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A Comparison of Comorbidity Measures for Predicting Healthcare Utilization in Cancer Patients

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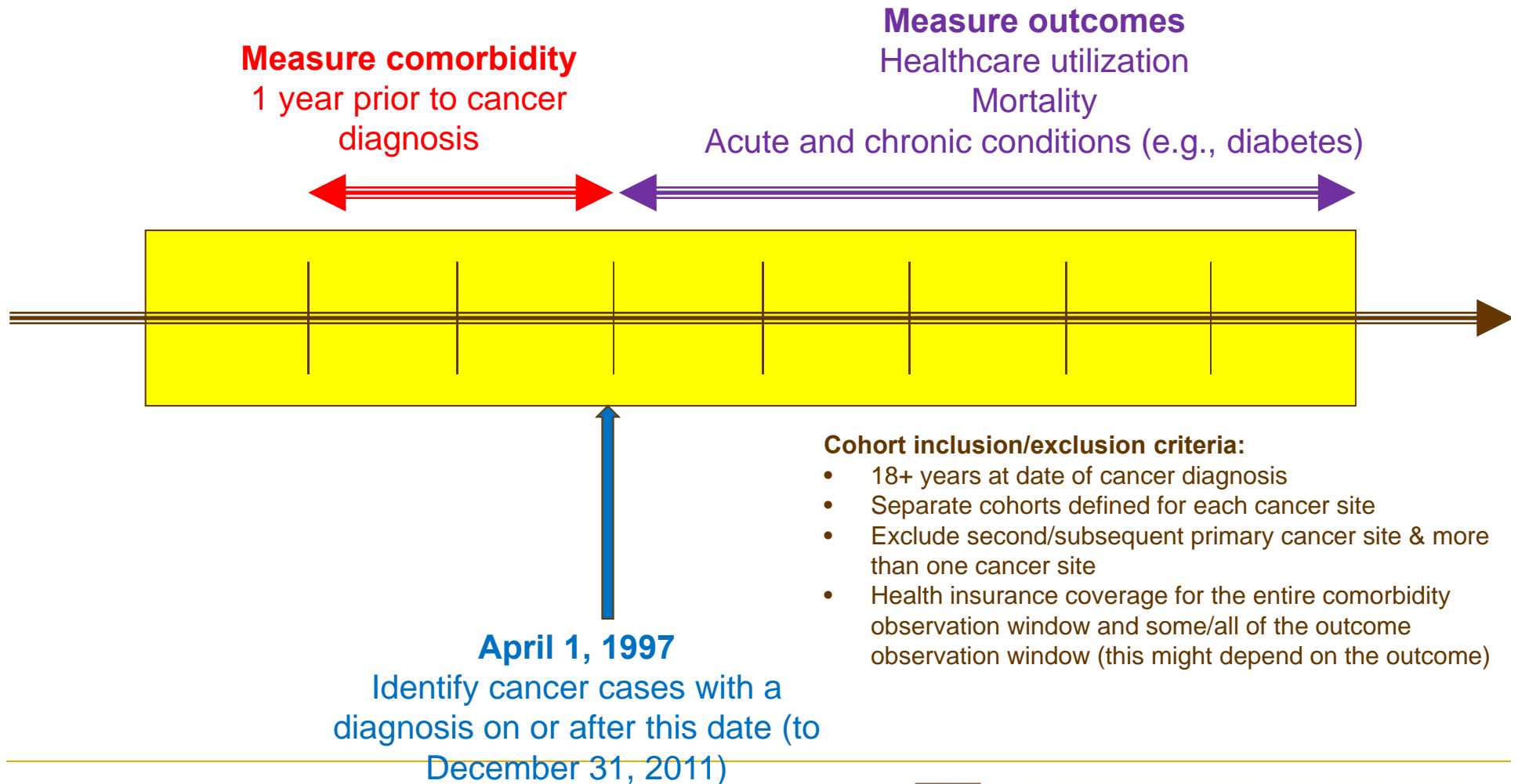
Background

- Measures of comorbid conditions are typically included as ***confounding covariates*** in statistical models that test the association between (disease) exposure(s) and health outcomes
- Controlling for the effects of comorbidity helps to ensure ***fair comparisons*** amongst exposure groups
- Multiple measures of comorbidity have been proposed, but it is not always clear ***which one to choose***

Research Purpose

- To compare the performance of comorbidity measures for predicting inpatient and outpatient healthcare utilization in diagnosed cancer cases

Study Design



Comorbidity Measures

- Number of different diagnoses
 - From hospital separations and medical claims data
- Number of different prescription drugs
- Chronic Disease Score
 - From prescription drug data for selected chronic diseases
- Number of Aggregated Diagnosis Groups (ADGs)
 - From Johns Hopkins ACG Case-Mix System
- Charlson index score
- Elixhauser index score

Outcome Measures

- Number of ambulatory physician visits
- Number of prescription dispensations
- Hospitalization

in the one-year period following cancer diagnosis

Analysis

- **Base model:** age group, sex, income quintile, region of residence, cancer treatment
- **Full model:** all of the covariates in the base model + **comorbidity measure/score**
- **Fit a multivariable model:**
 - **Logistic:** hospitalization
 - **Negative binomial:** # of physician visits; # of prescription drugs

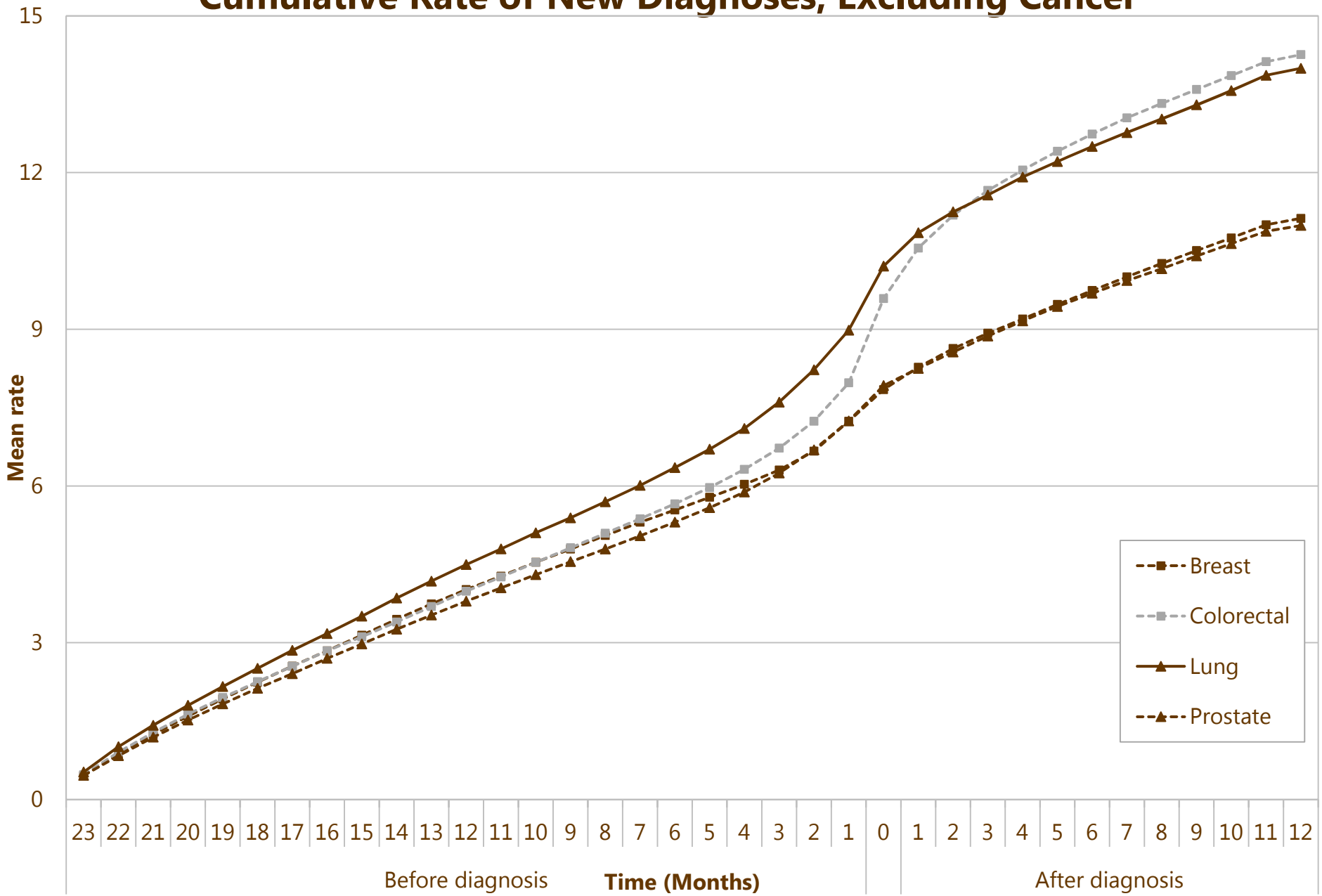
Analysis

- Compare base and full models:
 - **Discrimination or Explained variation:** Area under ROC curve; pseudo- R^2 statistic
 - **Prediction error:** Brier score; root mean square error (RMSEA)
 - **Reclassification statistics:** net reclassification index (NRI); integrated discrimination improvement (IDI)

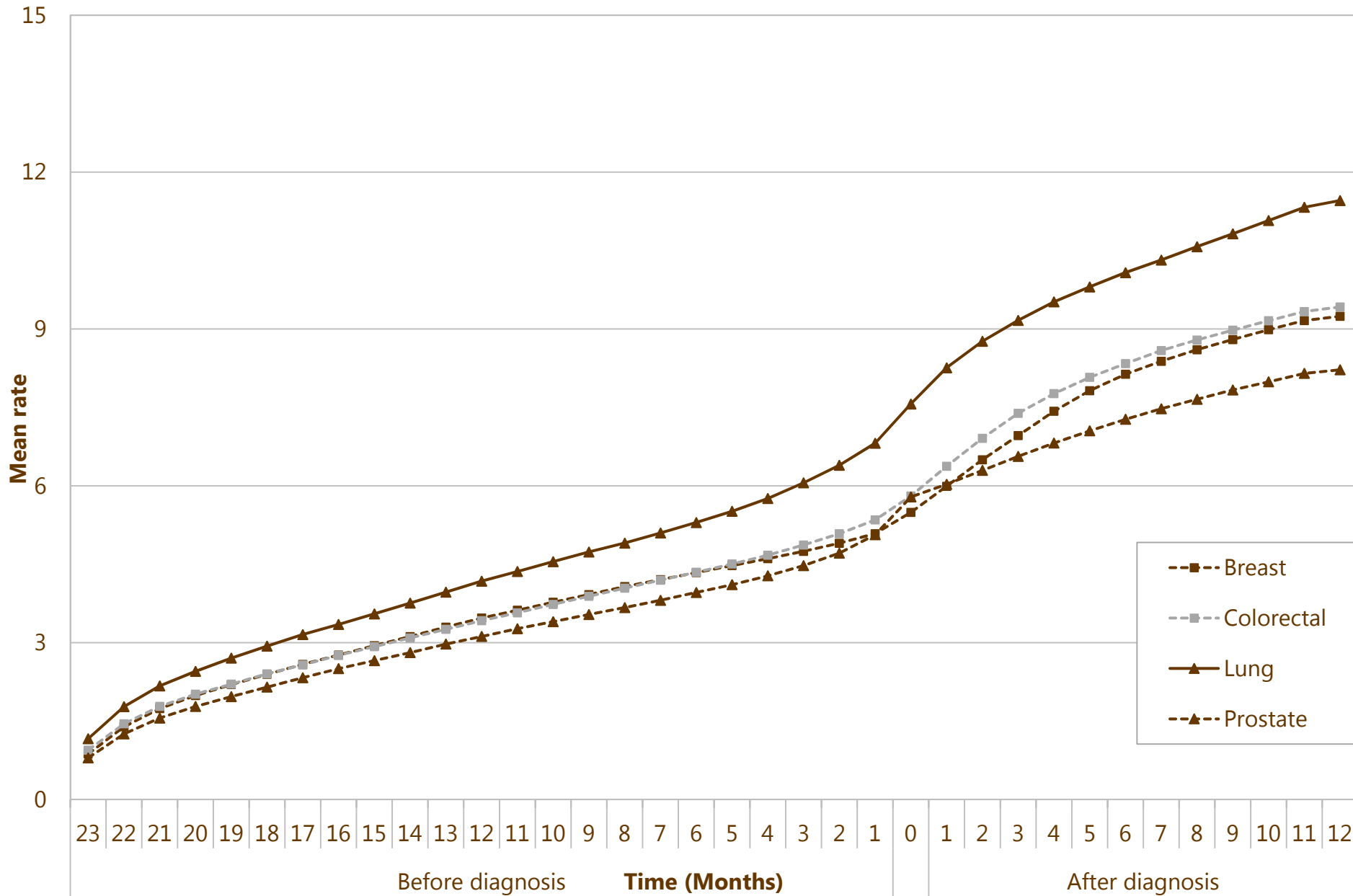
Cohort Demographics

Cancer Site	# Cases	Mean Age (Years)	Males (%)	Females (%)
Breast	8,485	62	1	99
Colorectal	7,903	69	53	47
Lung	8,689	69	51	49
Prostate	7,423	69	100	0

Cumulative Rate of New Diagnoses, Excluding Cancer



Cumulative Rate of New Prescription Drugs, Excluding Cancer



Predictive Performance of Comorbidity Measures for Ambulatory Physician Visits, *Breast Cancer*

	R ²	ΔR ² (%)	RMSE	Abs (ΔRMSE) (%)
Base Model	0.24		7.85	
No. of diagnoses	0.36	0.12 (49.78)	7.24	0.61 (7.77)
No. of drugs	0.35	0.11 (44.94)	7.29	0.56 (7.15)
No. of ADGs	0.35	0.11 (47.05)	7.26	0.59 (7.54)
Chronic Disease Score	0.32	0.08 (35.24)	7.42	0.43 (5.50)
Charlson Index	0.24	0.00 (1.89)	7.83	0.02 (0.25)
Elixhauser Index	0.32	0.08 (32.88)	7.45	0.39 (5.02)

Predictive Performance of Comorbidity Measures for Ambulatory Physician Visits, *Lung Cancer*

	R ²	ΔR ² (%)	RMSE	Abs (ΔRMSE) (%)
Base Model	0.66		6.21	
No. of diagnoses	0.68	0.02 (3.16)	5.94	0.27 (4.33)
No. of drugs	0.68	0.02 (2.58)	6.00	0.21 (3.37)
No. of ADGs	0.68	0.02 (2.98)	5.97	0.24 (3.89)
Chronic Disease Score	0.67	0.01 (1.84)	6.07	0.14 (2.33)
Charlson Index	0.66	0.00 (0.15)	6.20	0.01 (0.23)
Elixhauser Index	0.67	0.01 (1.78)	6.07	0.14 (2.29)

Predictive Performance of Comorbidity Measures for Prescription Drugs, *Breast Cancer*

	R ²	ΔR ² (%)	RMSE	Abs (ΔRMSE) (%)
Base Model	0.11		35.21	
No. of diagnoses	0.23	0.12 (107.53)	34.20	1.01 (2.87)
No. of ADGs	0.22	0.11 (100.36)	33.72	1.49 (4.23)
Chronic Disease Score	0.47	0.36 (328.75)	29.44	5.76 (16.37)
Charlson Index	0.14	0.03 (27.19)	34.99	0.22 (0.62)
Elixhauser Index	0.26	0.15 (136.33)	34.13	1.07 (3.05)

Predictive Performance of Comorbidity Measures for Prescription Drugs, *Lung Cancer*

	R ²	ΔR ² (%)	RMSE	Abs (ΔRMSE) (%)
Base Model	0.41		32.27	
No. of diagnoses	0.47	0.06 (14.27)	30.71	1.56 (4.82)
No. of ADGs	0.45	0.04 (10.47)	31.23	1.04 (3.22)
Chronic Disease Score	0.58	0.17 (42.56)	28.03	4.23 (13.12)
Charlson Index	0.43	0.02 (4.26)	31.88	0.38 (1.19)
Elixhauser Index	0.49	0.08 (20.56)	30.02	2.25 (6.98)

Predictive Performance of Comorbidity Measures Hospitalizations, Breast and Colorectal

	c-statistic (95% CI)	Brier score (SD)	Δc (%)
Breast			
Base Model	0.699 (0.686, 0.712)	0.165 (0.002)	--
No. of diagnoses	0.702 (0.689, 0.715)	0.165 (0.002)	0.003 (0.42)
No. of drugs	0.700 (0.687, 0.713)	0.165 (0.002)	0.001 (0.13)
No. of ADGs	0.702 (0.689, 0.715)	0.165 (0.002)	0.003 (0.46)
Chronic Disease Score	0.699 (0.686, 0.712)	0.165 (0.002)	0.000 (0.05)
Charlson Index	0.704 (0.691, 0.717)	0.164 (0.002)	0.005 (0.75)
Elixhauser Index	0.711 (0.698, 0.724)	0.163 (0.002)	0.013 (1.80)
Colorectal			
Base Model	0.808 (0.786, 0.830)	0.048 (0.002)	--
No. of diagnoses	0.811 (0.789, 0.833)	0.047 (0.002)	0.003 (0.31)
No. of drugs	0.808 (0.786, 0.830)	0.048 (0.002)	0.000 (0.00)
No. of ADGs	0.811 (0.790, 0.833)	0.048 (0.002)	0.003 (0.37)
Chronic Disease Score	0.808 (0.786, 0.830)	0.048 (0.002)	0.000 (0.00)
Charlson Index	0.816 (0.794, 0.838)	0.047 (0.002)	0.008 (0.94)
Elixhauser Index	0.843 (0.824, 0.862)	0.046 (0.002)	0.035 (4.34)

Predictive Performance of Comorbidity Measures for Hospitalization, Lung and Prostate

	c-statistic (95% CI)	Brier score (SD)	Δc (%)
Lung			
Base	0.828 (0.813, 0.842)	0.134 (0.002)	--
No. of diagnoses	0.835 (0.821, 0.849)	0.133 (0.002)	0.007 (0.89)
No. of drugs	0.832 (0.817, 0.846)	0.133 (0.002)	0.004 (0.50)
No. of ADGs	0.832 (0.818, 0.847)	0.133 (0.002)	0.005 (0.60)
Chronic Disease Score	0.833 (0.818, 0.847)	0.133 (0.002)	0.005 (0.62)
Charlson Index	0.829 (0.815, 0.843)	0.134 (0.002)	0.002 (0.21)
Elixhauser Index	0.843 (0.829, 0.857)	0.131 (0.002)	0.015 (1.83)
Prostate			
Base	0.828 (0.817, 0.838)	0.154 (0.003)	--
No. of diagnoses	0.829 (0.819, 0.839)	0.154 (0.003)	0.001 (0.17)
No. of drugs	0.829 (0.819, 0.839)	0.154 (0.003)	0.001 (0.17)
No. of ADGs	0.828 (0.818, 0.838)	0.154 (0.003)	0.001 (0.09)
Chronic Disease Score	0.829 (0.819, 0.839)	0.154 (0.003)	0.002 (0.19)
Charlson Index	0.830 (0.820, 0.840)	0.154 (0.003)	0.002 (0.29)
Elixhauser Index	0.839 (0.830, 0.849)	0.151 (0.003)	0.012 (1.43)

Conclusions

- The predictive validity of general-purpose comorbidity measures varied with the health outcome and cancer site of interest
 - The Elixhauser index performed best for predicting one-year hospitalization
 - The number of diagnoses performed best for predicting the one-year physician visit rate
 - The Chronic Disease Score and Elixhauser index performed best for predicting the one-year prescription drug dispensation rate

Thank You/Questions

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