**Ten Ways Predictive Modeling
Is Changing Health Care**

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SINI
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Agenda

- Discuss methods used to develop predictive modeling formulae to find those at highest risk for near term high care utilization
- Describe ten ways predictive modeling can be used to change the way health care is delivered, both in population-based and inpatient settings
- Present powerful health and financial outcomes from a large government entity.

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Definition of Predictive Modeling

- *"Predictive modeling is a set of tools used to stratify a population according to its risk of nearly any outcome… ideally, patients are risk-stratified to identify opportunities for intervention <u>before</u> the occurrence of adverse outcomes that result in increased medical costs."*

  Cousins MS, Shickle LM, Bander JA. An introduction to predictive modeling for disease management risk stratification. Disease Management 2002;5:157-167.

What Data Can Be Used for PM?

- Demographic data
- Medical claims
- Pharmacy claims
- Lab results
- Patient-supplied data
  - Including medical and psychographic info such as health status, clinical risk status, impactability factors

Practical Data-Type Considerations

- Does the data suit your purpose?
- Do you have access to the data?
- Is the data timely enough to suit your purpose?
- Can you pull it in? Can you work with it to get what you want out of it?
- How accurately does the data predict cost? Provider behavior? ID high care users?
- What's the cost to benefit of using this data?

Predictive Modeling Methods

- Regression—multiple & logistic
- Neural net
- Large datasets required
- Model validation is key step

Impactability: Issues

- Does patient *appear to have* a clinical or knowledge-deficit issue that can be impacted?
  - CHF/no BB and no contra-indications
  - CHF/ no ACEI-ARB and no contra-indications
  - DM + hypertension + age 55+ and no ACEI/ARB
  - Truly doesn't understand treatment regimen or pros/cons of various treatment options
- Does patient have a behavioral issue that can be impacted?
  - Poor adherence due to perceptual barriers
  - Need for coaching: stress management or behavior change
- Will they engage/enroll in the intervention?

A bit of my history…my first experience with why accuracy matters

	Observed Health Care Use			
Predicted Health Care Use	**0 = Low care use group**		**1 = High care use group**	
Traditional Claims-Based Predictive Model	N	%	N	%
	True Negatives		**False Negatives**	
People with No Disease (N)	2,602	41.2%	2,603	**41.2%**
People with No Disease (encounters)	7,430	14.1%	33,104	62.6%
People with No Disease ($)	$ 393,119	7.3%	$ 3,574,910	**66.0%**
	False Positives		**True Positives**	
People with Disease (N)	374	5.9%	735	**11.6%**
People with Disease (encounters)	1,234	2.3%	11,092	21.0%
People with Disease ($)	$ 73,392	1.4%	$ 1,376,572	**25.4%**
One Care Street® Predictive Formula	**True Negatives**		**False Negatives**	
Probability = 0 (N)	1,508	23.9%	1,201	**19.0%**
Probability = 0 (encounters)	4,250	8.0%	15,009	28.4%
Probability = 0 ($)	$ 226,607	4.2%	$ 1,691,932	**31.2%**
	False Positives		**True Positives**	
Probability = 1 (N)	1,468	23.2%	2,137	**33.8%**
Probability = 1 (encounters)	4,414	8.4%	29,187	55.2%
Probability = 1 ($)	$ 239,904	4.4%	$ 3,259,550	**60.2%**
	Check		Check	
Whole pop. N	6,314	6,314		6,314
Whole pop. Encounters	52,860	52,860		52,860
Whole pop. Dollars	$ 5,417,993	$ 5,417,993		$ 5,417,993

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Some Things Worth Knowing about Healthcare!

- We all know healthcare is expensive and that some diseases cost more than others
- What we don't know is that widely held beliefs often cause us to propose inadequate solutions
- The following slides dispel common misconceptions using analysis of a large employer data set

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Some Things Worth Knowing: Average Health Spend

Quintiles of Annual Health Costs

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
	$ 602	$ 7,740	$17,702	$41,195	$132,122
	12,503 (88.4%)	972 (6.9%)	424 (3.0%)	183 (1.3%)	57 (0.4%)
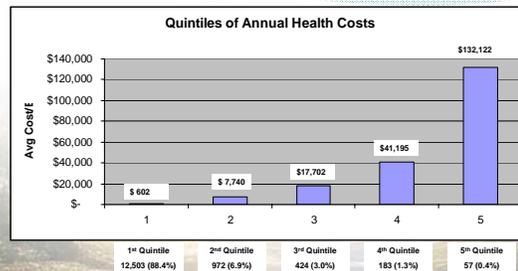
What we hear: "On average, people spend >$7,000 annually on healthcare costs."
- 41% (N=5.770) of the study cohort had $0 claims; 11.6% of this population incurred 80% of claims cost

What are the implications? Healthcare spend is relatively low for most people and is high for just a few. This data provides a compelling argument for the need for a real focus on predictive modeling.

Some Things Worth Knowing: Likelihood vs. Certainty

- **What we hear: "People with chronic conditions that are expensive in Year-1, stay expensive in Year-2."**
- In the study cohort (N=14,139), 10.19% (1,441 people) reported having diabetes
- A Chi Square was performed to determine how many of the diabetics who were part of the high cost 20% group in the Pre-Year (Y1), stayed in the high cost 20% group in the OCS-Program Year (Y2)

Results:
  - 20% (285) who were high cost Y1 stayed high Y2
  - 59% (847) who were low cost Y1 stayed low Y2
  - 11% (158) who were high cost Y1 became low Y2
  - 10% (151) who were low cost Y1 became high Y2

- **What we know: "Most people with chronic conditions that are expensive in Year-1, don't stay expensive in Year-2."**
- In this population, only 20% of diabetics who were expensive in Year-1, stayed expensive in Year-2.
- **What are the implications?** If you rely on conventional wisdom and use only claims-based stratification vs. adding survey-based predictive modeling, lots of people who could have been helped will be missed. This is the most important differentiating value added by survey-based predictive modeling.

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Some Things Worth Knowing: Likelihood vs. Certainty

- **What we hear: "On average, people with certain lifestyle practices are more expensive than others."**
- In the study cohort (N=14,139), 15% (2,102) people reported smoking and 85% (12,037) reported nonsmoking
- A Chi Square was performed to determine how many smokers were part of the high cost 20% group in the OCS-Program Year (Y2)

Results:
  - 20% of smokers (421) part of high cost group in Y2 (avg cost = $12,143)
  - 20% of nonsmokers (2,406) part of high cost group in Y2 (avg cost = $12,026)
  - 80% of smokers (1,681) part of low cost group in Y2 (avg cost = $274)
  - 80% of nonsmokers (9,631) part of low cost group in Y2 (avg cost = $323)

- **What we know: "On average, people with certain lifestyle practices are more expensive than others."**
- **What are the implications?** Most smokers are not more expensive; but a few are a lot more expensive, and the likelihood increases with age and duration over time. Think about the use of incentives vs. disincentives to create higher participation in smoking cessation classes vs. creating defensive-avoidant behavior.

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Some Things Worth Knowing: The Episodic Nature of Illness

- **What we hear: "People that are expensive, stay expensive."**
- Dr. Wendy Lynch *et al.** performed segment migration analysis on 10,000 people across 4 years, where between 2 and 6% of people accounted for 40% of health costs in a given year
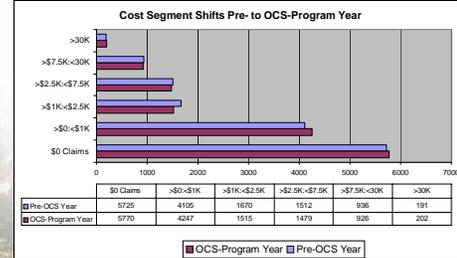
Results:
- In each year, between 73%-83% were in the high-cost group for the first time
- Only .4% to 1% of these people were expensive in two consecutive years
- Only 3 of 10 people were expensive more than once in a 4 year period

* Lynch WE, Aligning Incentives, Information, and Choice. Health as Human Capital Foundation: 2008, p. 36-37.

- **What we know: "People that are expensive, usually don't stay expensive."**
- **What are the implications?** Being expensive is very episodic. Having multiple conditions increases the likelihood that a person could be expensive, but in any given year, it would not be certain.
- A sound predictive model acts as an **"Early Warning System"** to provide help to the right people at the right time, much **EARLIER** than using other interventional models which sustains the lowest possible health cost trend.

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Some Things Worth Knowing: The Stability of Cost Segments

Cost Segment Shifts Pre- to OCS-Program Year

	$0 Claims	>$0:<$1K	>$1K:<$2.5K	>$2.5K:<$7.5K	>$7.5K:<30K	>30K
Pre-OCS Year	5725	4105	1670	1512	936	191
OCS-Program Year	5770	4247	1515	1479	926	202

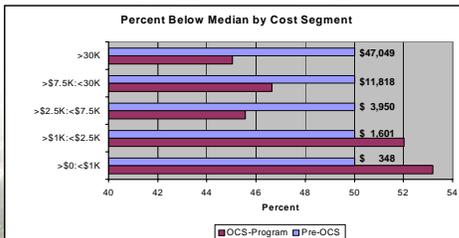Legend: OCS-Program Year, Pre-OCS Year

What we know: Even though people shift between segments from one year to the next, the % of the total population in each segment stays relatively stable.

Implications: The power of population health management is to shift more people into the lower end of each cost segment. The industry is looking closely at refining this metric.

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Some Things Worth Knowing: Coaching Shifts Median

Percent Below Median by Cost Segment

Segment	Value
>30K	$47,049
>$7.5K:<30K	$11,818
>$2.5K:<$7.5K	$ 3,950
>$1K:<$2.5K	$ 1,601
>$0:<$1K	$ 348

Legend: OCS-Program, Pre-OCS

Analysis Result: More people were below the median in the OCS-Program Year in both the >$0 - <$1K and >$1K - <$2.5K segments as well as more people overall in the $0 claims segment.

Implications: This is consistent with the highest impact being on Outpatient and Physician encounters/costs.

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Ten Ways PM Can Impact Care & Cost

Population Health Management
- Case Management
  - What/who is being managed?
- Complex Care Management
  - The sickest 1% of a population
- Health Coaching
  - Prospective identification based on low perceived health
- Health Risk Assessments
  - Predicting morbidity & mortality
  - (expense in the more distant future)
- Disease Management
  - People with existing chronic disease & low perceived health

Acute Care Management
- Fall Risk
  - To ID for widely implemented fall management programs
- Sepsis & Other Infectious Disease Risk
  - What are the predictors?
- Readmission Risk
  - CHF, Diabetes
- Caregiver Risk
  - Affects discharge planning
- Need for remote monitoring
  - The sickest 1%

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Why Predictive Modeling Accuracy Matters: Case Study

Government Entity |
49,000 eligible employees and insured spouses

Challenges Influencing Strategy (2006)
- Highly distributed workforce all over the state
- New Governor and team implementing lots of change so high cultural resistance to any new program
- Historically employees have had rich benefits with little cost sharing

Communications Strategy (2006)
- Made the effort to get face-to-face with employee kick-off meetings so did 445 meetings in six months across the state
- Used every communication channel possible – streaming video off of employee website; multiple internal channels – garnering local HR support as kick-off meetings happen
- Did another "push" during/just prior to open enrollment when people were thinking about their contribution amounts and the incentive
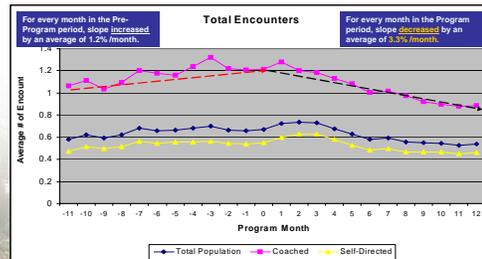
Incentive Strategy (2006)
- Used employee insurance contribution discount biweekly if employee & covered spouse took the survey and set a health goal, and if eligible for coaching, took the first coaching call.

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Raw Data Change in Encounters at Total Population Level

For every month in the Pre-Program period, slope **increased** by an average of 1.2%/month.

Total Encounters

For every month in the Program period, slope **decreased** by an average of 3.3% /month.

Y-axis: Average # of Encount
X-axis: Program Month (-11 to 12)

Legend: Total Population, Coached, Self-Directed

Analysis results reveal that the Program Year slope is statistically significantly different from the "Pre-Program" slope for Coached, Self-Directed and Total Population Groups. This means it's highly unlikely (p value 0.05; meaning <5 times in 100) that the slope change occurred by chance.

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Contribution to Reduction in Total Encounters by Service & Group

Contribution by Service*

Category	$	Contribution to Trend
Physician	$ 15.28	18%
Outpatient	73.37	85%
ER	10.30	12%
Inpatient	(12.77)	-15%
Total:	$ 86.18	100%

Category	Coached Group % Contribution to Trend	Self-Directed Group % Contribution to Trend
Physician	8%	10%
Outpatient	74%	11%
ER	8%	4%
Inpatient	8%	-23%
Total:	98%	2%

* ( ) indicates loss v savings

- In rank order, savings accrued from Outpatient, then Physician, ER and Inpatient services
- There were Inpatient savings in the Coached Group, but a 23% higher Inpatient spend in the Self-Directed Group
- **98%** of the total population savings came **from the Coached Group**

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Thank You!

- For the opportunity to share this information with you
- For being an open-minded and critically thinking listener
- For translating what I've shared into your strategy for health management

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