



The Johns Hopkins University's

 **2010 ACG International
Risk Adjustment Conference**



MAY 10-12 
Tucson, Arizona
Loews Ventana Canyon

The Impact of Local Calibration

Presenter: Chad Abrams

May 10, 2010



The Johns Hopkins University's

2010 ACG International
Risk Adjustment Conference



MAY 10-12
Tucson, Arizona
Loews Ventana Canyon

Applying diagnosis and pharmacy-based risk models to predict pharmacy use in Aragon, Spain: The impact of local calibration.

Amaia Calderón-Larrañaga^{2*}, Chad Abrams¹, Beatriz Poblador-Plou²,
Jonathan P Weiner¹ and Alexandra Prados-Torres²

¹Johns Hopkins University, Baltimore USA,

²Aragon Health Science Institute, Zaragoza, Spain

*Author for correspondence: acalderon.iacs@aragon.ex

BMC Health Services Research 2010, **10**:22

Research Question(s)

■ Risk Adjustment Using Pharmacy Data

- ❖ While diagnoses data (and diagnosis-based predictive models) well validated, how useful is pharmacy information for predicting future costs?
- ❖ Developed on US reference populations, how useful are these models in other settings (Spain)?
- ❖ What are the benefits of local calibration (recalibrating model using Spanish data)?



Data

❖ Aragon, Spain (2006-2007)

- Diagnostic
- Medication
- prior cost information
- n=84,152

❖ ACG Development Data Base is a subset of PharMetrics Integrated Database representative of the U.S. commercially insured population



Table 1. Characteristics of the Spanish study population and U.S. benchmark population

	Spanish Data		US Data	
	< 65	> 65	< 65	> 65
Demographic Characteristics (Year-1)				
Age (years) %				
0-4	6.8	---	6.6	---
5-11	7.6	---	11.6	---
12-17	6.2	---	10.3	---
18-34	28.8	---	24.5	---
35-44	16.2	---	19.5	---
45-54	16.8	---	17.3	---
55-64	17.6	---	10.2	---
65-69	---	24.3	---	24.0
70-74	---	27.3	---	28.9
75-79	---	22.6	---	22.3
80-84	---	15.7	---	14.6
>85	---	10.1	---	10.2
Age (years) mean	34.5	75.0	31.5	75.4
Female %	54.9	58.5	51.5	57.8

	Spanish Data		US Data	
	< 65	> 65	< 65	> 65
Clinical characteristics (Year-1)				
Chronic conditions %				
None	59.3	8.3	68.1	13.3
1	24.4	19.1	17.4	14.1
2 or more	16.3	72.6	14.5	72.6
Mean no. of chronic conditions	0.7	2.7	0.6	3.2
Prevalence of the diseases:				
Hypertension %	9.2	54.8	7.7	53.9
Hyperlipidaemia %	10.6	32.7	7.3	35.0
Depression %	6.3	11.9	3.6	3.3
Diabetes %	3.3	18.4	2.7	18.4
Asthma %	5.0	4.2	3.7	4.0
Congestive Heart Failure %	0.2	3.8	0.3	7.2

	Spanish Data				US Data			
	< 65		> 65		< 65		> 65	
Pharmacy expenditure (Year-2)								
Mean pharmacy expenditure	228€		950€		365€		840€	
Mean pharmacy expenditure of:		% of total (€)		% of total (€)		% of total (\$)		% of total (\$)
Highest 1%	4,988€	21.9	6,838€	7.2	7,608€	21.5	11,137€	13.7
Highest 5%	2,255€	49.5	4,064€	21.4	3,399€	48.1	4,677€	28.8
Highest 10%	1,518€	66.7	3,214€	33.8	2,312€	65.4	3,302€	40.6
Highest 30%	693€	91.3	2,083€	65.8	1,090€	92.4	1,922€	71.0
Highest 50%	443€	97.2	1,601€	84.3	701€	99.0	1,444€	88.9

Design and Methods

- Evaluated performance of ACG Predictive Models to predict pharmacy expenditures in next time period using:
 - ❖ Dx-PM (diagnoses only)
 - ❖ Rx-PM (pharmacy only)
 - ❖ DxRx-PM (diagnoses plus pharmacy claims)
 - ❖ DxRx-PM including prior pharmacy costs
- Evaluation Criteria
 - ❖ Prospective explanatory power (R²)
 - ❖ Predictive ratios (diagnoses categories, pharmacy categories, year-1 cost percentiles)
 - ❖ Ppv/sens & ROC for identification of top 5%



Table 2. Statistical performance of Alternative Predictive Models using U.S./Spanish weights

	Alternative Predictive Models							
	Dx-PM		Rx-PM		DxRx-PM		DxRx-PM w/ Prior costs	
	U.S.	Local	U.S.	Local	U.S.	Local	U.S.	Local
Variance explained. R ²	18.9%	29.4%	22.2%	40.6%	23.5%	42.6%	42.6%	60.8%
Area Under ROC Curve*	0.868	0.902	0.900	0.941	0.903	0.949	0.962	0.976
Sensitivity*	30.6%	39.4%	27.5%	52.3%	31.2%	53.2%	60.9%	74.2%
Specificity*	96.3%	96.8%	96.2%	97.5%	96.4%	97.5%	97.9%	98.6%
Mean pharmacy expenditure Year-2 (€)*								
True positives	3,059	3,076	3,244	3,236	3,248	3,244	3,448	3,239
True negatives	233	233	236	234	235	234	240	240

Dx: physician assigned diagnosis

Rx: pharmacy prescriptions filled by physicians

PM: predictive model

Table 3.1 Predictive Ratios for Year-2 pharmacy costs for Disease Groups

	Alternative Predictive Models							
	Dx-PM		Rx-PM		DxRx-PM		DxRx-PM w/ Prior costs	
	U.S.	Local	U.S.	Local	U.S.	Local	U.S.	Local
Medical condition groups:								
Hypertension	0.773	0.999	0.856	0.989	0.864	1.000	0.913	1.000
Hyperlipidaemia	0.776	0.925	0.900	1.007	0.911	1.010	0.935	1.002
Depression	0.847	1.000	0.961	0.979	1.009	1.000	1.032	1.000
Diabetes	0.714	1.000	0.774	0.984	0.793	1.000	0.860	1.000
Asthma	0.951	1.000	0.921	0.959	0.986	1.000	0.997	1.000
CHF	1.031	1.000	0.755	0.958	0.774	1.000	0.872	1.000

Medical condition groups consist of patients with at least 1 relevant diagnosis in Year-1

Dx: physician assigned diagnosis

Rx: pharmacy prescriptions filled by physicians

PM: predictive model

CHF: Congestive Heart Failure

Table 3.II Predictive Ratios for Year-2 pharmacy costs for Drug Use Groups

	Alternative Predictive Models							
	Dx-PM		Rx-PM		DxRx-PM		DxRx-PM w/ Prior costs	
	U.S.	Local	US	Local	U.S.	Local	U.S.	Local
Drug groups:								
Antihypertensives	0.721	0.918	0.856	1.000	0.859	1.000	0.909	1.000
Lipid-lowering	0.638	0.811	0.843	1.000	0.853	1.000	0.895	1.000
Antidepressants	0.646	0.774	0.920	1.000	0.936	1.000	0.999	1.000
Antidiabetics	0.654	0.917	0.785	0.998	0.797	1.002	0.856	1.001
Antiasthmatics	0.716	0.820	0.870	1.000	0.874	1.000	0.937	1.000
CHF	0.687	0.822	0.773	1.000	0.774	1.000	0.864	1.000

Drug utilisation groups include those with at least one relevant pharmacy fill in Year-1

Dx: physician assigned diagnosis

Rx: pharmacy prescriptions filled by physicians

PM: predictive model

CHF: Congestive Heart Failure

Table 3.III Predictive Ratios for Year-2 pharmacy costs for Cost Defined Groups

	Alternative Predictive Models							
	Dx-PM		Rx-PM		DxRx-PM		DxRx-PM w/ Prior costs	
	U.S.	Local	U.S.	Local	U.S.	Local	U.S.	Local
Year-1 percentiles								
Highest 1%	0.175	0.240	0.247	0.345	0.249	0.368	0.484	0.619
Highest 5%	0.301	0.421	0.419	0.548	0.421	0.572	0.659	0.828
Highest 10%	0.378	0.519	0.517	0.642	0.519	0.665	0.699	0.854
Highest 30%	0.582	0.736	0.735	0.835	0.738	0.846	0.817	0.912
Highest 50%	0.746	0.859	0.882	0.935	0.886	0.938	0.919	0.948

Dx: physician assigned diagnosis

Rx: pharmacy prescriptions filled by physicians

PM: predictive model

Caveats and Limitations

- No split half validation; consequently, results may be overly optimistic
- Study limited to only predicting pharmacy



Discussion and Next Steps

- **For predicting pharmacy expenditures**
 - ❖ Adding diagnoses markers to medication data does not appear to add significantly to accuracy of predictions of pharmacy
 - ❖ As supported in the literature, pharmacy expenditures appear to be sticky; consequently prior cost is a good indicator of next year's expenditures (and note the impact of the inclusion of this variable in the models)
- **As to considering the benefits of local calibration**
 - ❖ US weights work, but significant opportunity for improvement
 - ❖ Similar results found in other studies/countries
 - ❖ Substantial improvement in all areas of model evaluation (R2, predictive ratios, PPV/SENS and ROC curve)

