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Using Predictive Modeling to Enhance Group Underwriting

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December 13, 2007

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What is Predictive Modeling?

- A process that predicts future resource use or costs for an individual or a group of individuals
- A precursor to predictive modeling was risk adjustment which refers to the process of quantifying differences in health status among populations

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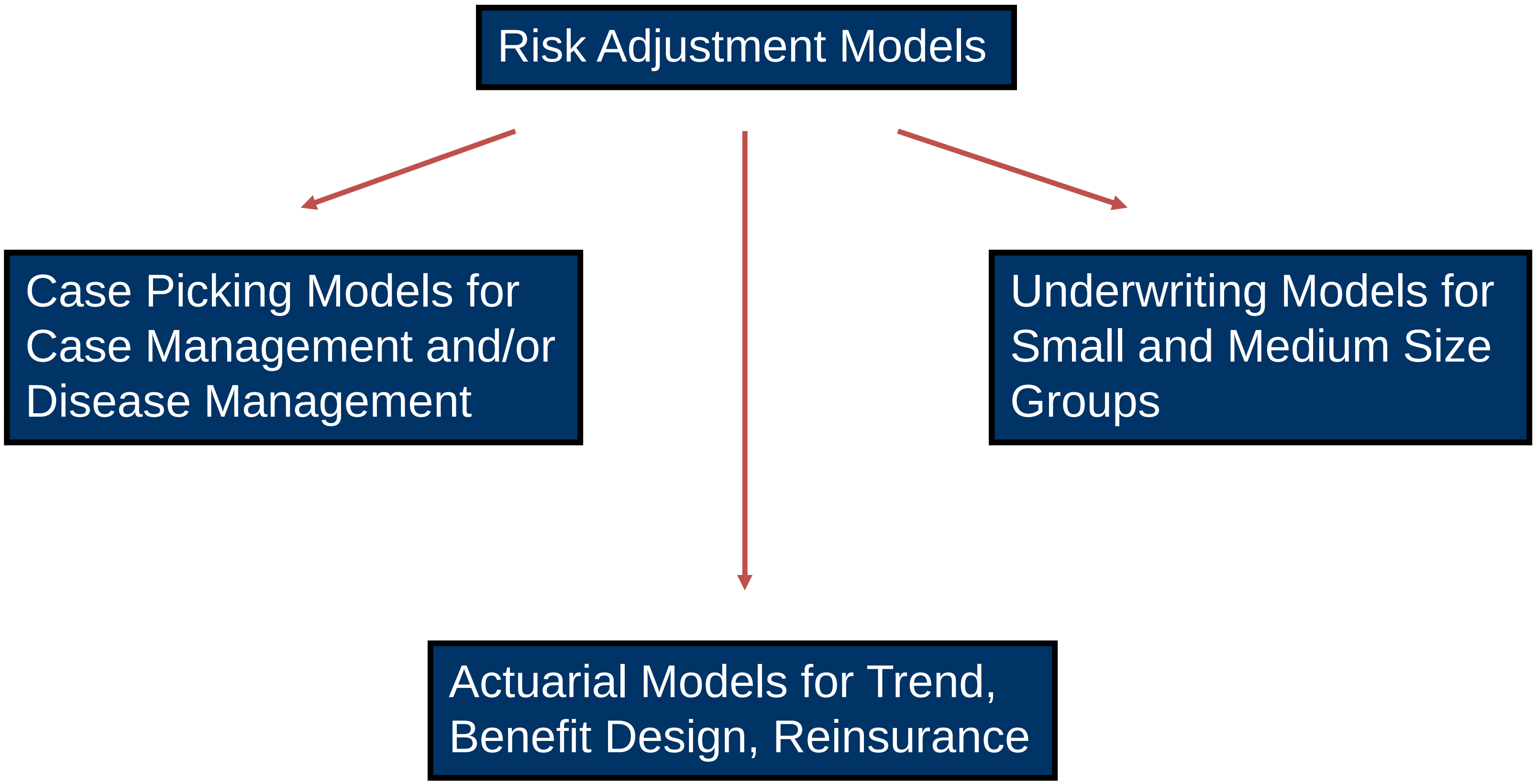
Model Evolution



Variables Used in Predictive Modeling Are Not Restricted

When risk adjustment is used for provider payment, variables such as prior utilization or costs are not used so that differences in fee structures or provider practice patterns do not influence prediction

In predictive modeling, any information (such as prior utilization or costs) that enhances the prediction of future resource use can be used

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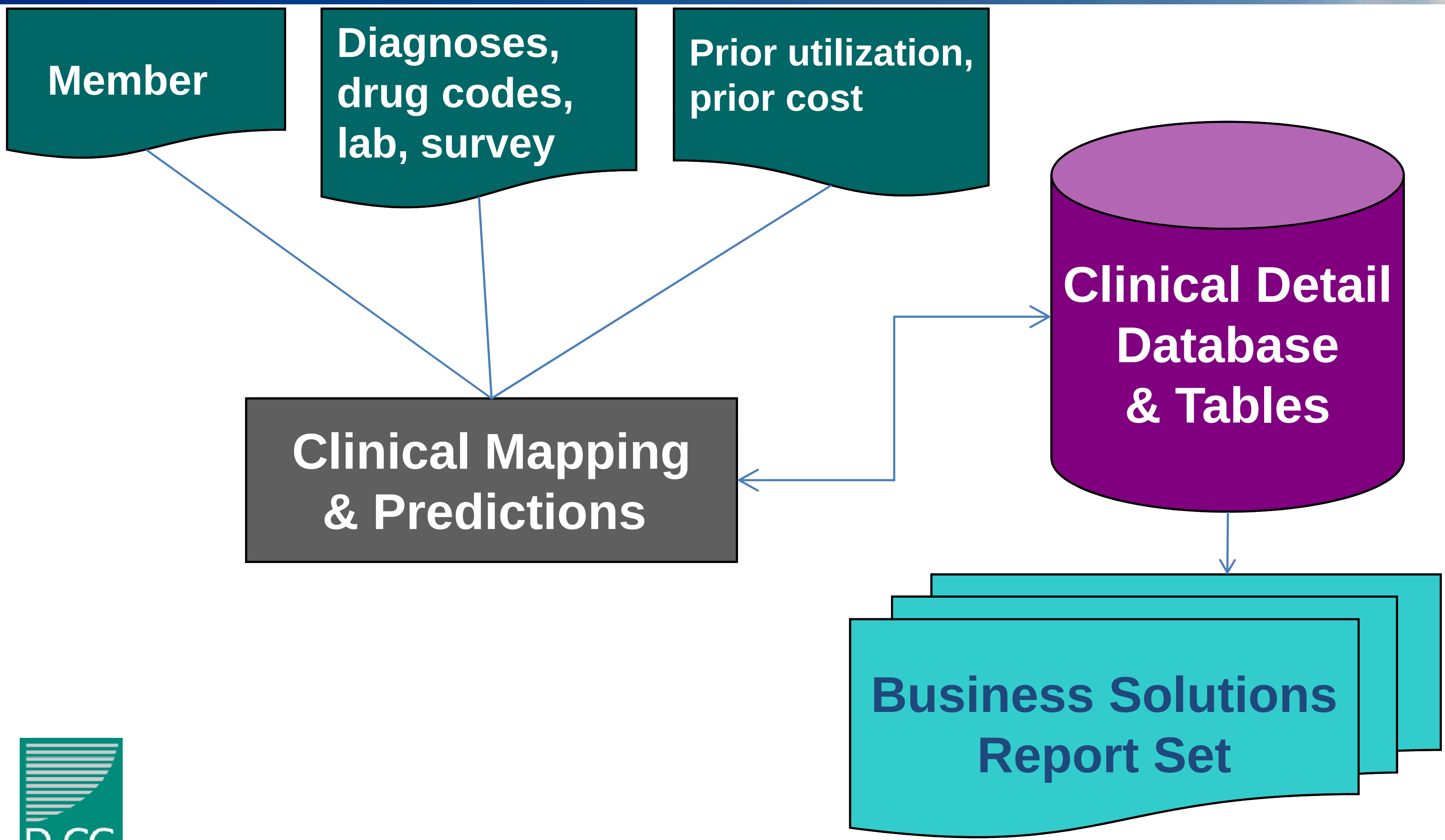
Predictive Modeling Process



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Underwriting Models
A Case Study

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Traditional Vs Predictive Modeling (PM)

"Traditional"

- Uses demographic risk (age and gender) and prior costs
- Uses different weighting for the above 2 factors based on group size

Predictive Modeling

- Uses age, gender, diagnoses, prior costs (medical and pharmacy)

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Weights Used in Case Study for "Traditional" Method

Group Size	Age Gender Weight	Prior Cost Weight
75	.48	.52
250	.24	.76
1000	.08	.92

Ref: Fuhrer C. (1988) *Some Applications of Credibility Theory to Group Insurance*, Transactions of Society of Actuaries, Vol. 40 Pt 1

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Study Methodology

- Took random samples of size 75, 250 and 1000 from the benchmark database
  - Real group identifier is not available
- Applied two rating methods at the end of the baseline analytic period
  - Traditional (Age gender + Prior cost)
  - PM (Age gender + Prior cost + Diagnoses)
- Used a $100K threshold when comparing the two rating methods

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Case Study Data Set

- Benchmark Marketscan® database
  - N ~ 4.7 million, PMPY = $3,699
- 30 months of claims and enrollment data
- Characteristics
  - Commercial population
  - Primarily non-elderly
    - Average age 35.5 years (F: 36.3 yrs, M: 34.6 yrs)
  - Mix of products
  - Mix of regions

Case Study Time Frame

- Baseline analytic period
  - Jan 2003 – Dec 2003
- 6 month lag period
  - Jan 2004 – June 2004
- Prediction period
  - July 2004 – Jun 2005

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Lagged Approach Defined

Un-lagged approach

12 months
(Analytic Period)

12 months
(Prediction)

Lagged approach

12 months
(Analytic Period)

6 months (Lag)

12 months
(Prediction Period)

DxCG Predictive Modeling (PM) Methodology

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Grouping of Clinical Information
Example: DCG/HCC Classification System

ICD 9 CM codes
N = 15,000+

↓

DxGroups - DxGs
N = 781

↓

Condition Categories - CCs
N = 184
→ **Hierarchies imposed for predictions**

↓

Aggregated Condition Categories - ACCs
N = 30
→ **Reporting Only**

How Do DxCG Models Predict?

- Linear additive formulas (OLS regressions) predict based on CCs, age and sex, with:
  - Hierarchical restrictions
    - E.g, ignore the cough when a person has COPD
  - Disease interactions
    - E.g, COPD + CHF costs more than separately
  - Sub-population interactions
    - E.g., asthma costs more in kids

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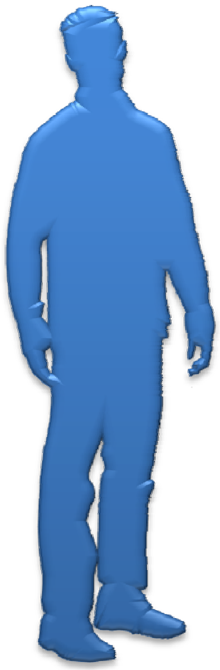
Inside the Risk Scores

Example: Prediction from a Regression Model



John Smith

RRS 6.35

0.50 50 year old male

0.72 HCC52 Drug/Alcohol

DxG 52.01 *ICD-9 303*

0.00 HCC91 HYPERTENSION

DxG 91.01 *ICD-9 401.1*

2.89 HCC15 TYPE I DIABETES MELLITUS

DxG 15.02 *ICD-9 250.41*

1.64 HCC80 CONGESTIVE HEART FAILURE

DxG 80.01 *ICD-9 402.01*

0.60 *- Interaction* TYPE I DIABETES MELLITUS & CHF

6.35 Relative Risk Score

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HCCs Provide More Relevant Information for Prediction

Mean # of HCCs* by Age and Gender

Age (Years)	Female	Male
0 – 17	2.7	2.7
18 - 44	3.4	2.5
45 and over	4.4	3.7
	3.7	3.0

*HCCs based on baseline analytic period diagnoses

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Results by Group size

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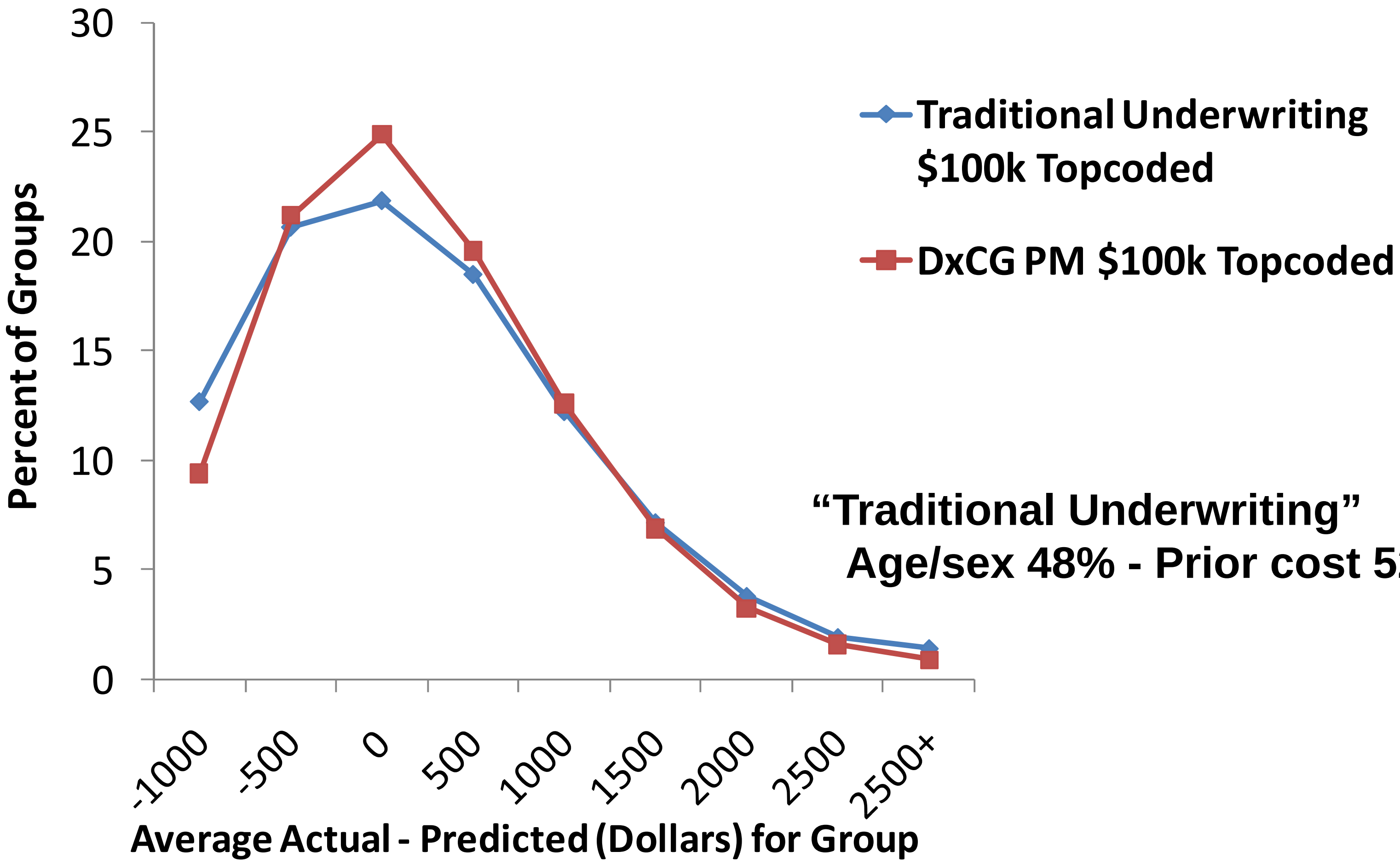
DxCG PM Outperforms Traditional Approach (63,170 **random groups of 75 lives)**



"Traditional Underwriting" Age/sex 48% - Prior cost 52%

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Traditional Vs DxCG PM
(63,170 random groups of 75 lives)

Group Level Average Residual = Actual $ - Expected $	DxCG PM 100K Topcoded	Traditional 100K Topcoded
Percent Less than -$500	30.6%	33.3%
Percent Between -$500 and +$500	44.4%	40.4%
Percent Greater than $500	25.0%	26.3%

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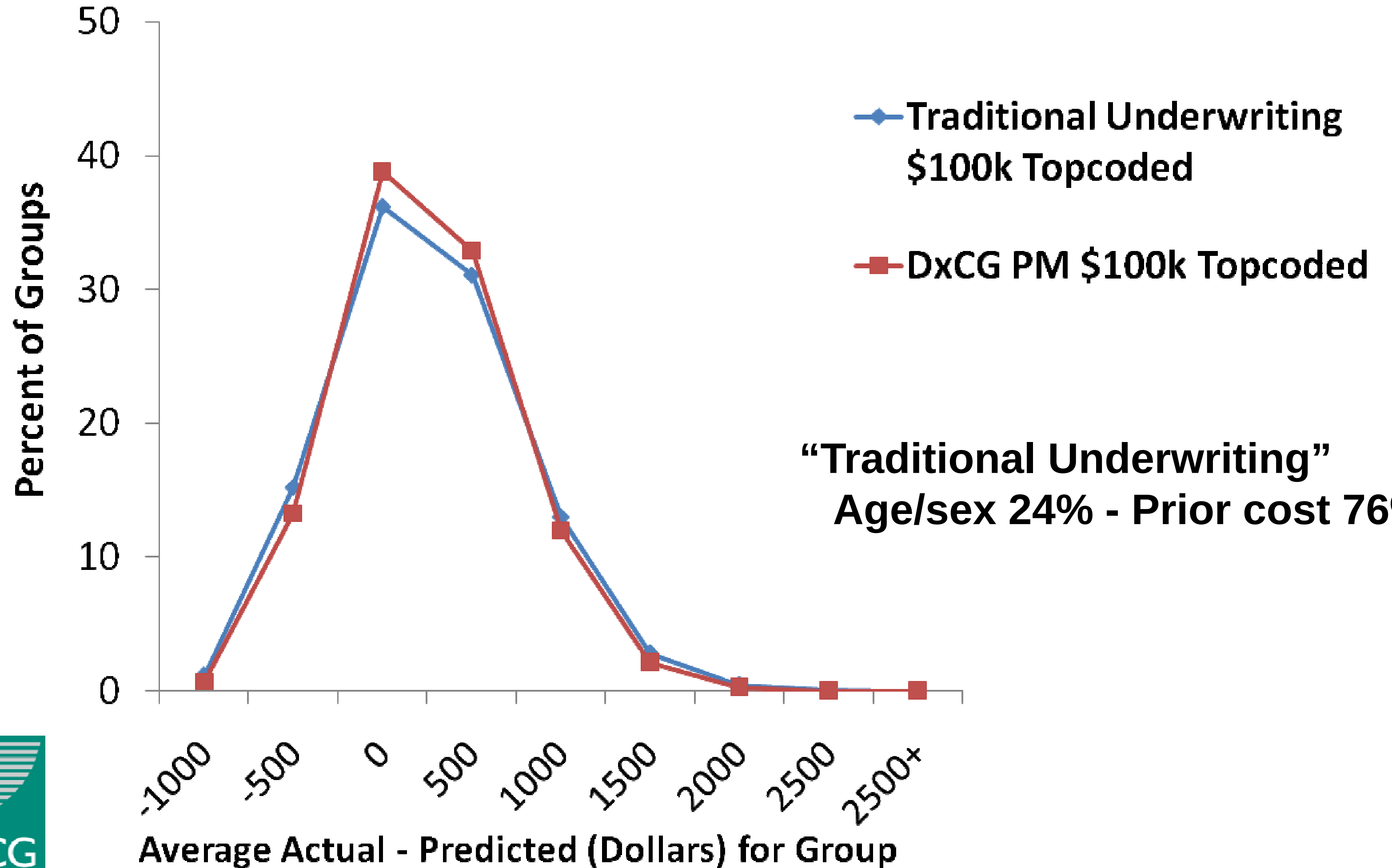
DxCG PM Outperforms Traditional Approach
(18,951 random groups of 250 lives)



"Traditional Underwriting"
Age/sex 24% - Prior cost 76%

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Traditional Vs DxCG PM
(18,951 random groups of 250 lives)

Group Level Average Residual = Actual $ - Expected $	DxCG PM 100K Topcoded	Traditional 100K Topcoded
Percent Less than -$500	13.9%	16.4%
Percent Between -$500 and +$500	71.7%	67.3%
Percent Greater than $500	14.4%	16.3%

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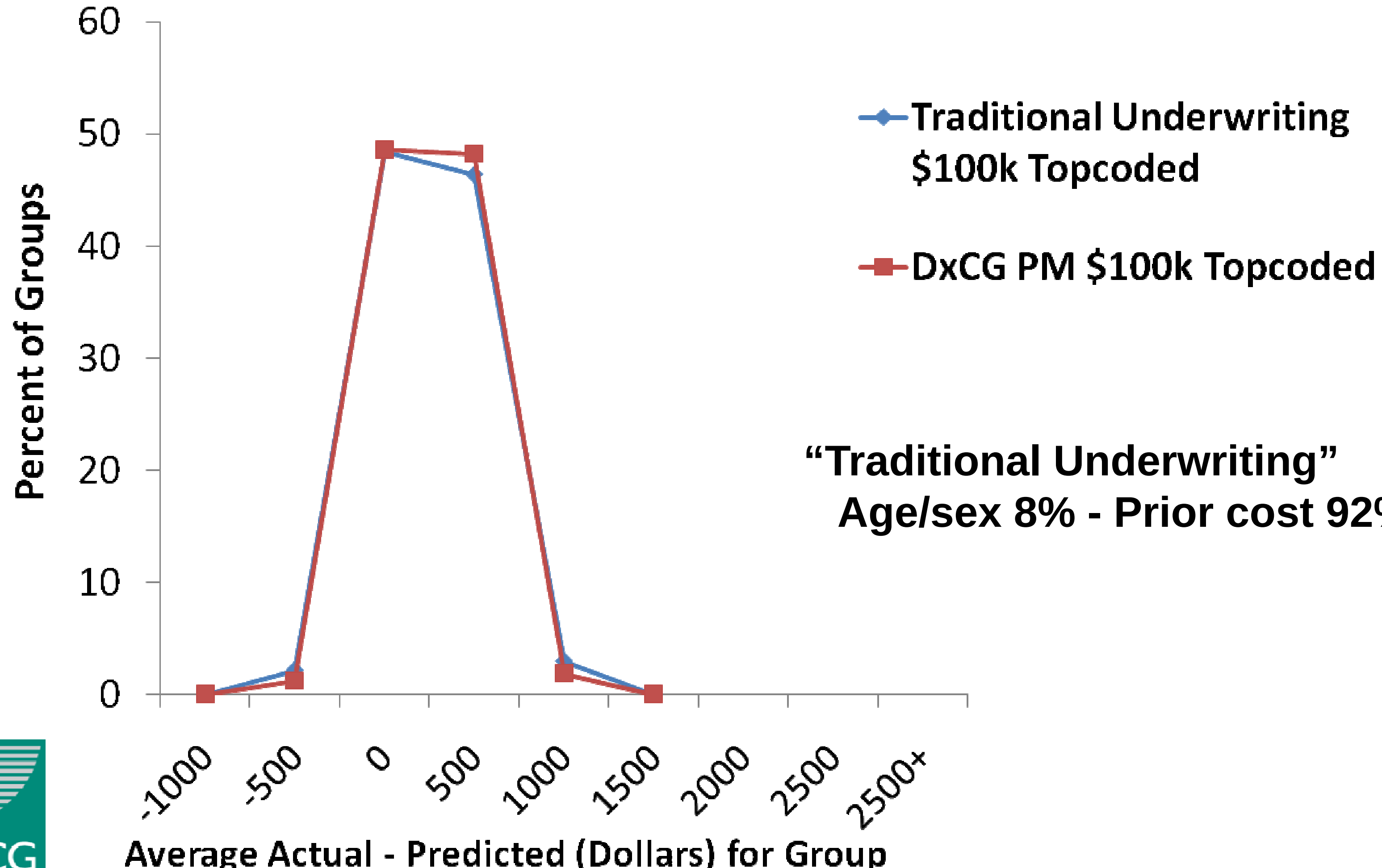
Traditional and DxCG PM Difference Narrows With Increasing Group size
(4,737 random groups of 1,000 lives)



"Traditional Underwriting"
Age/sex 8% - Prior cost 92%

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Traditional Vs DxCG PM
(4,737 random groups of 1,000 lives)

Group Level Average Residual = Actual $ - Expected $	DxCG PM 100K Topcoded	Traditional 100K Topcoded
Percent Less than -$500	1.2%	2.2%
Percent Between -$500 and +$500	96.9%	94.8%
Percent Greater than $500	1.9%	3.0%

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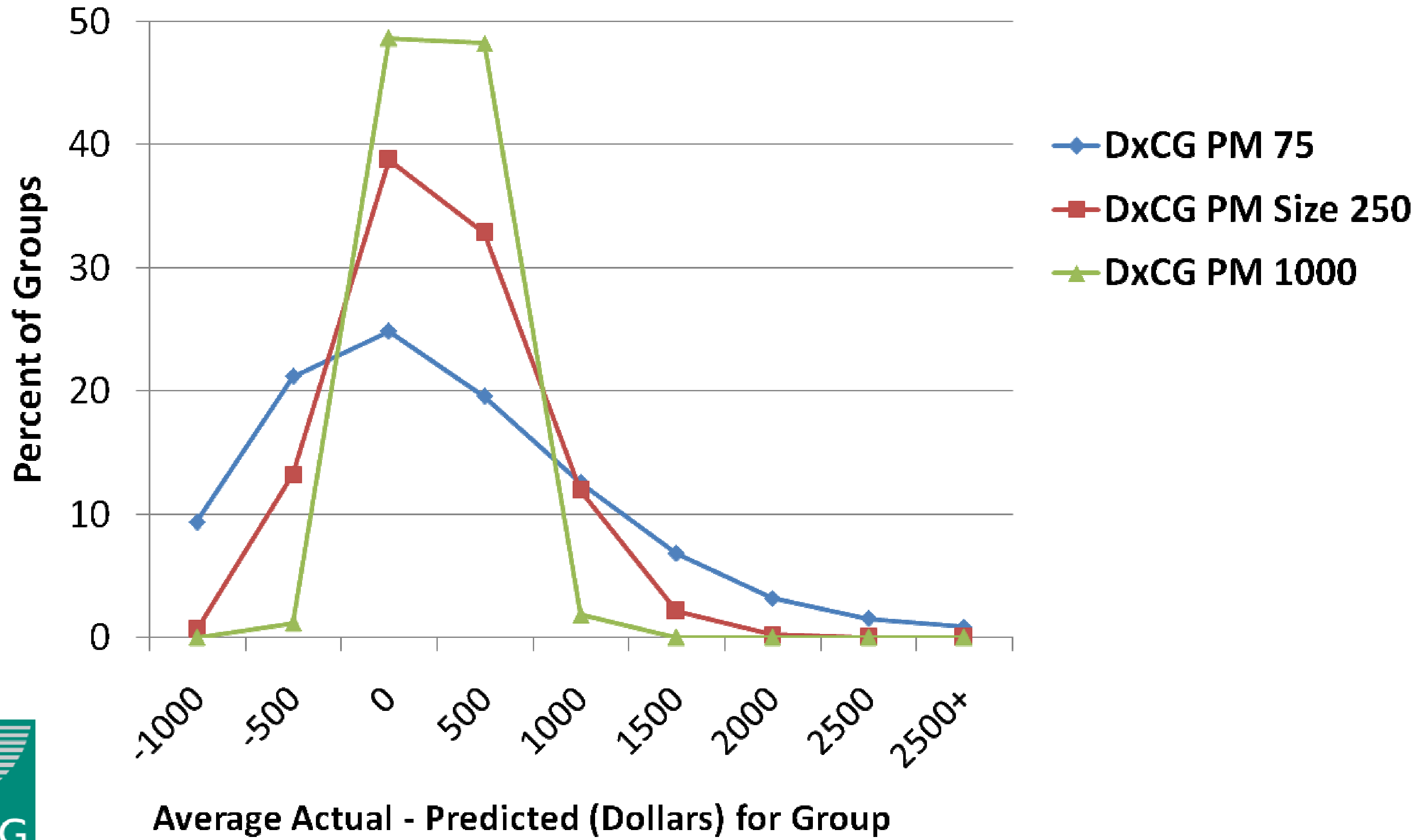
DxCG PM Performance Improves With Increasing Group Size



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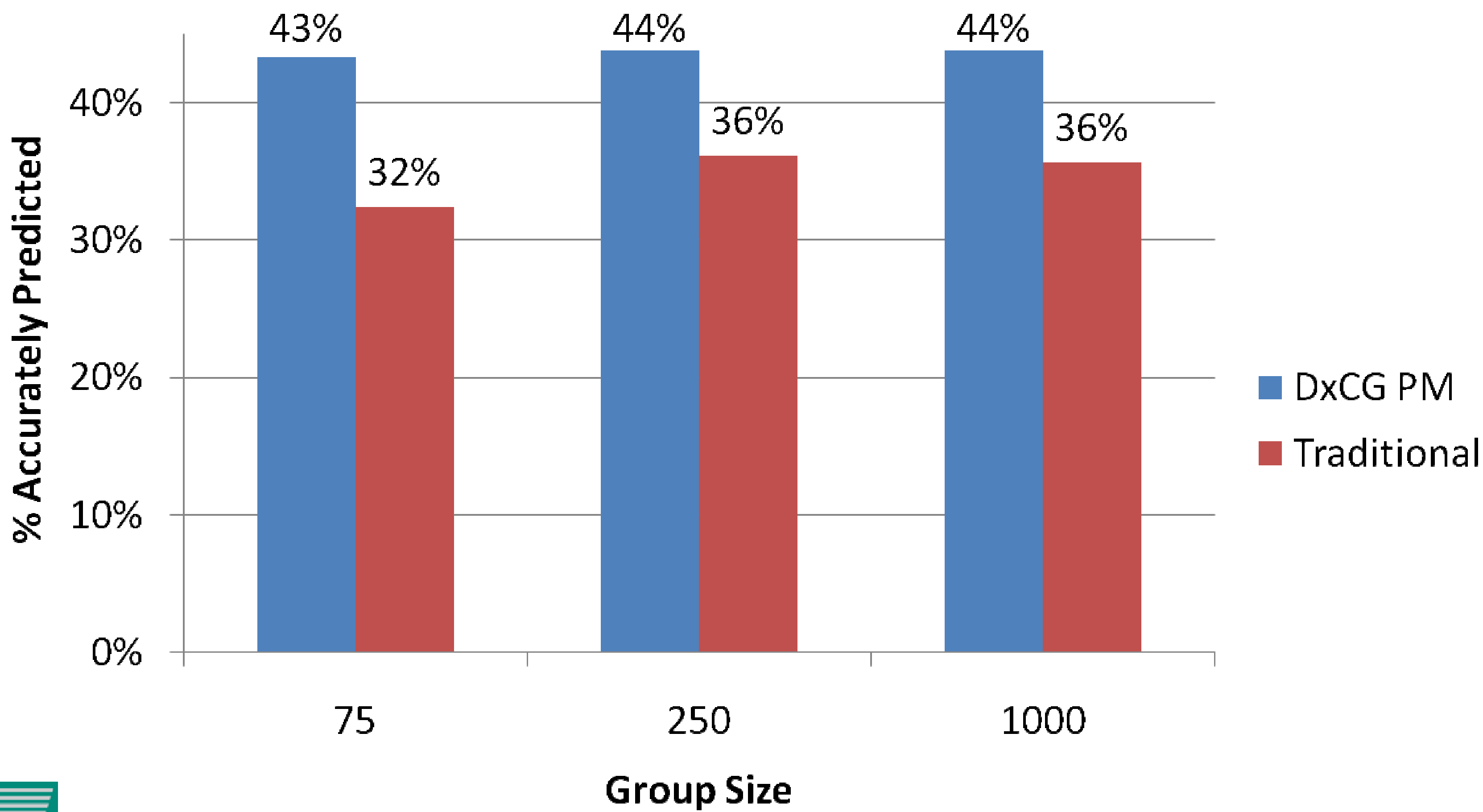
Positive Predictive Value (PPV) – Another Performance Measure

- Out of the groups predicted to be in the top 20%, how many were actually in the top 20%?
- Out of the groups predicted to be in the bottom 20%, how many were actually in the bottom 20%?

DxCG PM Has a Higher PPV in Top 20%



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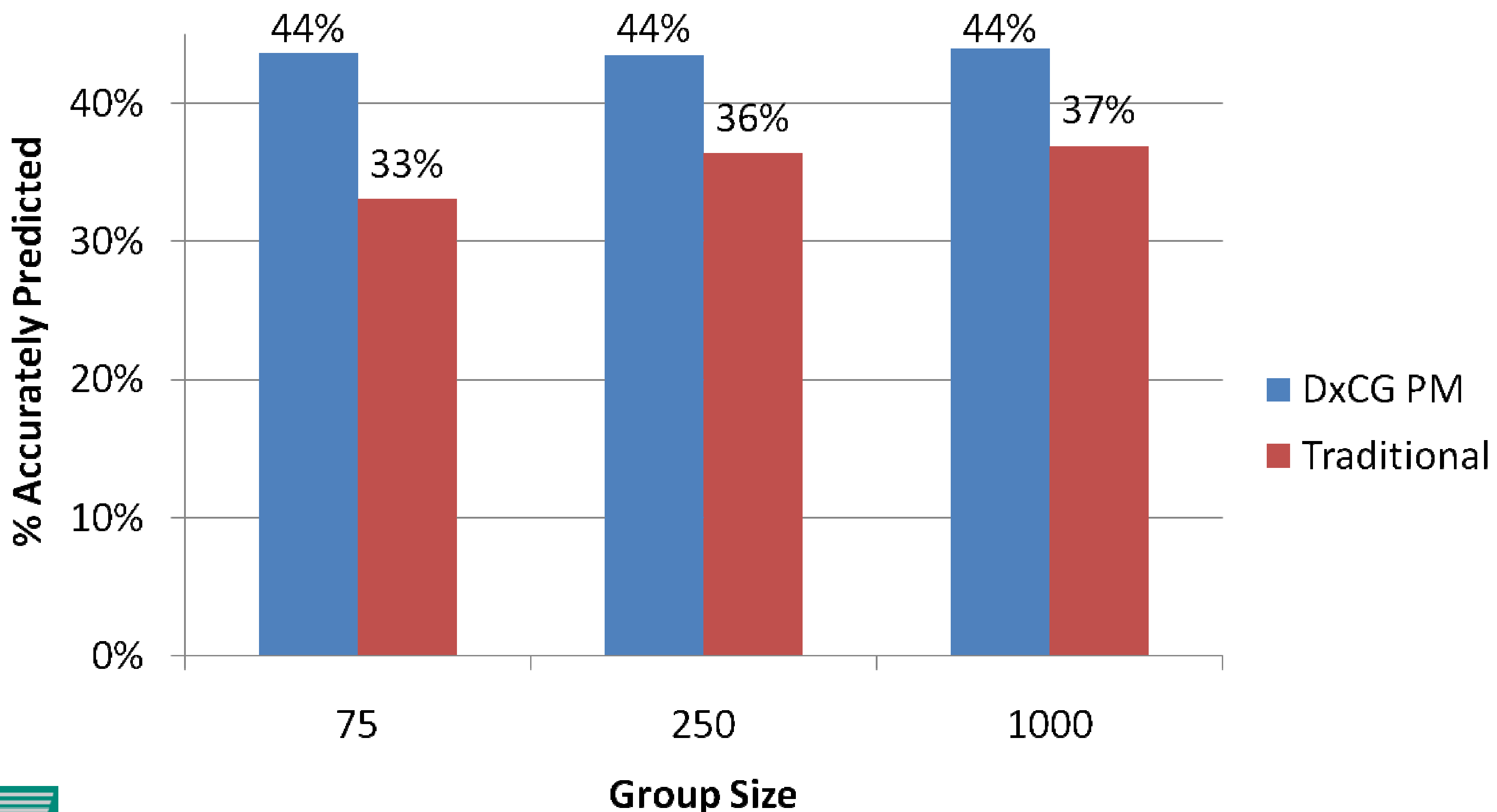
DxCG PM Has a Higher PPV in Bottom 20%



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Summary and Conclusions - I

- DxCG performed a simulation case study using a large, commercial database
- Creating random groups of size 75, 250 and 1,000, we compared traditional underwriting methodology with DxCG's predictive modeling approach

Summary and Conclusions - II

- We measured model performance using 2 methods
  - Distribution of mean actual minus predicted $
  - Positive Predictive Value (PPV) in top and bottom 20% groups
- DxCG PM approach for underwriting produced superior results for all group sizes
- Traditional method's performance improves with increasing group size

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