VALIDATION OF CLUSTERS OF ICD-9 CODES DEFINING COMORBIDITIES RELEVANT TO AMBULATORY CARE

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RATIONALE: I

- Risk Adjustment for Outcomes Comparison
  - Foundation for observational comparative effectiveness research;
  - The likelihood of an outcome will vary with patient risk;
  - Adjustment for differences in risk is essential when comparing outcomes across groups of patients.

RATIONALE II

- Risk-Adjustment for Process Measures:
  - Uncommonly reported for process measure comparisons, such as guideline adherence;
  - Intuitively, guideline adherence seems likely to vary with patient characteristics.

RATIONALE III

- Risk adjustment requires data on comorbidity:
  - The most accessible comorbidity measures in the electronic health record are ICD codes;
  - There are ~14,000 ICD-9 codes -
    - More than 60 for diabetes mellitus, alone;
  - Analyses of large populations of patients require that ICD-9 codes be aggregated into clinically meaningful diagnostic clusters.

BACKGROUND: COMORBIDITY INDICES

- Charlson, M.E., 1987
  - Population: 604 medical admissions in to the New Your Hospital medical service in 1984;
  - Identified 30 comorbidities by manual chart abstraction;
  - Weighted comorbidities based using the adjusted relative risk for one-year mortality;
    - Dropped 11 with RR <1.2 = Charlson Index
- Multitude of risk indices since.

DIAGNOSTIC CLUSTERS OF ICD CODES: I

- Deyo, R.A., 1992
  - Assigned ICD-9 codes to the 19 comorbidities in the Charlson Index;
  - Patient population: 27,111 patients undergoing lumbar spine surgery
  - Validation: Highly predictive of need for blood transfusion, length of stay, total hospital charges, discharge to nursing home, and six-week mortality.

DIAGNOSTIC CLUSTERS OF ICD CODES: II

- Elixhauser, A. 1998
  - Population: 1,779,167 admitted to 438 California hospitals in 1992;
  - Focused on secondary diagnoses (ICD-9 codes) unlikely to be complications of care;
  - Excluded comorbidities:
    - Those included in the admitting DRG;
    - Those that were not statistically related to length of stay, hospital charges, or hospital death; and
    - Those felt to be "unimportant" comorbidities (e.g., prostatic hypertrophy).
  - Result: 30 comorbidities defined by ICD-9 codes with strong relationships to hospital length of stay, hospital charges, and in-hospital mortality.

DIAGNOSTIC CLUSTERS OF ICD CODES: III

- Quan, H. 2005
  - Reviewed and modified the Charlson/Deyo and Elixhauser clusters;
  - Clusters were translated into ICD-10 codes;
  - Validated ICD-9 clusters against in-hospital mortality among 56,585 hospital discharges 2001

DIAGNOSTIC CLUSTERS OF ICD CODES: IV

- Schneeweiss, R.
  - Goal: describe the diagnostic content of ambulatory care;
  - Derived 92 diagnostic clusters from the 1977 and 1978 National Medical Ambulatory Care Survey (NAMCS), a probability sample survey of office-based physicians in the contiguous U.S.;
  - Required clusters to include $\geq$0.1% of diagnoses in NAMCS file, which resulted in inclusion of 86% of all diagnoses;
  - No attempt at validation against outcomes of processes of care was reported.

DIAGNOSTIC CLUSTERS IV: UPDATED SCHNEEWEISS DIAGNOSTIC CLUSTERS

- Wilson Pace initiated this update because the diagnostic content of primary care had changed;
  - For example, there was no cluster for hyperlipidemia.
- Source: 2001 – 2003 NAMCS data
- Three clusters deleted and 12 added for had 101 clusters versus 92 in the original Schneeweiss version.

METHODS: PATIENT POPULATION

- All 232,172 patients receiving care in 33 fee-for-service clinics in the U.S.:
  - Clinics were participating in the NHLBI-funded Cardiovascular Risk Reduction Learning Community (CRRLC)
  - Patients were ≥18 years of age;
  - Patients had ≥1 clinic visit in the preceding 2 years; and
  - There were no other inclusion or exclusion criteria.

METHODS: CARDIOVASCULAR RISK REDUCTION LEARNING COMMUNITY

- An observational study using electronically downloaded data from the electronic health record to:
  - Develop and implement automated point-of-care, patient-specific clinical, decision support (CDS) based on national guidelines for control of blood pressure and LDL-cholesterol;
  - Supplement the CDS with periodic audit and feedback of clinic-level guideline concordance; and
  - Assess changes in guideline concordance over time.

SPECIFIC AIMS OF PRESENT PROJECT

- Update an Existing Set of Diagnostic Clusters of ICD-9 Codes for Ambulatory Care;
- Validate the Modified Set of Diagnostic Clusters by Its Ability to Risk Adjust for Guideline Concordance; and
- Compare the Modified Set Against Three Other Sets of Diagnostic Clusters; and
- Assess Effect of Risk-adjustment on Guideline Non-concordance.

METHODS: DATA ANALYSES-I

- Multiple Logistic Regression:
  - Dependent variable: patient-level guideline concordance:
    - Blood pressure or LDL control; or
    - Timeliness of measurement of blood pressure or LDL.
  - Independent variables:
    - Elixhauser set of 30 hospitalization-based diagnostic clusters;
    - Quan set of 30 hospitalization-based diagnostic clusters;
    - Schneeweiss R set of 92 diagnostic clusters for ambulatory care; and
    - Our modification of the Schneeweiss ambulatory care set (101 clusters).

METHODS: DATA ANALYSES - II

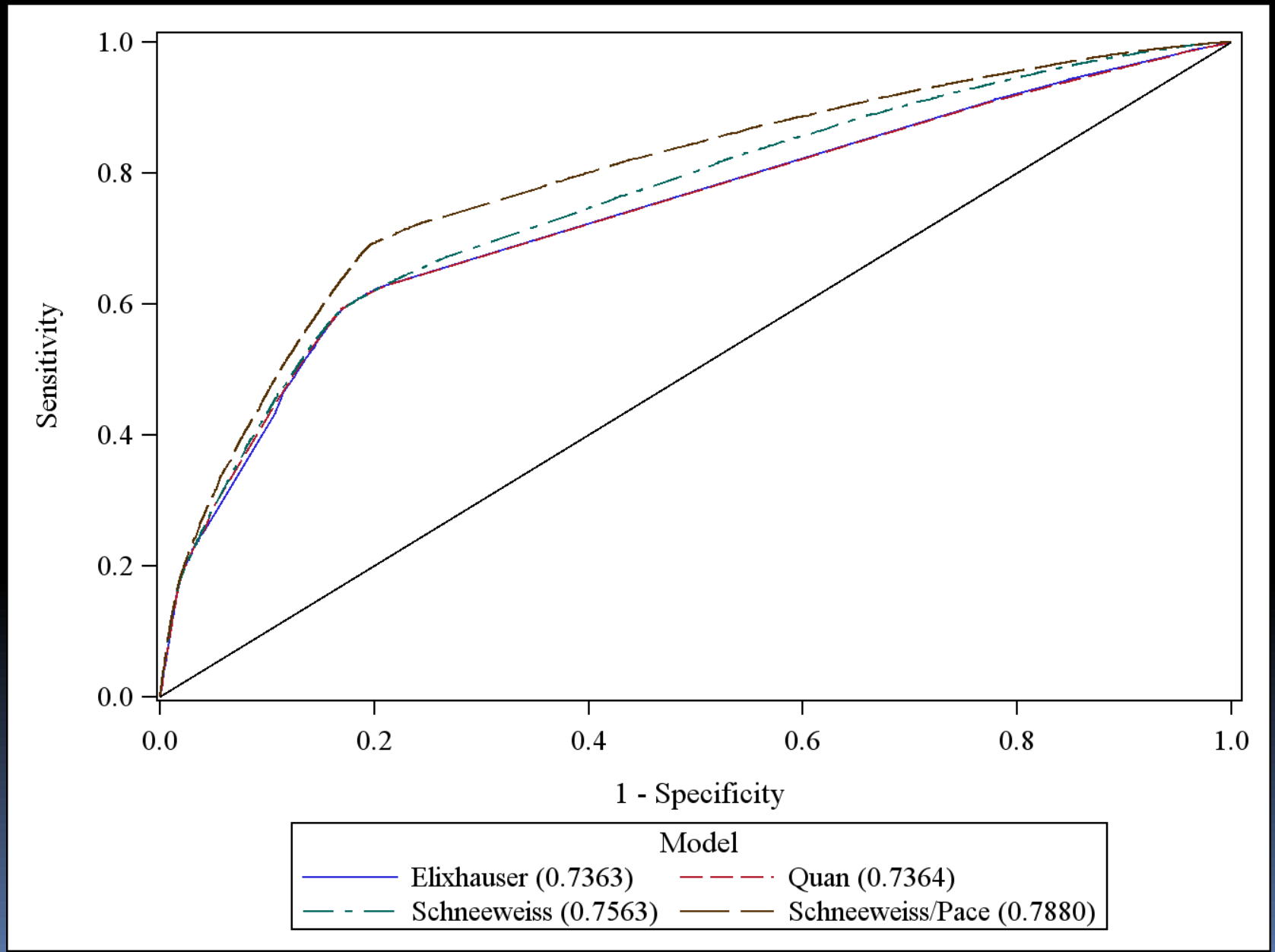
- C-index to compare the four diagnostic clusters' ability to discriminate between:
  - BP control and non-control;
  - LDL control and non-control;
  - Timely versus not timely BP measurement; and
  - Timely versus not timely LDL measurement.
- Examine effects of risk-adjustment versus no risk-adjustment on clinics ranked by BP or LDL non-control.

PATIENT CHARACTERISTICS	PREVALENCE	
	Number	Percent
DEMOGRAPHICS		
Age (years)		
18 – 40	95,639	41.2
41 – 60	94,978	40.9
61 – 80	35,971	15.5
>80	5,584	2.4
Male gender	101,184	43.6
VISIT FREQUENCY (per year)		
1 – 2	141,393	60.9
3 – 4	47,948	20.7
5 - 6	17,764	7.7
>6	25,067	10.8
FOUR LEADING REASONS FOR VISIT		
Routine health maintenance	126,419	54.5
Hyperlipidemia	65,343	28.1
Hypertension	58,849	25.3
Depression or anxiety	50,822	21.9

Example of a Logistic Regression Analysis: Outcome – BP Control; Diagnostic Cluster: Pace/Scheeweiss

Diagnostic Cluster	Odds Ratio	c-index	% max c	p
Hypertension	6.93	0.730	92.6%	<.0001
Diabetes mellitus	5.06	0.758	96.2%	<.0001
General Medical Examination	0.89	0.771	97.8%	<.0001
Chronic Rhinitis	0.85	0.774	98.2%	<.0001
Ischemic heart disease	0.70	0.775	98.4%	<.0001
Contraception	0.59	0.777	98.6%	<.0001
Menstrual disorders	0.76	0.779	98.9%	<.0001
URI	0.84	0.781	99.1%	<.0001
Hyperlipidemia	0.85	0.781	99.1%	<.0001
Obesity	1.23	0.781	99.1%	<.0001
Thyroid disease	0.89	0.782	99.2%	<.0001
Pregnancy and abortion	0.60	0.783	99.4%	<.0001
Vaginitis	0.83	0.783	99.4%	<.0001
Acne	0.86	0.784	99.5%	<.0001
Congestive heart failure	0.69	0.784	99.5%	<.0001

Comparison of ROCs for BP Control

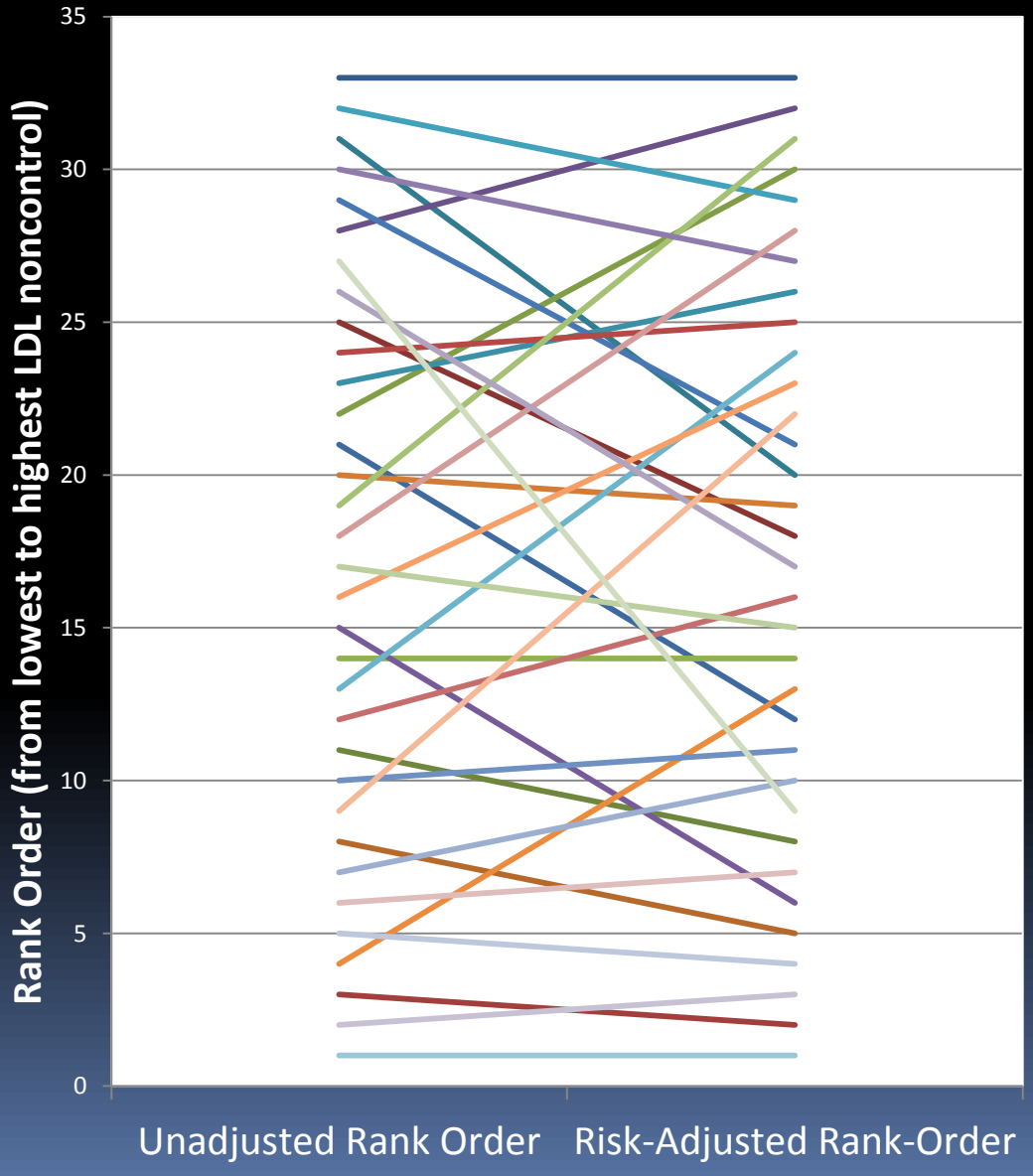


RESULTS: COMPARISON OF DISCRIMINATION (C-INDICES)

DIAGNOSTIC CLUSTER	C-INDEX			
	Blood Pressure		LDL	
	Timeliness	Control	Timeliness	Control
Elixhauser	0.559	0.736	0.584	0.642
Quan	0.560	0.736	0.587	0.640
Schneeweiss	0.660*	0.756*	0.710*	0.670*
Scheeweiss/Pace	0.669*	0.788*	0.723*	0.720*

*Differences in C-indices between Scheeweiss and Schneeweiss/Pace diagnostic clusters are highly significant (p = 0.0000).

CLINIC RANK ORDER FOR LDL NON-CONTROL



CONCLUSIONS

1. Comorbidities are strongly associated with guideline concordance.
2. The Pace modification of the Schneeweiss diagnostic clusters produces the best discrimination:
   a. Between guideline concordance and non-concordance for BP and LDL;
   b. Between timely and not timely measurement of BP and LDL;
3. The rank-order of clinics is very different for risk-adjusted versus non-adjusted non-control of BP or LDL