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A Cost Prediction Model for Identifying Members by Avoidable Healthcare Expenses

Analysis of a Medicaid Population



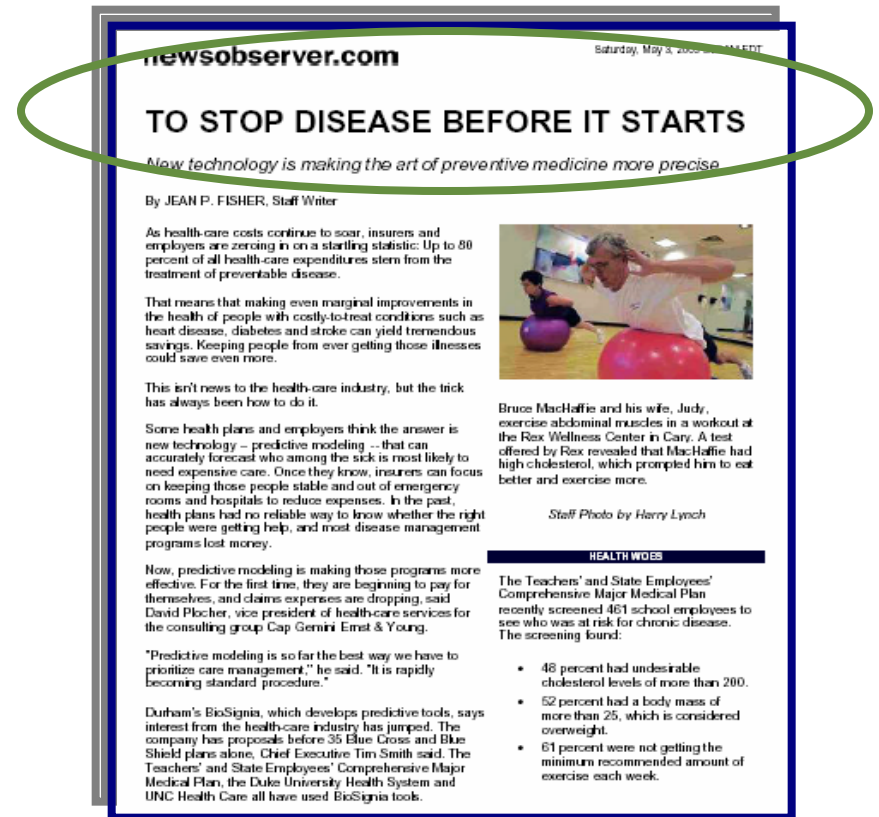
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Agenda

- Introduction to BioSignia™'s Cost Prediction model for determining avoidable costs
 - Cost Prediction vs. Health Risk Adjustment
 - High Prediction Accuracy
 - Avoidability
- Validation of Predicted Avoidable vs. Predicted Total costs via a Case Study

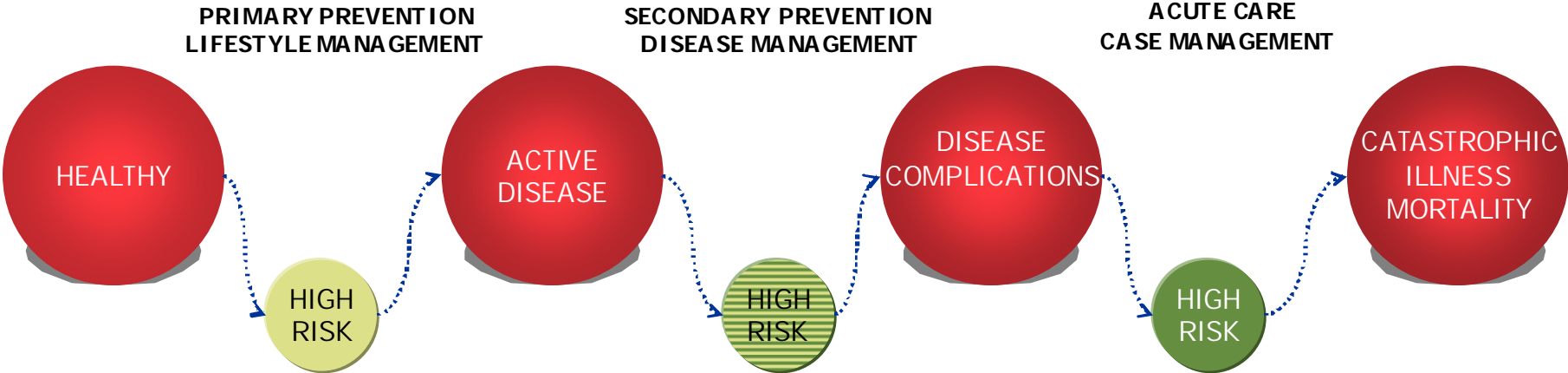
BioSignia, Inc.

- Established 1997 in RTP, NC and privately held
- Founded to provide tools for prospective medicine
 - Prediction
 - Preventive care
- Predictive modeling company
- Commercialization mainly through strategic alliances
- Industry targets
 - Healthcare: providers, payors, plans, disease management
 - Life Insurance Underwriting
 - Pharmaceutical Industry



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Prospective Health Modeling Entire Disease Continuum



BioSignia Healthcare Vision

- Prospective medicine – disease prediction and prevention – is a reality
- An integrated delivery system and reimbursement focused prospectively on healthcare

Improve the ROI of population health management initiatives by more correctly identifying future high-cost members with diseases that have a preventable cost component

Cost vs. Risk Adjustment Model

Key Difference:

- Risk Adjustment models attempt to explain variations attributable to health risk or disease severity only
- Cost Prediction models strive to account for all variations in medical cost without regard to the source

Sources of Cost Variation

- Health risk or disease severity
 - COPD > severe common cold and more \$
 - HT less burden of illness than HT w/ CHD
- Provider's cost effectiveness
 - Different Phys Tx patterns resulting in varying costs even though the health risk of the patients are similar
 - Some phys may prefer more aggressive procedures
- Patient Compliance
 - Variation in patient adherence to prescribed Tx regimen can vary significantly even given the same disease severity and same Tx
 - Differing level of compliance manifests itself in varying recovery outcomes which differentially affects future health and probable medical utilization
- Random Error
 - Sudden acute disorder/accident, newly dx'd chronic disease – i.e., occurrences w/out any explanatory variables that could have been used to predict its onset

Stratification of Future High-Cost Members

- For proper intervention
- To prevent unnecessary and/or high cost
- From wherever that cost may originate
- For this purpose Cost Prediction models take into account all cost variations
- Potential over-utilization and higher cost identified may be due to a higher health risk or provider's poor cost-effectiveness or poor patient compliance
- A Health Risk Adjustment model would miss certain high utilizers; e.g., those that do not have high health risk but received lower cost-effectiveness or poor compliance
- Such patients would be good candidates for DM

Defining Model Accuracy

- Accuracy of a cost prediction model determined by measuring closeness of each individual prediction from actual observed value
- Measure of accuracy of the HRA model should indicate the closeness of the model's outcomes to the true health risk related cost variation
- Can only observe the cost among individuals reflecting TOTAL variations of health care cost
- Overall predictive accuracy indicators such as R^2 and predictive ratio have been used but used inappropriately
- Important to recognize that objective of HRA explain variations attributable to disease risk alone -- Objective is not to achieve high prediction accuracy for cost

Defining Model Accuracy

- Therefore higher R^2 does not necessarily indicate a better risk adjustment model
- To measure accuracy need data set in which the provider's treatment quality and patient's compliance are held constant
- Difficult to obtain but is only situation in which the variations of medical cost is attributable to disease risk only

Making Educated Decisions

- Necessary for Health Plans, MCO's and DM companies to understand the difference in order to make appropriate purchase decisions

Origins of H-CAT

- Prospective cost prediction model
- Customized from claims history (2 yrs)
- Third year held back for the prediction and then model validation
- Utilizes a proprietary disease classification
- Prediction equation for each disease per patient
- Iterative variable selection for statistical and for clinical significance

R² Comparison

Improvements in prediction models has achieved greater accuracy in identifying high-cost utilizers.

Models	Claims Truncated at			
	\$25,000	\$50,000	\$100,000	None
ACG	N/A	0.172	0.140	0.099
CDPS	N/A	0.134	0.125	0.103
DCG	N/A	0.195	0.180	0.143
RxGroup	N/A	0.206	0.181	0.134
ERG	0.240	0.214	0.193	0.146
H-CAT	0.280	0.235	0.195	0.143

Results of other models SOA study, 2002

Sensitivity and ROC Analysis

Models	Sensitivity	Area Under ROC
A	0.23	0.66
B	0.19	0.63
C	0.21	0.66
D	0.16	0.63
E	0.25	0.67
F	0.17	0.62
H-CAT	0.35	0.82

Results of the six anonymous models (referred as leading prediction models) were from Dr. Weiner's presentation at BCBS Association meeting in January, 2003. High risk is defined as top 5%, prediction cut-off point is also set at 5%.

Accuracy Advances in Stratification

- Does identification of high-cost utilizers produce the best stratification of patients most suitable for intervention?
- Not necessarily. Patients may be identified as a future high-cost utilizer, but that does not unequivocally translate into potential savings.
- Solution is to find those patients with potential for improvement in care and decrease in cost
- BioSignia has termed this actionable decrease
“AVOIDABLE COSTS”

BioSignia Approach

- Determine avoidable potential for each and every disease from evidence-based medicine
 - Diabetes is more avoidable than cancer
- For a given disease determine the avoidable depending on pattern of care
- For a given patient with given disease determine that particular avoidable
 - Average asthma patient has 30% chance of an ER visit
 - Given asthma patient with a history of 3 ER visits will have a relatively high avoidable potential

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Direct cost prediction system for determining high-cost utilizers with potentially highly avoidable costs (diseases)

Claims History
Dx, Rx, Costs, Ux

This screenshot shows a table with columns for member ID, age, gender, and predicted costs. The table is titled 'Stratification Report Based on Predicted Costs' and includes a sub-header 'Use and Incomplete Claims for Total Population'. The data is organized into rows for each member, with columns for various cost categories.

Predicted Total Costs
For Each Member

This screenshot shows a table with columns for member ID, age, gender, and predicted total costs. The table is titled 'Stratification Report Based on Predicted Costs' and includes a sub-header 'Use and Incomplete Claims for Total Population'. The data is organized into rows for each member, with columns for various cost categories.

Predicted Avoidable Costs
For Each Member

This screenshot shows a table with columns for member ID, age, gender, and predicted avoidable costs. The table is titled 'Stratification Report Based on Avoidable Costs' and includes a sub-header 'Use and Incomplete Claims for Total Population'. The data is organized into rows for each member, with columns for various cost categories.

Model
Each
Disease
State

Model
Avoidable
Per
Disease



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Member Profile



Patient Profile - Claims History from last 12 months

Patient Id	Employer	Payor	Age/Gender
244802144		PAYOR_X	54F

Disease Group	Total Predicted \$	Predicted Avoidable \$
Urinary, Renal Failure	\$3,749	\$299
Diabetes, w/ complication	\$1,478	\$295
Cardio, Coronary Atherosclerosis \ Post_MI	\$1,379	\$242
Cardio, Congestive Heart Failure	\$1,143	\$178
Diabetes, w/o Complications	\$519	\$105
Musc-skel, other musculoskeletal and connective tis.	\$791	\$79
Eye, Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	\$909	\$73
Cardio, other	\$424	\$73
Urinary, Dialysis Status	\$1,231	\$72
Vascular, Disease	\$696	\$49
GI, other	\$940	\$46
Hemat, other	\$758	\$45
Cerebral, stroke	\$362	\$45
Metabolic, other nutritional and metabolic	\$400	\$37
Urinary, other urinary system	\$694	\$33
Pneumonia, other lung	\$432	\$21
Symptoms, sings and ill defined cond	\$1,020	\$0
Screening/history	\$695	\$0
Nerve, Polyneuropathy	\$893	\$0
Major Complications of Medical Care and Trauma	\$793	\$0
Total	\$19,306	\$1,692

Employer = _____
 Payor = _____
 Diseases = _____

Clear Filter


Validity of Predicted Avoidable Costs to Stratify Membership

Does enrollment in DM based on predicted high avoidable costs increase ROI compared to enrollment based on predicted high total costs ?



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Prevalence and Avoidable Costs

	Diseases and associated prevalence in claims history	High Avoidable Cost Group	High Total Cost Group
Low Avoidable	Lung Cancer	1.07%	3.25%
	Breast Cancer	1.04%	5.94%
	Prostate Cancer	0.78%	2.11%
	Chronic Renal Failure	7.69%	8.33%
	Diabetes w/o Complication	47.9%	25.2%
High Avoidable	Diabetes w/ Complication	29.5%	13.4%
	Disorders of Lipid Metabolism	32.1%	24.9%
	Hypertension	30.4%	26.3%
	Acute Myocardial Infarction	5.13%	2.08%
	Other CHD	41.8%	22.2%
	CHF	12.6%	11.5%




Pattern of Care

	Predicted Avoidable	Predicted Total
# ER Visit	0.8	0.5
Actual/Expected Cost Ratio	1.6	1.2

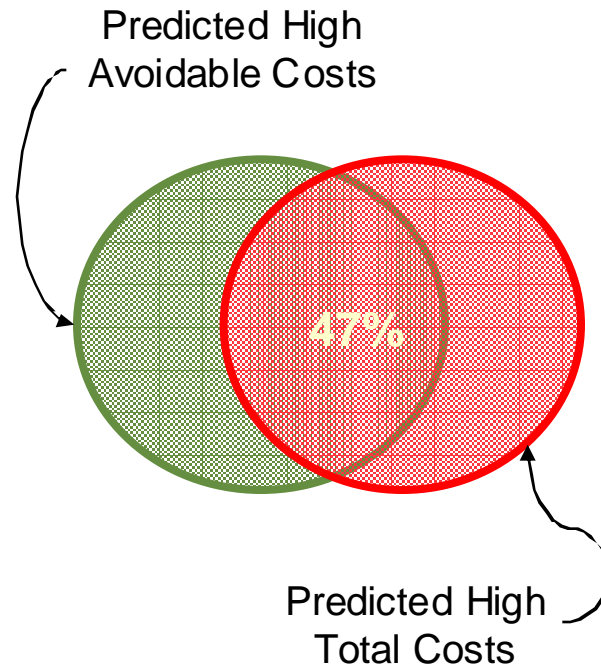
Expected cost was calculated based on retrospective risk adjustment model

Predicted Avoidable Costs



Stratification Report Based on Avoidable Costs
 Total and Avoidable Claims for Total Population

Member ID	Age	Gender	Plan Type	Total Next Year Cost	Total Avoidable Cost
314990	57	M	HMO	\$180,020	\$79,031
155255	31	M	PPO	\$237,898	\$44,328
30030	56	M	PPO	\$131,650	\$34,837
189982	34	F	HMO	\$334,672	\$30,729
3104	54	F	PPO	\$285,392	\$28,205
34553	44	M	PPO	\$277,716	\$27,848
231256	37	F	PPO	\$239,643	\$23,499
246517	39	F	PPO	\$212,601	\$22,931
107746	53	F	POS	\$139,799	\$21,645
26005	56	M	HMO	\$148,869	\$20,848
273054	43	M	POS	\$162,709	\$20,237
200112	61	M	PPO	\$117,831	\$19,430
159900	28	F	PPO	\$74,425	\$17,976
274411	46	F	POS	\$143,971	\$17,579
21073	57	M	HMO	\$158,573	\$17,512
241794	53	F	HMO	\$143,956	\$16,726
221014	51	F	PPO	\$138,091	\$16,406
223307	51	M	HMO	\$142,699	\$16,159
183596	55	M	PPO	\$134,260	\$15,780
108601	53	M	POS	\$136,683	\$15,673
46020	64	M	PPO	\$120,460	\$15,579
124615	57	M	POS	\$126,692	\$14,915
183066	57	M	PPO	\$130,737	\$14,839
261813	61	M	HMO	\$122,313	\$14,692
4747	46	F	POS	\$146,294	\$14,599
265088	56	M	HMO	\$118,283	\$13,862
217750	71	M	PPO	\$104,810	\$12,270
141618	62	F	HMO	\$119,166	\$12,084
239642	59	M	POS	\$120,469	\$11,895
238887	60	F	POS	\$115,740	\$11,421
239710	61	M	POS	\$114,305	\$11,187
2507	61	F	PPO	\$110,336	\$11,100
259773	40	F	POS	\$112,159	\$11,047
314374	23	M	PPO	\$65,094	\$10,929
239318	59	F	PPO	\$158,545	\$10,632
71999	26	M	PPO	\$68,658	\$10,433
103778	64	M	POS	\$110,660	\$10,379
229210	29	F	HMO	\$59,413	\$10,018
13548	53	F	POS	\$79,815	\$9,349



Empirical Validation

Do members with relatively high predicted avoidable costs translate into a relatively high savings after undergoing DM intervention?



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Horizon/Mercy

- Largest Medicaid Managed Care Plan in New Jersey
- 270,000 members (45% market share)
- Operating since 1993
- A program of Horizon HMO, Horizon Blue Cross Blue Shield of New Jersey
- Karen Clark, Chief Executive Officer
- Philip Bonaparte, M.D., Chief Medical Officer

Horizon/Mercy Asthma Program

- Asthma program offered to members since 1995
- Revised in 1998 to reflect national asthma education recommendations
- Op-out design
- Program designed to stratify based on severity of disease via administrative and clinical information
- Members identified by:
 - Medical claims
 - Pharmacy claims
 - Case Management department
 - Physician referral
 - Self referral
- Asthma program management functions in coordination with case management, pharmacy management and social case management staff



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Horizon/Mercy Asthma Program

Many challenges to reaching out and educating the publicly insured population. Program participation challenges:

- Members can be involuntarily dis-enrolled by the state any given month, for any given duration
 - Dis-enrollment may be due in part to the severity of the member or a family member's illness, preventing them from physically going to their county Medicaid office to maintain benefits.
- Competing life priorities in this population – very different from the commercial 'world'
- Environmental and socio-economic 'triggers'

Horizon/Mercy Asthma Program

- Program success based on several metrics
 - Reduction in ER visits
 - Reduction in IP admissions and readmissions
 - Savings
- Asthma population defined as program participants and non-participants
- Identified historical costs trend for asthma population
- Defined program savings as asthma population costs that were less than historical trend

Description of Study

- Asthma Patients
 - Medicaid population
 - Patients identified through Asthma ICD-9, but
 - All claims for those patients considered
 - Referred to Asthma Intervention program (“CASE”) vs.
 - Those never referred (“CONTROL”)
- Model developed using 1998-99 claims data
 - Year 2000 held back for validation
- Focus of analysis on the “case” patients (2202)

Objective of Study

- Compare the improvement in patient stratification by using Avoidable over Predicted
- By comparing the savings from the Asthma Intervention program to the predicted cost and predicted avoidable
- (Not a study of “savings”)

Study Design Concerns - Savings

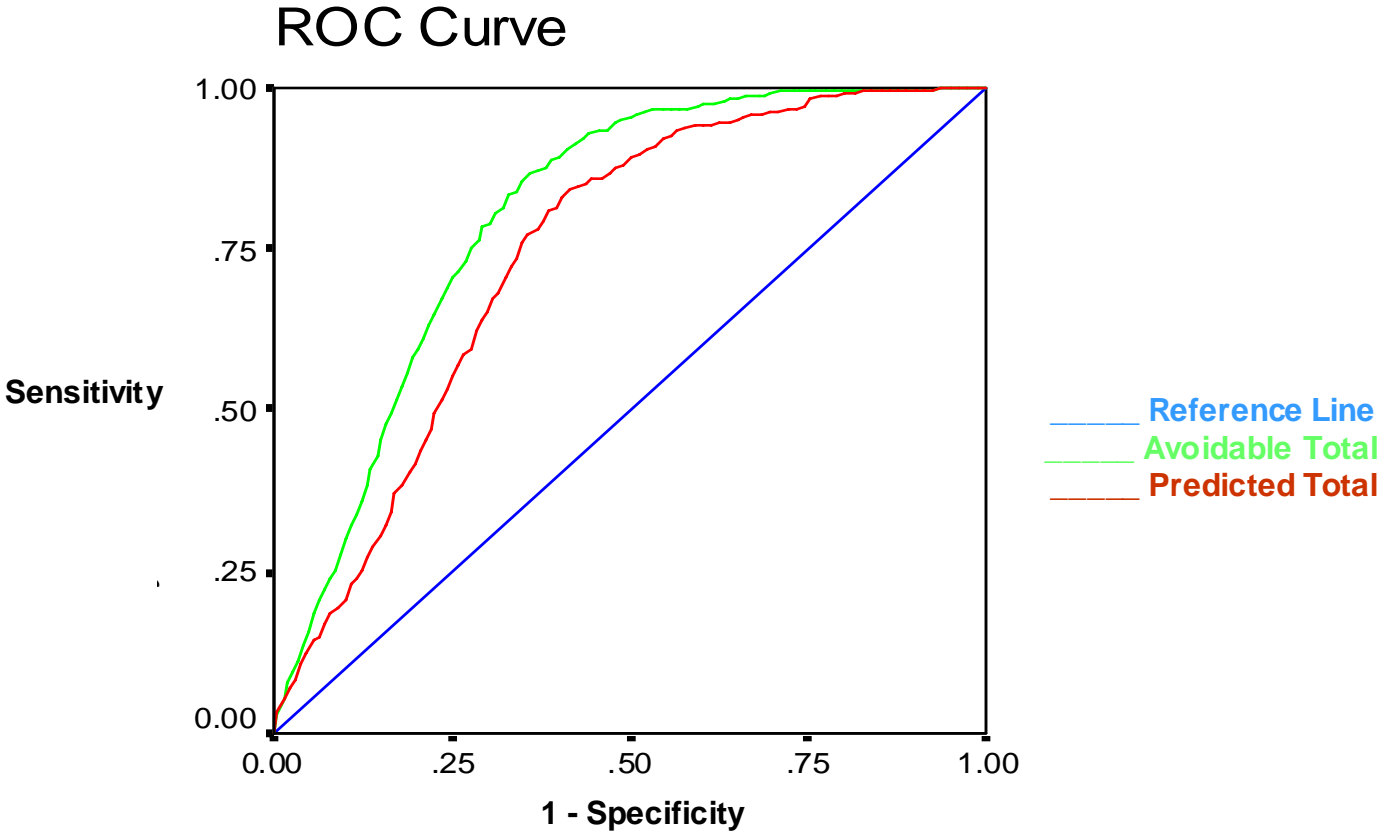
- Consistently elusive – what is the industry-wide operational definition that has been accepted
- No true random controlled experiment due to DM applications
- Horizon/Mercy definition
- BioSignia paralleled that definition by
 - Using “Control Group” median difference obtained
 - Post-adjusted by this factor before savings computed
- We term this surrogate savings “S_Savings” to differentiate this difference from the “TRUE” savings
- These S_Savings are calculated for asthma related costs only

S_Savings with 20% Cut-Off

		S_Savings	
		Low	High
Predicted	Low	1473	289
	High	289	151
Sensitivity = 34%			
Specificity = 84%			

		S_Savings	
		Low	High
Avoidable	Low	1509	252
	High	253	188
Sensitivity = 43%			
Specificity = 86%			

Avoidable vs. Predicted



Significant at the 0.001 level



Predicted Savings/Cost Correlations

	Asthma Savings	Actual Cost
Total Predicted	0.31	0.38
Total Avoidable	0.36	0.34

- If objective is to predict total true cost, then our prediction for total cost does better than the predicted avoidable.
- But for the objective of determining the prediction of savings, our avoidable would be preferred.

Avoidability Impact

- Commercial plan
- Top 5000 ranked by total and avoidable

Rank by Predicted Total Costs

Rank by Predicted Avoidable Costs

	Rank by Predicted Total Healthcare Costs	Rank by Predicted Avoidable Healthcare Costs	Incremental Avoidable Healthcare Costs	Incremental Avoidable Costs per Member (5000)
Predicted Avoidable Costs	\$19,899,873	\$23,339,878	\$3,470,005	\$694

Conclusion

- For stratifying patients according to predicted *future costs* the Cost Prediction model is more appropriate than the Health Risk Adjustment model
- To measure accuracy need data set in which the provider's treatment quality and patient's compliance are held constant
- R^2 is robust
- BioSignia's AVOIDABLE has been shown empirically to outperform the predicted total cost

Next Steps Horizon/Mercy and BioSignia

- Calculate average savings per member for DM participation
- Evaluate by disease stratification definition



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Thank you very much for your kind attention.

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