National Predictive Modeling Summit

September 14, 2009

New Applications Of Predictive Models

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Outline of the Session

- Overview of CRGs
- Program Identification
- Member Selection
- Case Load Management
- Evaluating Care Management and Provider Performance
- Sales and Retention
- Other Applications for Predictive Model

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Underlying Algorithm: CRGs

- Clinical Risk Groups (CRGs) developed by 3M Health Information Systems
  - Developed by clinicians and actuaries
  - Utilizes diagnosis codes, selected procedure codes and pharmacy information form claims to classify members
  - 271 chronic diseases creating about 1,100 case mix and severity categories
  - Each member of the population is assigned to a single mutually exclusive category based on their clinical information/experience
  - Recommend minimum of 2 years of medical and pharmacy data

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“Severity”

- “Severity” is used to describe a disease with multiple co-morbidities or “with complications”
- “Case mix” and “severity” maybe used ambiguously
- Added value when models distinguish and display grades of case mix and levels of severity

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Underlying Algorithm: CRGs

Example: Quantify Health Status and Cost Drivers

1	Healthy	Non-user vs. user distinctions
2	One or More Significant Acute Diseases	Chest pain
3	One Minor Chronic Disease	Hyperlipidemia or Migraine
4	Multiple Minor Chronic Diseases	Hyperlipidemia and Migraine
5	One Major Chronic Disease	Diabetes or Asthma
6	Two Significant Chronic Diseases	Asthma and Hypertension
7	Three or More Chronic Diseases	CHF, Diabetes & COPD
8	Complicated Malignancies	Lung Cancer or Brain Malignancy
9	Catastrophic Conditions	AIDS, Dialysis or Ventilator Dependent

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Case Mix and Severity Grid

Diabetes Distributed within a Case Mix and Severity Matrix for a Representative Commercially Insured Population of 250,000

		Severity Level					
	Case Mix Type	1	2	3	4	5	6
1	Healthy						
2	One or More Significant Acute Diseases						
3	One Minor Chronic Disease						
4	Multiple Minor Chronic Disease						
5	One Significant Chronic Disease	2290	665	227		57	
6	Two Significant Chronic Diseases	3718	1430	963	631	239	29
7	Three or More Significant Chronic Disease	372	285	378	96	79	35
8	Complicated Malignancies	1	40	68	52	19	
9	Catastrophic Conditions	3	23	9	17	17	9

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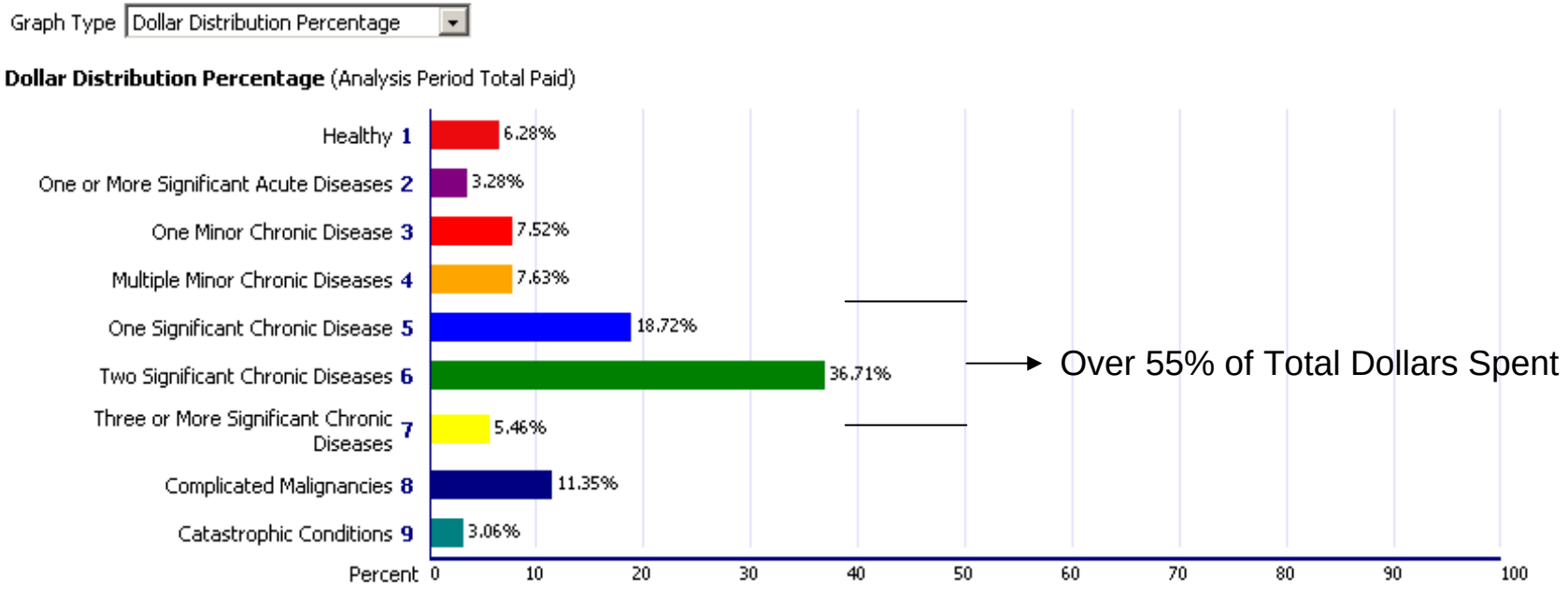
Reports and Analyses

Quantify Health Status and Cost Drivers

Graph | Report

Graph Type: Dollar Distribution Percentage



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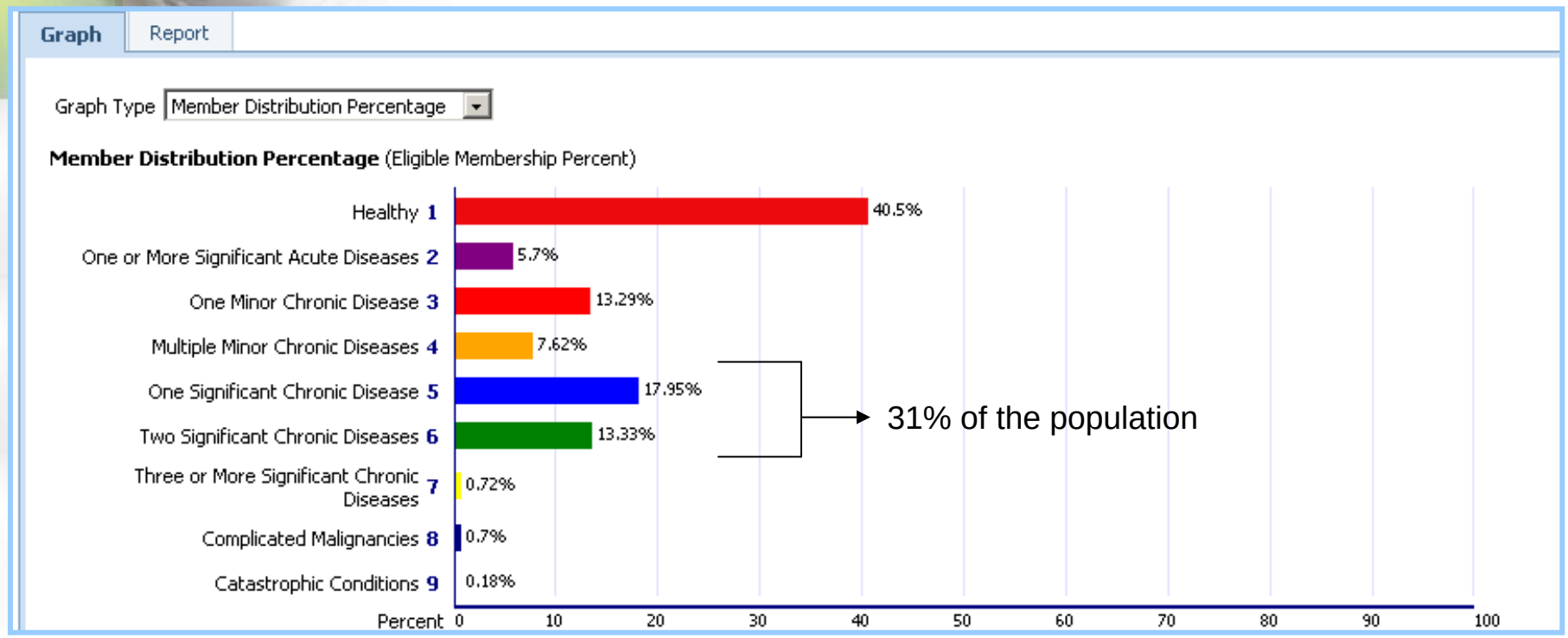
Reports and Analyses

Quantify Health Status and Cost Drivers



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Reports and Analyses

PMPM by Status and Severity

Status	Severity 1 Member PMPM	2 Member PMPM	3 Member PMPM	4 Member PMPM	5 Member PMPM	6 Member PMPM
One Chronic Disease	1,984 $54	720 $210	388 $165		83 $170	
Two Chronic Diseases	3,304 $148	1,501 $277	1,199 $310	810 $513	323 $870	31 $998
Three or More Chronic Diseases	388 $363	273 $405	381 $918	97 $1,348	64 $2,689	32 $2,130
Catastrophic Conditions			3 $78	8 $1,289	13 $2,918	16 $3,537

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DISEASE PROGRAM IDENTIFICATION

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Program Identification

- Which diseases are costing the most?
- Which diseases are projected to cost the most?
- Which diseases have:
  - High utilization
  - Potentially avoidable complications/admissions
  - Gaps in care
- What is the size of the population with the disease?
- Internal or external management?

Programs should be member centric

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Disease Drivers

Description	Analysis Period			Eligible					
	Average Membership	Total Paid	Average PMPM Paid	Eligible Count	Average PMPM Paid	Projected Average PMPM	Change in PMPM	Membership Percent	Projected Cost Drivers
Plan	78,263	$405,433,829	$432	78,645	$416	$458	$41.98	100.00%	$41.98
Merge	77,809	$405,304,250	$434	78,190	$418	$460	$42.06	99.42%	$41.81
Diabetes	5,599	$87,863,896	$1,308	5,485	$1,171	$1,379	$207.48	6.97%	$14.47
Hypertension	8,761	$39,059,241	$372	8,714	$369	$600	$230.73	11.08%	$25.57
End Stage Renal Disease	372	$29,821,203	$6,680	356	$5,070	$3,910	($1,159.71)	0.45%	($5.25)
Coronary Artery Disease	1,221	$27,456,480	$1,874	1,182	$1,861	$1,544	($317.63)	1.50%	($4.77)
Chronic Obstructive Pulmonary Disease	1,609	$24,422,633	$1,265	1,566	$1,187	$1,611	$424.24	1.99%	$8.45
Asthma	3,853	$19,785,627	$428	3,792	$424	$562	$137.56	4.82%	$6.63
Congestive Heart Failure	379	$17,966,530	$3,949	366	$3,505	$2,257	($1,247.19)	0.47%	($5.80)
Obesity	403	$14,425,474	$2,982	398	$2,647	$1,442	($1,204.97)	0.51%	($6.10)
Breast Cancer	350	$10,096,901	$2,404	346	$2,416	$1,725	($691.14)	0.44%	($3.04)
Cerebrovascular Accident (Stroke)	326	$9,599,785	$2,457	315	$2,268	$1,635	($632.98)	0.40%	($2.54)
Human Immunodeficiency Virus	176	$3,274,280	$1,550	173	$1,538	$3,202	$1,663.62	0.22%	$3.66
Hyperlipidemia	1,203	$2,474,414	$171	1,204	$171	$244	$73.55	1.53%	$1.13
Depression	795	$1,999,076	$210	779	$209	$451	$242.57	0.99%	$2.40
Prematurity	8	$977,933	$10,187	8	$4,975	$304	($4,671.02)	0.01%	($0.48)
Peripheral Vascular Disease	38	$625,612	$1,390	36	$1,289	$935	($354.34)	0.05%	($0.16)

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MEMBER SELECTION

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Methods to Identify High Opportunity Members

- Past cost and utilization thresholds
- Predicted cost
- Predicted utilization: risk of admission
- Compound risk index (cost, utilization, complications, gaps in care)
- Potential Under/Overutilizers
- Disease progression indicator
- Pre-disease identification (false positives)

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Cost and Utilization Thresholds

Members with Diabetes and Acute Stay >=1/(12 mos) OR ER>2/(12 mos) AND IP cost>$10K

12 Month Analysis Period Ending: 12/31/2006

Disease: Any selected disease(s) Diabetes **Criteria:** Month Begin on 01-2006 and Month Ending 12-2006 'ER_VISITS' > 2 Or 'IP_STAYS_CNT' > 1 And 'IP_COST' > 10000

Case Mix and Severity Result Matrix

Member List Type: Care Management

Population: **143,170** | Sub Population: **143,170** | Criteria Result Count: **165**

Red : Population
(Black) : Sub Population
Blue : Criteria Result

Status	Severity of Illness Level						
View All Members	0	1	2	3	4	5	6
5 One Significant Chronic Disease		19,438 (19,438) 2	4,892 (4,892) 3	1,000 (1,000) 3	164 (164)	116 (116)	92 (92)
6 Two Significant Chronic Diseases		11,112 (11,112) 6	4,336 (4,336) 17	2,151 (2,151) 23	1,096 (1,096) 26	349 (349) 16	43 (43)
7 Three or More Significant Chronic Diseases		293 (293) 3	225 (225) 2	350 (350) 27	78 (78) 10	70 (70) 20	17 (17) 4
8 Complicated Malignancies		186 (186)	352 (352)	277 (277)	158 (158)	31 (31)	
9 Catastrophic Conditions		56 (56)	72 (72)	35 (35)	66 (66)	16 (16) 2	13 (13) 1

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Potential Under - Utilizers

Diabetes(Expected Cost)–(Actual Cost) >=$10K(~7% of population with DM)

"Expected Cost" = Retrospective predicted cost

Matrix - Microsoft Internet Explorer

Care Management Matrix Result CLOSE

12 Month Analysis Period Ending: 12/31/2006

Disease: Any selected disease(s) **At Risk Index:** 'AT RISK INDEX' <= -10
Diabetes

Case Mix and Severity Result Matrix

Member List Type: Care Management

Population: **143,170** | Sub Population: **143,170** | Criteria Result Count: **367**

Red : Population
(Black) : Sub Population
Blue : Criteria Result

Status	Severity of Illness Level						
View All Members	0	1	2	3	4	5	6
5 One Significant Chronic Disease		19,438 (19,438) 2	4,892 (4,892) 17	1,000 (1,000) 3	164 (164)	116 (116)	92 (92)
6 Two Significant Chronic Diseases		11,112 (11,112) 48	4,336 (4,336) 60	2,151 (2,151) 65	1,096 (1,096) 51	349 (349) 18	43 (43)
7 Three or More Significant Chronic Diseases		293 (293) 19	225 (225) 24	350 (350) 31	78 (78) 9	70 (70) 17	17 (17) 2
8 Complicated Malignancies		186 (186)	352 (352)	277 (277)	158 (158)	31 (31)	
9 Catastrophic Conditions		56 (56)	72 (72)	35 (35)	66 (66)	16 (16) 1	13 (13)

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Potential Under - Utilizers

Diabetics who are deteriorating)~4% of population with DM
"Deteriorating"=Significant increase in burden of illness index

Matrix - Microsoft Internet Explorer

Care Management Matrix Result — CLOSE

12 Month Analysis Period Ending: 12/31/2006

Disease: Any selected disease(s) Diabetes **Disease Progression Index:** 'DISEASE PROGRESSION INDEX' > 4

Case Mix and Severity Result Matrix

Member List Type: Care Management

Red : Population
(Black) : Sub Population
Blue : Criteria Result

Population: **143,170** | Sub Population: **143,170** | Criteria Result Count: **243**

Status	Severity of Illness Level						
View All Members	0	1	2	3	4	5	6
5 One Significant Chronic Disease		19,438 (19,438)	4,892 (4,892)	1,000 (1,000)	164 (164)	116 (116)	92 (92)
6 Two Significant Chronic Diseases		11,112 (11,112)	4,336 (4,336) 6	2,151 (2,151) 5	1,096 (1,096) 33	349 (349) 68	43 (43) 3
7 Three or More Significant Chronic Diseases		293 (293)	225 (225) 11	350 (350) 53	78 (78) 28	70 (70) 24	17 (17) 9
8 Complicated Malignancies		186 (186)	352 (352)	277 (277)	158 (158)	31 (31)	
9 Catastrophic Conditions		56 (56)	72 (72)	35 (35)	66 (66)	16 (16) 1	13 (13) 2

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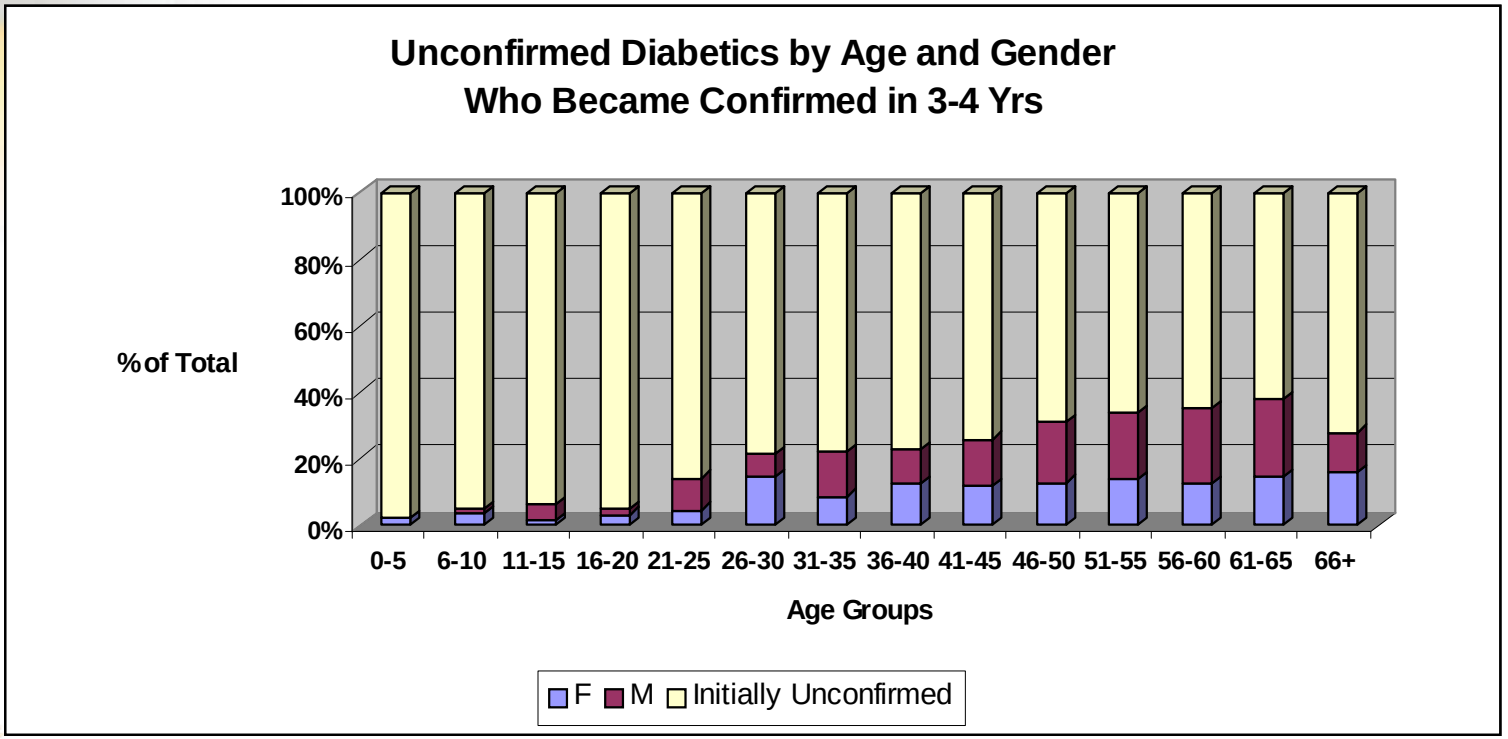
Pre-Disease Identification

36% of those initially risk stratified to unconfirmed DM in Year 1 transition to confirmed diabetes Year 3-4.

Predictors: male>female and age>40



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CASE LOAD MANAGEMENT

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Determining Appropriate Caseloads

- Case Management Society of America and National Association of Social Workers
  - Caseload Workgroup (CLWG)
  - White Paper June 8, 2008
  - Second annual town hall meeting June 20, 2008 in Orlando, FL
- Elements impacting caseload
  - Initial business factors
  - Comprehensive assessments
  - Care plans
  - Desired outcomes

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Predictive Models

- URAC Standards require:
  - Method for basing caseload on factors such as
    - Severity of Illness
    - Complexity of cases
  - Other “relevant factors”
- Elements impacting caseload
  - Case mix complexity and severity (Burden of Illness or BOI)
  - Composite opportunity index to aggregate and score the relative number of outstanding issues for case managers (Care Management Index or CMI)

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Burden of Illness

- All PMs reduce case mix complexity to a numerical score or weight that can help predict future costs of utilization of resources
- BOI is function of:
  - Age
  - Gender
  - Case mix of diseases and an indicator of severity
- CRGs use a severity grading from 1-6 within each case mix group

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Case Mix/Severity Impact on Burden of Illness (CRGs)

	Severity					
Case Mix	*1*	*2*	*3*	*4*	*5*	*6*
One Chronic	0.6857	1.4435	2.9515	5.0421	5.2942	5.5589
Two Chronics	1.7137	2.8508	3.9650	5.4371	9.8301	10.8131
Three or More Chronics	2.9552	5.7071	7.3588	10.3551	17.4995	19.2494
Aggressive Cancer	3.8874	8.4256	14.2910	29.7343	32.7078	
Catastrophic	3.6256	7.7972	8.5769	12.8754	14.1629	25.8472

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Opportunity / Care Management Index

- Besides BOI, PMS can prioritize cases bases on certain opportunity scores
- These may be a function of:
  - Likelihood of admission or re-admission
  - ER use
  - Cost outliers – High or low
  - Rx cost and utilization

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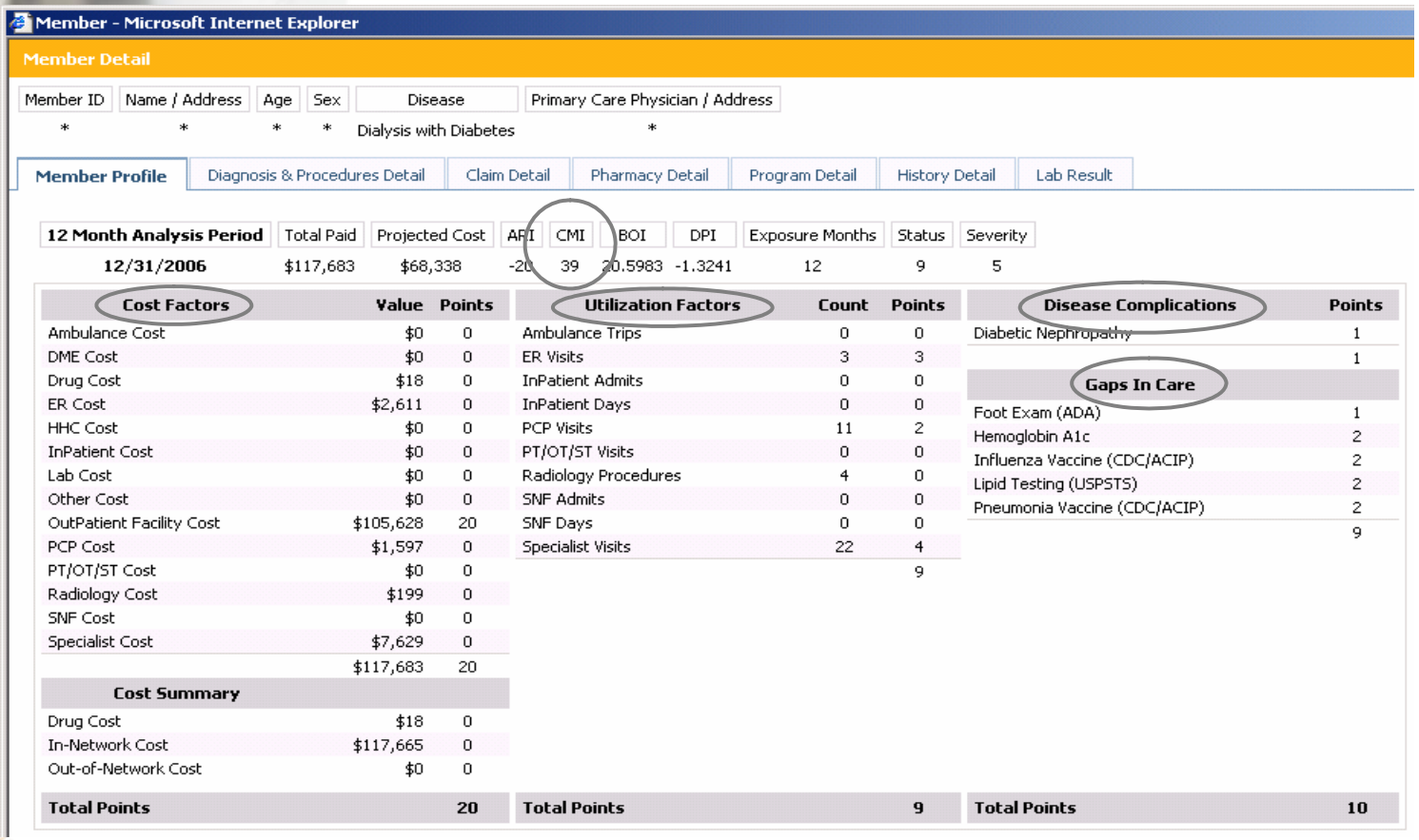
Opportunity / Care Management Index



Member - Microsoft Internet Explorer

Member Detail

Member ID	Name / Address	Age	Sex	Disease	Primary Care Physician / Address
*	*	*	*	Dialysis with Diabetes	*

Member Profile | Diagnosis & Procedures Detail | Claim Detail | Pharmacy Detail | Program Detail | History Detail | Lab Result

12 Month Analysis Period	Total Paid	Projected Cost	ARI	CMI	BOI	DPI	Exposure Months	Status	Severity
12/31/2006	$117,683	$68,338	-20	39	20.5983	-1.3241	12	9	5

Cost Factors	Value	Points
Ambulance Cost	$0	0
DME Cost	$0	0
Drug Cost	$18	0
ER Cost	$2,611	0
HHC Cost	$0	0
InPatient Cost	$0	0
Lab Cost	$0	0
Other Cost	$0	0
OutPatient Facility Cost	$105,628	20
PCP Cost	$1,597	0
PT/OT/ST Cost	$0	0
Radiology Cost	$199	0
SNF Cost	$0	0
Specialist Cost	$7,629	0
	$117,683	20
Cost Summary		
Drug Cost	$18	0
In-Network Cost	$117,665	0
Out-of-Network Cost	$0	0
Total Points		**20**

Utilization Factors	Count	Points
Ambulance Trips	0	0
ER Visits	3	3
InPatient Admits	0	0
InPatient Days	0	0
PCP Visits	11	2
PT/OT/ST Visits	0	0
Radiology Procedures	4	0
SNF Admits	0	0
SNF Days	0	0
Specialist Visits	22	4
		9
Total Points		**9**

Disease Complications	Points
Diabetic Nephropathy	1
	1
Gaps In Care	
Foot Exam (ADA)	1
Hemoglobin A1c	2
Influenza Vaccine (CDC/ACIP)	2
Lipid Testing (USPSTS)	2
Pneumonia Vaccine (CDC/ACIP)	2
	9
Total Points	**10**

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Opportunity / Care Management Index

- CMI may consist of outlier levels of cost and utilization:
  - Home health
  - Hospital
  - Specialty care
  - DME
  - Pharmacy
  - Quality gaps in care

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Opportunity / Care Management Index

- Threshold indicators
  - Excessive cost and utilization
  - Disease complications
  - Quality gaps in care
- Directs case managers to areas for intervention

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Opportunity / Care Management Index

- Both the BOI and CMI:
  - May be tracked over time
  - Help monitor the relative caseload mix
  - Quality gaps in care
- These scores help ensure:
  - Equitable distribution of work
  - More than a simple total count of cases

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Patient Tracking

Selected Member List | Enrollment List | **My Member List**

My Member List

Menu Manager: All

Program: - All -

Status: - All -

CM Case	DM Case	ME Case	Total Members	Average CMI	Average BOI
3	1	0	4	33.00	11.1309

	No.	Enroll Date	CM	DM	ME	Member ID	Name	Age	Sex	Status	Severity	Disease	CMI	BOI
⊞	1	7/1/2008	◉			00009123210019510823M	MEM100004033	56	M	9	5	Dialysis with Diabetes	62	20.7377
⊟	2	7/1/2008	◉			00083048850119450207F	MEM100020891	62	F	6	1	Diabetes and Hypertension	13	2.0649

Period	Status	Severity	Disease	CMI	BOI
8/31/2007	6	1	Diabetes and Hypertension	13	2.0649
12/31/2006	5	1	Hypertension	7	0.7322
12/31/2005	5	1	Hypertension	4	0.7589
12/31/2004	5	1	Hypertension	6	0.8245

⊞	3	4/1/2008		◉		00084274560119431027M	MEM100033215	63	M	9	5	Dialysis with Diabetes	48	20.7377
⊞	4	2/20/2008	◉			00085621920219900331F	MEM100051161	17	F	5	2	Asthma	9	0.9831

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Workload Balancing

Tools like the average Care Management Index and BOI can help managers balance caseloads more equitably among CMs

My Member List

Menu Manager: All

Program: - All -

Status: - All -

CM Case	DM Case	ME Case	Total Members	Average CMI	Average BOI
5	0	0	5	12.40	2.8072

	No.	Enroll Date	CM	DM	ME	Member ID	Name	Age	Sex	Status	Severity	Disease	CMI	BOI
⊞	1	2/13/2008	◉			*	*	51	F	6	2	Diabetes and Advanced Coronary Artery Disease	12	3.2119
⊞	2	2/1/2008	◉			*	*	61	M	6	2	Diabetes and Hypertension	19	2.3164
⊞	3	2/15/2008	◉			*	*	69	F	6	2	Diabetes and Other Moderate Chronic Disease	9	3.3151
⊞	4	1/16/2008	◉			*	*	64	M	6	2	Diabetes and Hypertension	14	2.3164
⊞	5	2/11/2008	◉			*	*	59	F	6	2	Diabetes and Other Moderate Chronic Disease	8	2.8762

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EVALUATE CARE MANAGEMENT AND PROVIDER PERFORMANCE

INTERNAL AND EXTERNAL

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Quality Performance/Evidence Based Medicine (EBM)

PMI Provider Detail - Microsoft Internet Explorer

File | PMI Provider Detail

Analysis Period Ending	Provider Id	Members	Name	Address	Specialty	RiskGroup	Scores
12/31/2006	*	1,628	*	*	Family/General Practice	*	Utilization: 24.89 Complication: 26.54 Gaps In Care: 27.19 Total Score: 78.62

Utilization Threshold | Preventable Complication | **Gaps In Care**

Affected Member Count	Metric Member Count	Gaps In Care Metric	Percent Gaps
1	28	Appropriate Use Of Asthma Medicine	3.57%
0	0	Beta Blocker After Heart Attack	0.00%
136	481	Cervical Cancer Screening	28.27%
228	348	Colorectal Cancer Screening	65.52%
1	56	Eye Exam	1.79%
48	55	Foot Exam (ADA)	87.27%
17	56	Hemoglobin A1c	30.36%
495	610	Influenza Vaccine (CDC/ACIP)	81.15%
353	692	Lipid Testing (USPSTS)	51.01%
59	173	Mammography Screening	34.10%
29	53	Nephropathy Monitoring (NCQA)	54.72%
90	1,266	Office Access Issues	7.11%
7	13	Pediatric DtaP/DT Immunizations	53.85%
4	13	Pediatric Hepatitis B Immunization	30.77%
1	13	Pediatric HIB Immunizations	7.69%
4	13	Pediatric MMR Immunizations	30.77%
4	13	Pediatric Polio Immunizations	30.77%
8	13	Pediatric Varicella Immunizations	61.54%
406	444	Pneumonia Vaccine (CDC/ACIP)	91.44%

Including a quality analysis provides an important check on "cost efficient practices" to see if efficient providers are also cost effective (Q/$) by maintaining high EBM quality scores

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Program Performance

- Clinically matched cohorts
- Pre and post analysis
- ROI
- Metrics
  - Cost
  - Quality
    - Gaps
    - Complications

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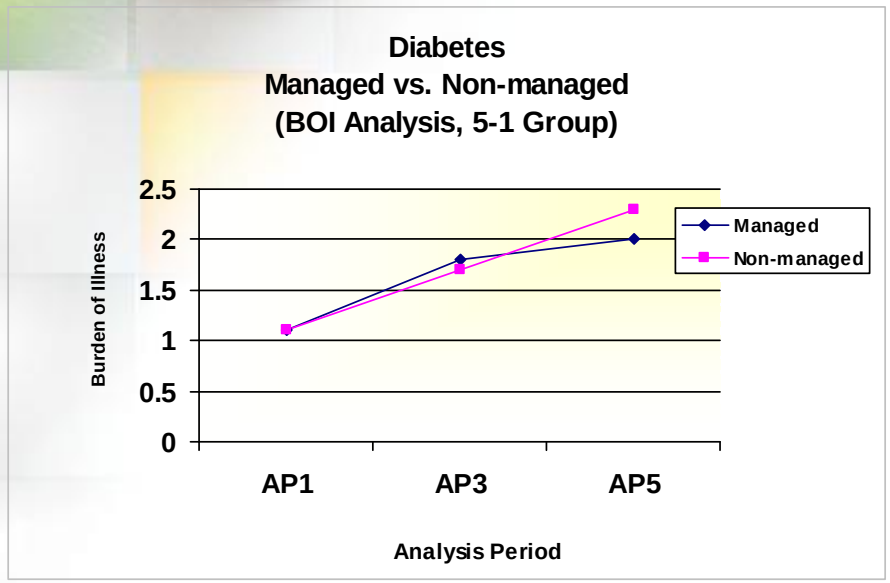
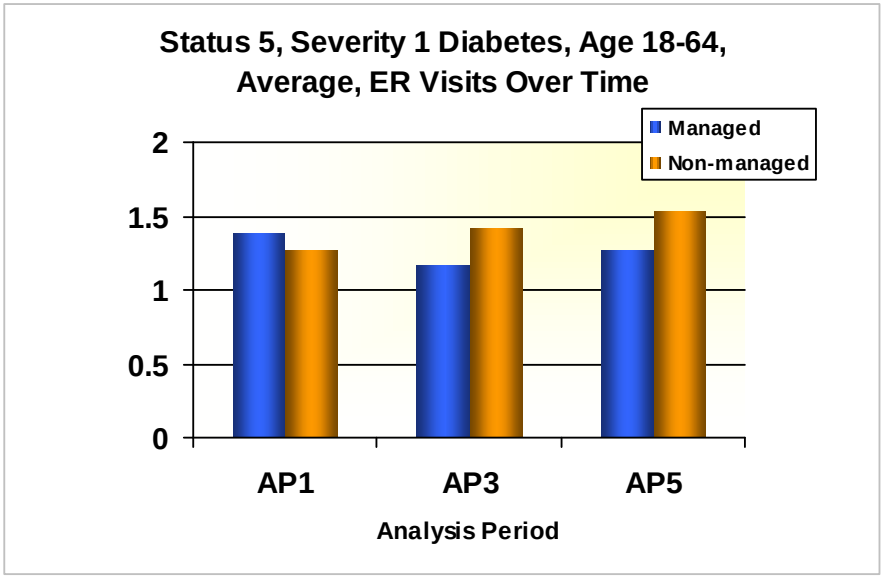
Disease Program Management





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Program/Vendor/Carrier Evaluation

Total Cost/PMPM								
Carrier / Provider	Specialty	AP Members	Avg BOI	Actual Total Cost/PMPM	Expected Total Cost/PMPM	A/E	% Share of Total Cost	Efficiency Driver
Enterprise		160,496	1.58	$146.95	$146.95	1.00	100.00	
XXXXXXXXXXX		13,237	1.42	$138.72	$125.74	1.103	7.786	858.926
XXXXXXXXXXX		10,680	1.46	$138.40	$131.25	1.055	6.268	660.934
XXXXXXXXXXX		6,176	1.38	$130.51	$125.13	1.043	3.418	356.480
XXXXXXXXXXX		33,451	1.58	$139.71	$143.73	0.972	19.815	1,926.075

Note: 4th Plan with sickest individuals (highest BOI) has the best performance (lowest A/E)

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Sales and Retention

- Show what you can do
- Show how you do it
- Demonstrate outcomes and value
- Client specific

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Other Applications

- Actuarial/underwriting
  - May be helpful for small group underwriting
  - Credibility adjustment for partial exposure
  - Exogenous factor adjustments (e.g., with/without Rx in a subset of the population
  - Expected number of cases reaching stop loss threshold
- Health plan reimbursement: risk adjusted capitation (Medicare, NYS Medicaid)
- Health care vouchers

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Summary

- Predictive models can be used to;
  - Identify diseases for management at client specific level
  - Select members for interventions
  - Assist in managing caseload
  - Evaluating impact of interventions
- Risk scores and other metrics form an excellent basis for performance evaluation
- Promote new sales and retention

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