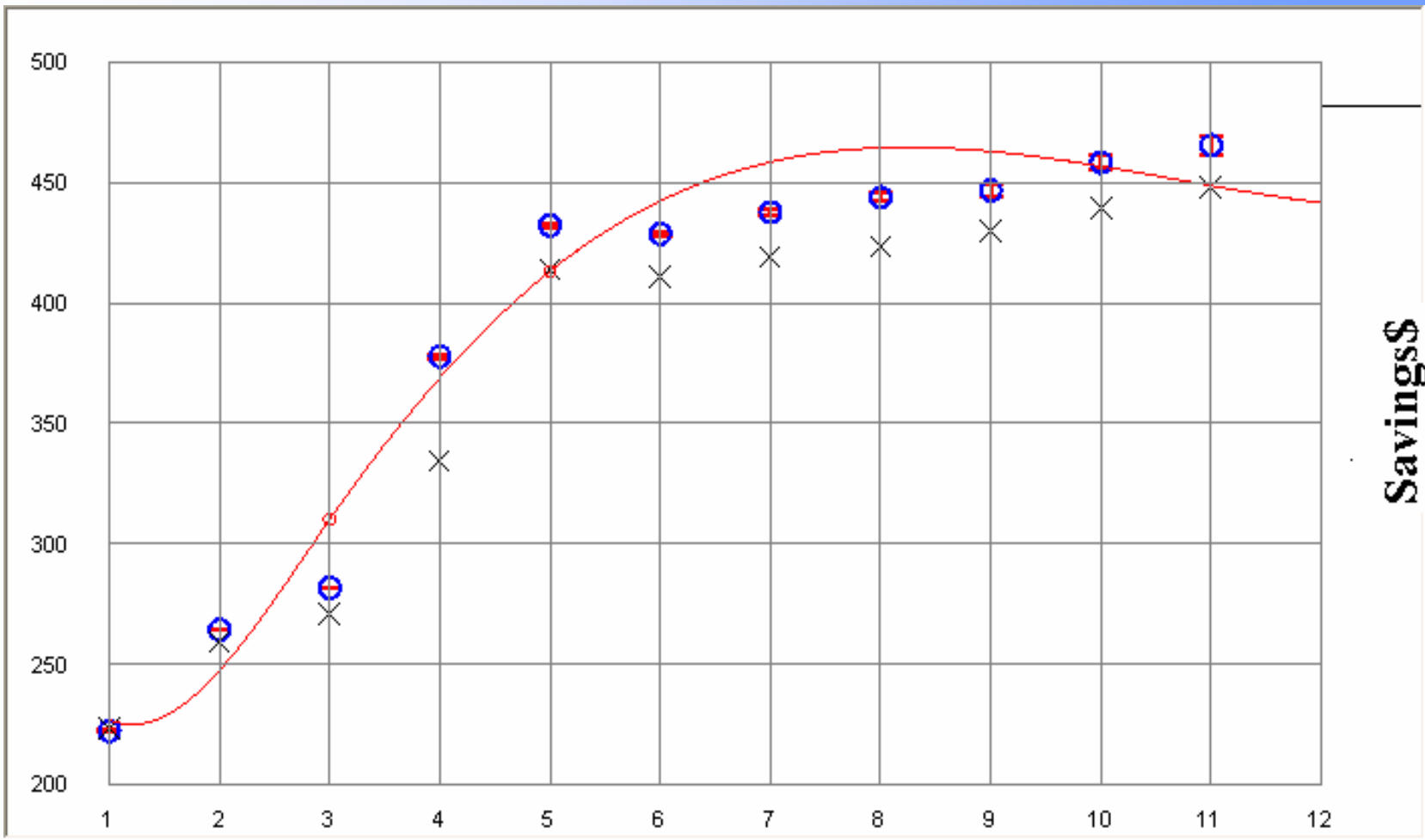
Results



Chronic1$<=$5,000

More opportunity for savings with less severe chronic patients

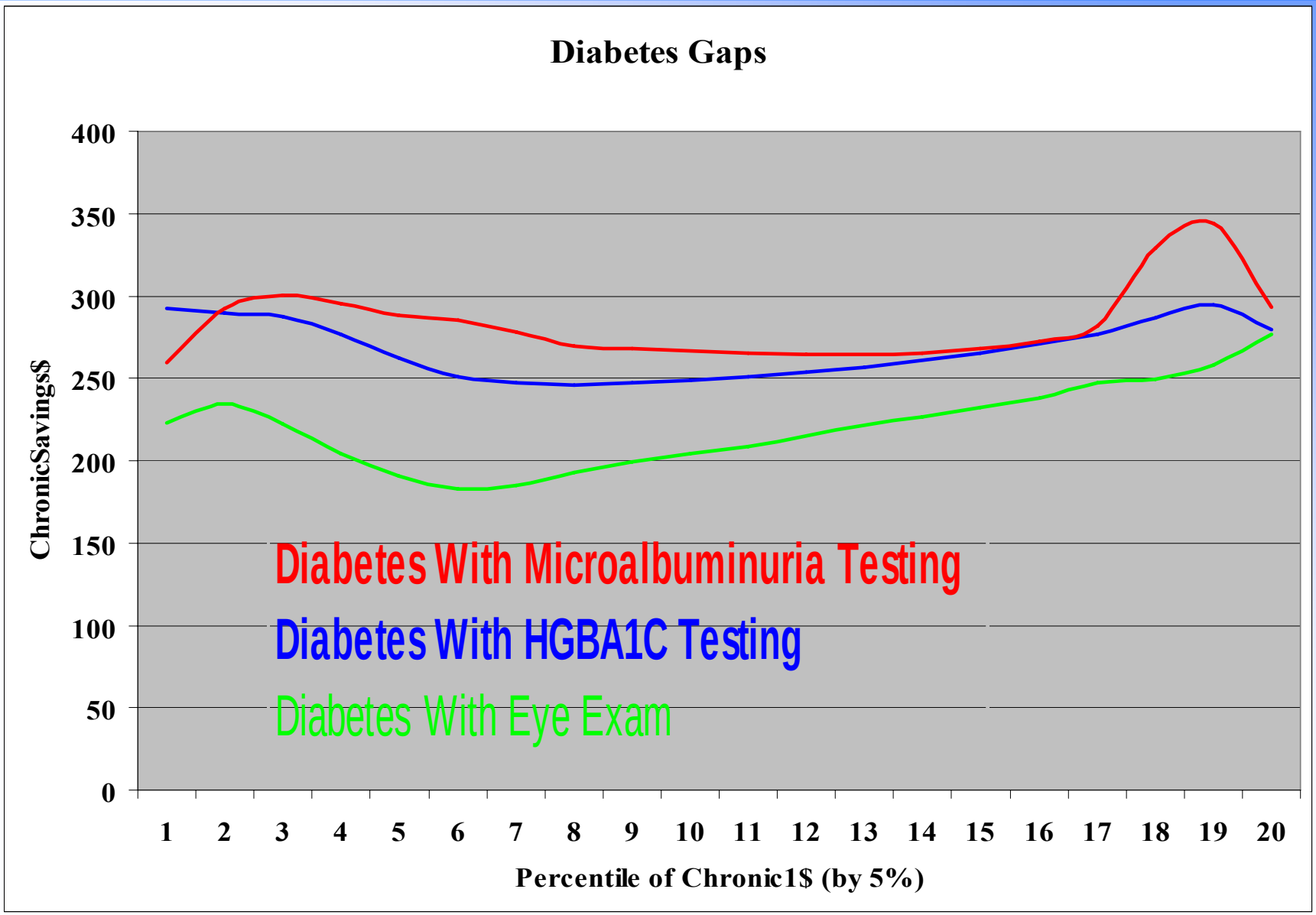
Results



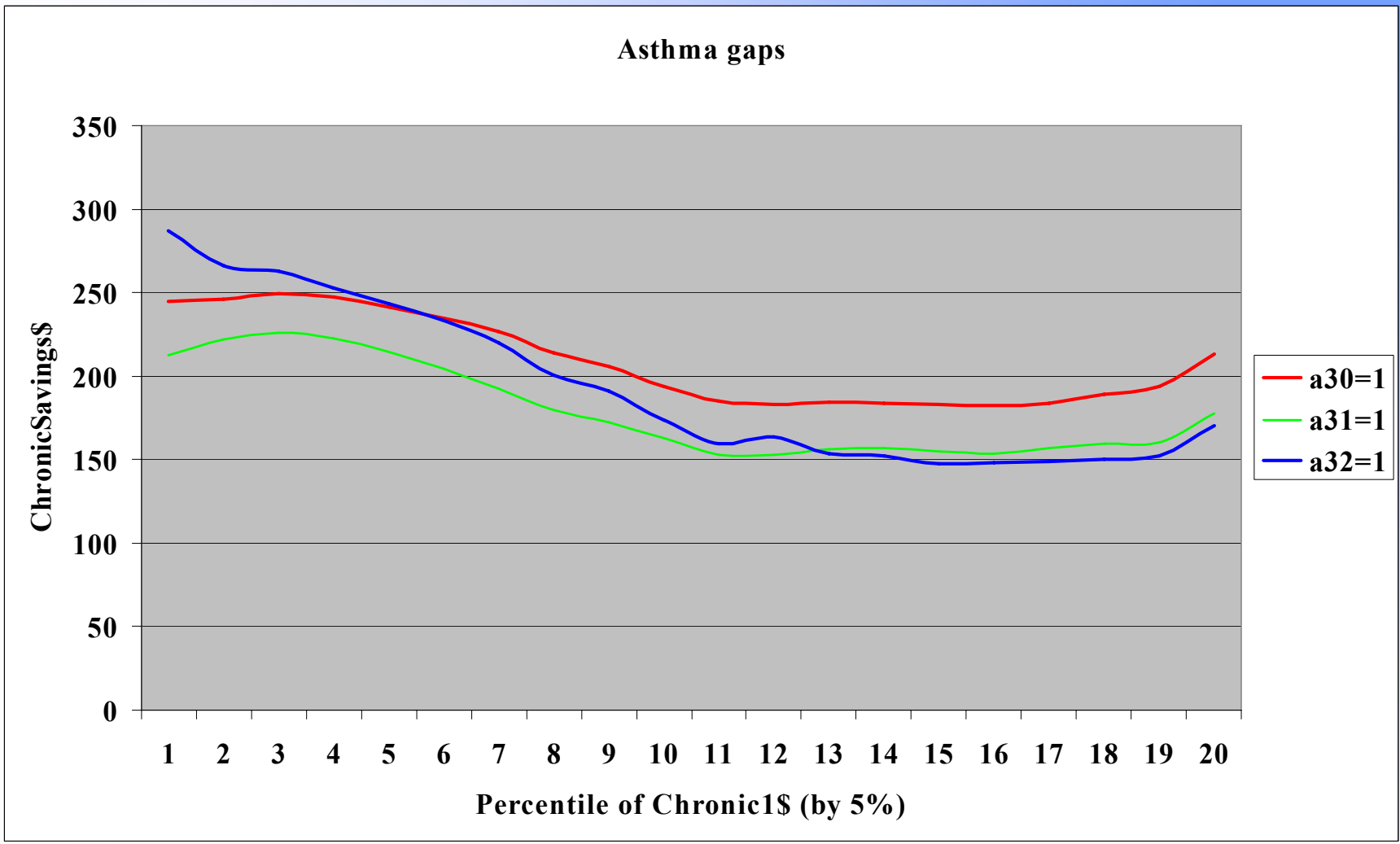
Gaps Count - 93,094 Diabetic Members with Chronic1$<=$10,000

Savings increase with noncompliance until Rx uncontrolled

Results


Diabetes Gaps
ChronicSavings$
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Percentile of Chronic1$ (by 5%)
Diabetes With Microalbuminuria Testing
Diabetes With HGBA1C Testing
Diabetes With Eye Exam

Results



Asthma and received primary treatment medications

Asthma and received inhaled steroid

Asthma and received PFT's

Chronic Impact Index - Summary

- Identifies members producing highest level of future savings by adherence to guidelines
- Members Ranked using Chronic Impact Index
- Implement via Care Management application
  - Integrated Member Profiles
    - Diagnosis / RX / Lab History
    - Risk Driver Profile
    - Guideline Compliance Profile
  - Data mining capability
  - Employer Reporting
  - Physician Profiles

Acute Impact Index

Acute Impact Index

- Ranks individuals by opportunity to avoid high cost acute care
- Reflects IP and ER component of overall prediction
- Score of 97 or greater identifies patients with greatest potential for controlling cost

Calculation

- Each Member receives Forecasted ER Visits / Inpatient LOS
- Normalized to Dollars
- Creating a forecasted Acute Care Cost
- Cost Ranked Ascending
- Then Transformed to Percentile 1-100

- Acute Index used for care management ranking
  - 0–79.99 – Members in the 0-95% of forecasted acute events
  - 80-100 – Members in the top 5% of forecasted acute events

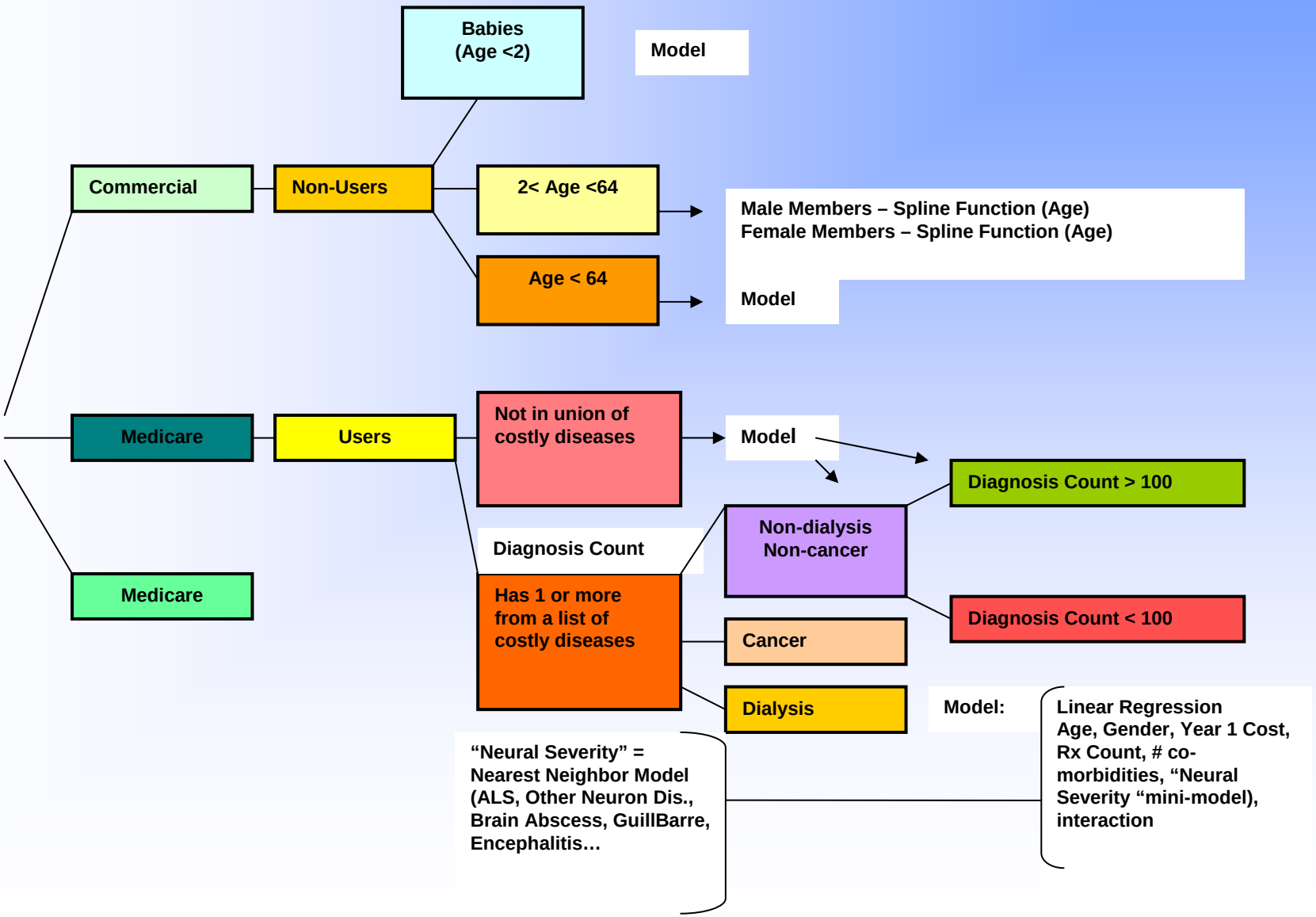
Models used for creating Acute Index

- Models for predicting
  - Inpatient LOS (Yr2)
  - ER Visits (Yr2)
- Models built on
  - 2 yrs medical & Rx claims
  - From repository of 14 million lives
- Independent Variables
  - Yr1 - Diagnoses/Comorbidities/Drugs/Visits…
- Non-linear models
  - interactions/transformations of the predictors
  - mini-models for more than 18 different body systems
- Statistical procedures used
  - decision trees /nonlinear regressions/nearest neighbors
  - spline estimators

New Prediction – Acute Cost

- Care Management reduction of IP and ER visits create substantial cost reduction
- Potential savings are typical for IP/ER events
- We decided to predict simultaneously both of them, creating a model for Acute Cost. Such an approach has its pros and cons, however ***it is innovative and summarizing all acute dollars***

Acute Models – Model Decision Tree



Acute Models - Clusters Used

	Cluster	Count	Actual	Predicted
1	Commercial Non-HMO Non-Users	279,859	423	444
2	Medicaid Non-Users	92,715	603	622
3	Baby & EC	13,351	1,981	2,001
4	Baby & No EC	16,992	1,165	1,073
5	DiagCnt=0 & Chronic$ <$120	27,592	822	778
6	DiagCnt=0 & Chronic$ ≥$120	26,387	2,003	1,906
7	Medicaid, No Drugs, EC, CM <4	26,829	1,143	1,148
8	Medicaid, No Drugs, EC, CM ≥4	21,190	3,171	3,012
9	Medicaid, No Drugs, No EC, CM <2	42,144	619	603
10	Medicaid, No Drugs, No EC, CM ≥2	50,401	1,121	1,125
11	Medicaid, Drugs, EC, CM <5	41,922	1,250	1,298
12	Medicaid, Drugs, EC, CM ≥5	69,957	3,235	3,305
13	Medicaid, Drugs, No EC, CM >3	32,185	651	668
14	Medicaid, Drugs, No EC, CM ≥3	47,935	1,206	1,221
15	Commercial, No Drugs, EC, CM <3	36,680	1,122	1,142
16	Commercial, No Drugs, EC, CM ≥3	48,501	2,849	2,851
17	Commercial, No Drugs, No EC, CM <2	65,151	769	768
18	Commercial, No Drugs, No EC, CM ≥2	45,410	1,263	1,195
19	Commercial, Drugs EC, CM <4	127,084	2,531	2,477
20	Commercial, Drugs EC, CM ≥4	147,105	5,515	5,486
21	Commercial, Drugs No EC, CM <3	148,110	1,483	1,513
22	Commercial, Drugs No EC, CM ≥3	71,026	2,590	2,594

Results
Validation set: Commercial / 893k members

- **LOS**
  - Frequency = 3.83%
  - Truncation = 60 days

Cluster	Correlation	R2	Sensitivity (10%)
All	.281	.075	20.6%
Year1≥$500	.291	.081	21.8%
Year1≥$3,000	.320	.100	25.8%

- **Emergency Room Visits**
  - Frequency = 12%
  - Truncation = 15 visits

Cluster	Correlation	R2	Sensitivity (10%)
All	.380	.144	28.7%
Year1≥$500	.400	.160	23.9%
Year1≥$3,000	.471	.221	29.9%

Results

Inpatient Admissions

Predictive Model	Accurate Prediction		
	Top0.5%	Top1%	Top2%
Acute Cost (new)	39.1%	31.7%	24.7%
Acute Impact Index	38.7%	31.4%	25.4%
LOS	38.3%	30.9%	25.1%
Total Cost	35.8%	28.3%	23.3%
Emergency Room Visits	29.3%	23.9%	19.0%
Total Members	4,463	8,925	17,852

Green – the best result

Yellow – the second best result

Results

Emergency Room Visits

Predictive Model	Accurate Prediction		
	Top0.5%	Top1%	Top2%
Emergency Room Visits	65.1%	56.8%	47.9%
Acute Cost (new)	41.0%	37.7%	33.7%
Acute Impact Index	38.6%	36.2%	34.0%
LOS	37.0%	34.4%	32.0%
Total Cost	35.4%	33.3%	30.7%
Total members	4,463	8,925	17,852

Green – the best result

Yellow – the second best result

Results

Acute Cost

Predictive Model	Avg Actual Acute Cost		
	Top0.5%	Top1%	Top2%
Acute Cost (new)	$18,349	$13,596	$9,882
Total Cost	$16,466	$12,236	$9,354
Acute Impact Index	$16,391	$11,952	$8,829
LOS	$16,149	$11,870	$8,796
Emergency Room Visits	$10,524	$8,073	$6,250
Total members	4,463	8,925	17,852
Potential savings over	**$4.2M**	**$6.07M**	**$4.7M**

Green – best result / Yellow – second best

Conclusions

- Problem
  - Identifying impactable members for Care Management
- Solution
  - Indexes very useful for identifying members in order to produce highest level of future savings & ROI
    - Chronic Impact Index
    - Acute Impact Index
      - New model for Prediction of Future Acute Cost
- Implemented
  - Into Care Management application
  - Detailed Member Profiles
  - Data mining integrated

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