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Hospital Mortality Risk Adjustment for Comorbid Disease

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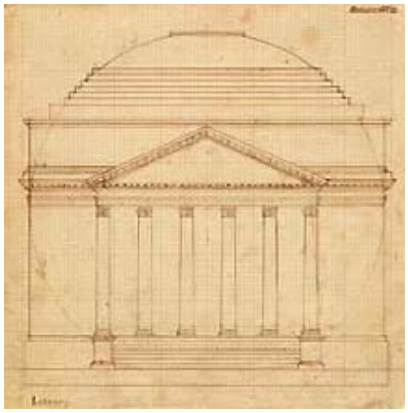

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Discussion Topics

- health services research using administrative data
- hospital mortality risk adjustment
- AHRQ R01 HS10134
- California hospital data
- aspiration pneumonia study population
- pilot study methods and results
- limitations
- conclusions

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Administrative data provides a population based perspective on hospital patient characteristics, health services utilization, and outcomes. This perspective is organized by payer or by state.

- MEDPAR data for Medicare patients
- single state level discharge abstract data
- collections of state level data (HCUP)
- private insurer data bases (Aetna, BCBS)
- health system / hospital data systems

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Efficacy vs. Effectiveness of carotid endarterectomy

- RCT's are the 'gold standard'
- RCTs demonstrate that CE reduces the risk of stroke and death in selected patients when performed in selected institutions

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Administrative data has been used to address the following topics:

- disease incidence and risk factors
- spatial/geographic variation in health services utilization
- hospital variation in mortality rates
- surgical/medical therapy outcomes
- quality of care
- efficacy vs. effectiveness

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Efficacy vs. Effectiveness of carotid endarterectomy

- The number of CE's performed among Medicare patients doubled after the release of data from the RCTs
- Can the evidence of efficacy from the RCTs be generalized to the population at large?

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Administrative data has been used to address the issues of efficacy vs. effectiveness for carotid endarterectomy

- Stukenborg GJ. Archives of Neurology. 1997; 54: 826-832.
- Wennberg DE, Lucas FL, Birkmeyer JD, Bredenberg CE, Fisher ES. JAMA. 1998; 279: 1278-1281.
- Cebul RD, Snow RJ, Pine R, Hertzer NR, Norris DG. JAMA. 1998; 279: 1282-1287.

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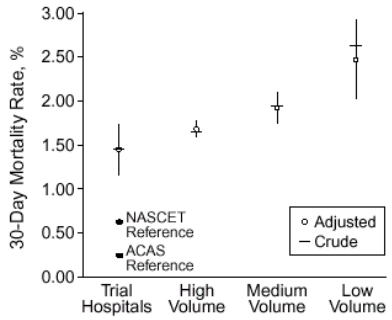

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Medicare Patient Outcomes for Carotid Endarterectomies Performed in 1989 by Similarity to RCT Participants		
	Patient received procedure in hospital with CE perioperative mortality rate greater than 0.90%*	Patient had one or more comorbid diseases listed as exclusionary criteria in CE RCTs**
Death (all cause) within 2 years	1.36 (1.29 – 1.44)	1.72 (1.64 – 1.84)
Hospitalization for TIA or stroke, or death (all cause) within 2 years	1.21 (1.16 – 1.27)	1.49 (1.42 – 1.56)

Notes:

Odds Ratio (95% Confidence Interval)

* 0.90% is mean perioperative mortality rate among all surgical patients in RCTs of carotid endarterectomy (NASCET, ECST, VACSP/sym, ACAS, CASANOVA, MAYO, VACSP/asym)
** peripheral vascular disease, chronic diabetes, malignant neoplasm, metastatic disease, AIDS, chronic pulmonary disease, mild liver disease, severe liver disease, renal disease, dementia

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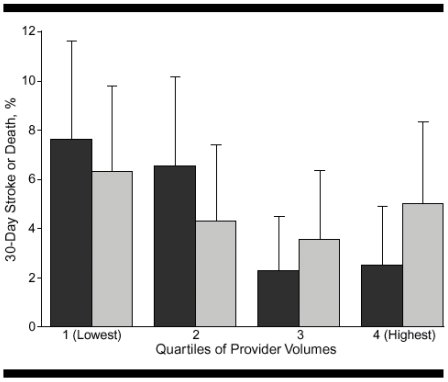

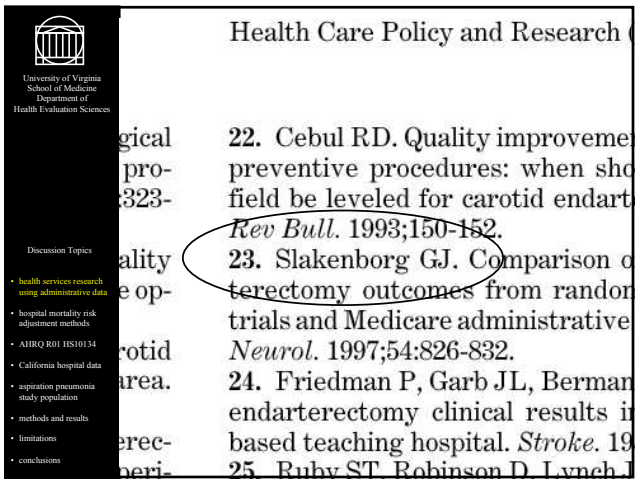
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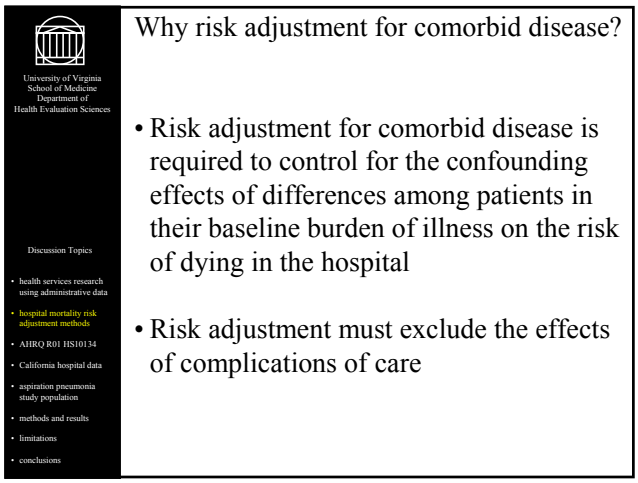
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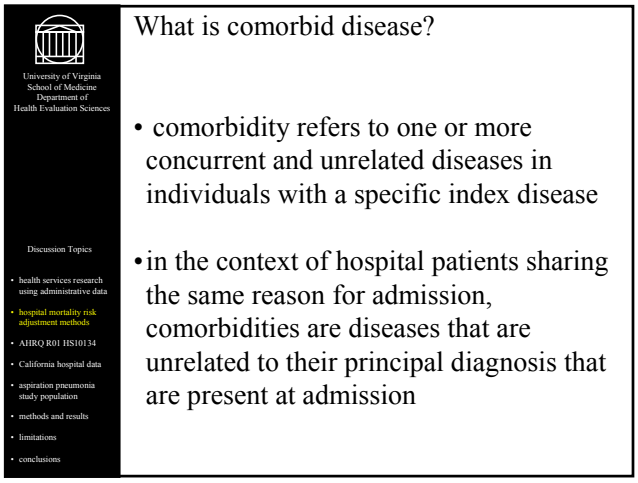
Why risk adjustment for comorbid disease?
• Risk adjustment for comorbid disease is required to control for the confounding effects of differences among patients in their baseline burden of illness on the risk of dying in the hospital
• Risk adjustment must exclude the effects of complications of care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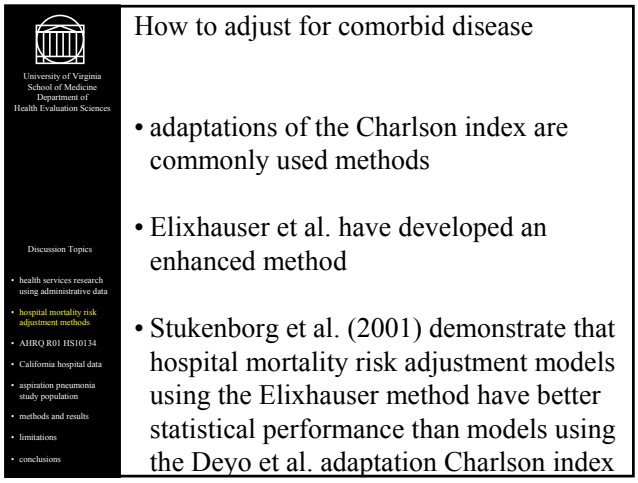
What is comorbid disease?
• comorbidity refers to one or more concurrent and unrelated diseases in individuals with a specific index disease
• in the context of hospital patients sharing the same reason for admission, comorbidities are diseases that are unrelated to their principal diagnosis that are present at admission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How to adjust for comorbid disease
• adaptations of the Charlson index are commonly used methods
• Elixhauser et al. have developed an enhanced method
• Stukenborg et al. (2001) demonstrate that hospital mortality risk adjustment models using the Elixhauser method have better statistical performance than models using the Deyo et al. adaptation Charlson index

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AHRQ R01 HS10134

Project staff

- George J. Stukenborg, PhD (P.I.)
- Alfred F. Connors, MD
- Frank E. Harrell, PhD
- Douglas P. Wagner, PhD
- M. Norman Oliver, MD
- Kerry Kilbridge, MD
- Jonathan Einbinder, MD
- Jason Lyman, MD
- Xin-Qun Wang, MS

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8 study populations

- aspiration pneumonia
- acute myocardial infarction
- acute cerebrovascular disease
- chronic obstructive pulmonary disease
- congestive heart failure
- pneumonia
- respiratory failure
- septicemia

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Specific aims

- develop improved hospital mortality risk adjustment models for use with administrative data
- rigorously validate models in external data
- compare the developed model's statistical performance to that of existing methods
- facilitate public access to the developed risk adjustment methods

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Research process: Stage 1

criteria will be developed for defining indicators of comorbid disease and primary diagnosis severity for use as predictors of hospital death in disease specific models. The criteria will be developed using a process that combines empirical assessment with a physician panel review of the selected diagnoses.

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Research process: Stage 2

parameters for predictor variables in the developed risk adjustment models will be estimated using California hospital discharge abstract data for calendar years 1998 and 1999.

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Research process: Stage 4

compare the statistical performance of the developed models to that of other comparable methods (Deyo/Charlson method and the Elixhauser et al. method) in each study population.

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Research process: Stage 3

the developed risk adjustment models will be rigorously validated by applying them to identically defined patient groups identified using California hospital discharge abstract data for calendar years 1996 and 1997 and using the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP)

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California hospital discharge abstract data

- 3.6 million records per calendar year
- records from all state licensed hospitals
- separate patient discharge data form used
- good data quality demonstrated by audits
- up to 25 diagnoses and 21 procedures
- present on admission indicator for every diagnosis

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Face validity of the present on admission

- considered diagnoses from 55,841 CABG surgery patients in 1998 or 1999
- ICD-9-CM diagnosis code types identified by the Deyo/Charlson method as reliable indicators of comorbid disease present on admission 96% of the time.
- ICD-9-CM diagnosis code types that exclusively identify surgical and medical care complications present on admission 11% of the time.

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Aspiration pneumonia caused hospitalizations in California

- 29,428 patients hospitalized in 1998-1999
- nearly all (99.87%) had at least one secondary diagnosis
- an average of 8 secondary diagnoses reported per patient
- a total of 3,527 ICD-9-CM diagnosis code types reported

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Why aspiration pneumonia?

- hospital patients with aspiration pneumonia are at significant risk of death
- 186,000 hospitalizations in U.S. caused by aspiration pneumonia during 1997
- 19% die during their hospital stay
- aspiration pneumonia is the leading cause of death among patients with stroke related dysphagia, which affects between 300,000 and 600,000 persons annually in the U.S.

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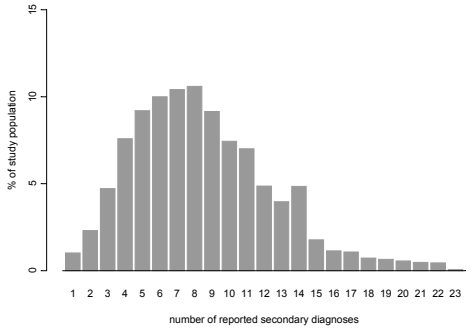
Number of secondary diagnoses



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Hospital mortality risk adjustment using different measures of comorbid disease

- all models include age, race, emergency admission, and sex as predictors
- each model estimated using multivariable logistic regression
- models developed using 1998-99 data
- models validated using 1996-97 data
- model statistical performance assessed using C index, R^2, and Nagelkerke R^2

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Hospital mortality risk adjustment for comorbid diseases using the Deyo et al. adaptation of the Charlson Index

- model had 13 comorbid disease groups
- 13% of diagnoses used as indicators of comorbidities

	Deyo/ Charlson			
C	0.600			
R^2	0.024			
N,R^2	0.038			

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- C-index estimates the model's ability to discriminate between death and survival
- R^2 measures the amount by which the average predicted probability of death for those patients who died in the hospital exceeds the average predicted probability of death for those patients who survived
- Nagelkerke index, similar to R^2, but scaled so that the maximum achievable range for the statistic runs from 0, for models which provide no predictive information to 1, for models that perfectly predict the outcome

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Hospital mortality risk adjustment for comorbid diseases using the Elixhauser et al. method

- model had 27 comorbid disease groups
- 38% of diagnoses used as indicators of comorbidities

	Deyo/ Charlson	Elixhauser		
C	0.600	0.651		
R^2	0.024	0.047		
N,R^2	0.038	0.073		

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Hospital mortality risk adjustment for comorbid diseases using POA diagnoses grouped by Clinical Classification System

- model had 236 comorbid disease groups
- 87% of diagnoses used as indicators of comorbidities

	Deyo/ Charlson	Elixhauser	Diagnoses POA, grouped by CCS	
C	0.600	0.651	0.735	
R^2	0.024	0.047	0.115	
N,R^2	0.038	0.073	0.177	

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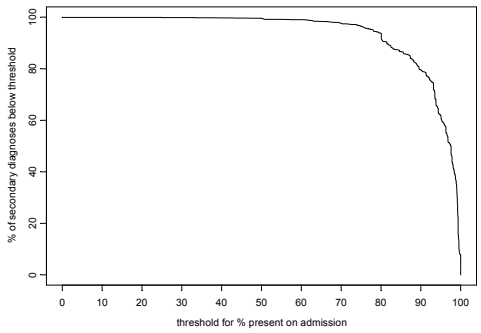
Diagnoses POA among patients with aspiration pneumonia



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Diagnoses POA among patients with aspiration pneumonia

- 249,465 secondary diagnoses reported
- 3,527 ICD-9-CM diagnosis code types
- 08% of ICD-9-CM code types POA 100%
- 80% of ICD-9-CM code types POA 90%
- 94% of ICD-9-CM code types POA 80%
- 98% of ICD-9-CM code types POA 70%

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New method

- uses ICD-9-CM diagnosis code types that are commonly reported as present on admission, grouped using the CCS
- infrequent categories (<0.01%) excluded
- threshold for diagnoses ‘commonly’ reported as present on admission selected empirically

New method

- threshold too high yields poor performance
- threshold too low yields poor validity
- model series developed using diagnoses POA at thresholds between 70% and 90%
- validity of selected threshold assessed by applying models to patient data containing ONLY diagnoses reported as POA

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Hospital mortality risk adjustment for comorbid diseases using new method

- model had 92 comorbid disease groups
- 79% of diagnoses used as indicators of comorbidities

	Deyo/ Charlson	Elixhauser	Diagnoses POA, grouped by CCS	Diagnoses commonly POA, grouped by CCS
C	0.600	0.651	0.735	0.713
R^2	0.024	0.047	0.115	0.095
N,R^2	0.038	0.073	0.177	0.147

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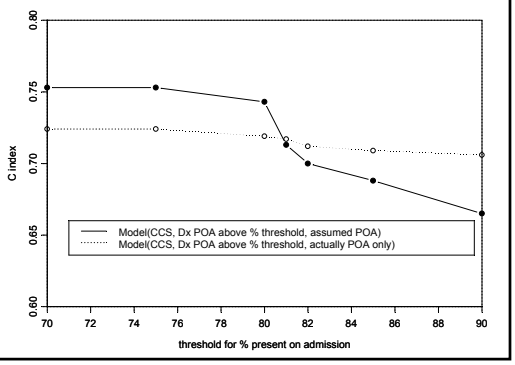
Setting threshold for new method



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Limitations

- reliability of the present on admission indicator crucial to the validity of our results
- 81% standard for defining diagnoses commonly reported as present on admission represents a trade-off between improved statistical performance and validity

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Limitations

- statistical performance assessed only with California hospital discharge data
- some conditions included as comorbid disease are closely related to aspiration pneumonia and are potentially useful as measures of the severity of the principal diagnosis
- determining 'relatedness' requires clinical review

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Automated 'Delphi' review - Stage 1

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Determining 'relatedness'

- 5 member physician panel review
- ICD-9-CM diagnoses scored as related, equivocal, or not related
- automated Delphi process
- first round scores identify diagnoses with disagreement
- second round review to re-score diagnoses with disagreement
- diagnoses related to principal diagnosis used as indicators of principal diagnosis severity in risk adjustment model

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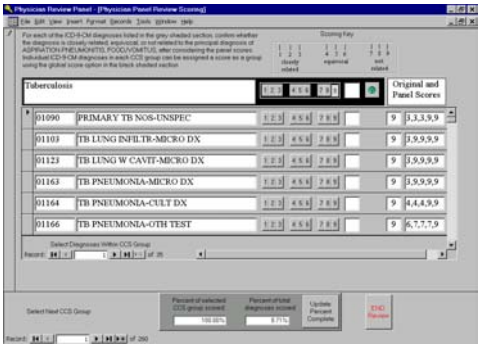
Automated 'Delphi' review - Stage 2



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Conclusions

- collecting information about whether or not diagnoses are present on admission is an effective method for improving hospital mortality risk adjustment for comorbid disease in population based health services research using administrative data

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Conclusions

- methods that use more of the information about comorbid disease available in administrative data can result in substantive improvements in predictive accuracy and discrimination, and thereby enhance the value of population level patient information available only from administrative data

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Conclusions

- the information available for California hospital patients can also be used to meaningfully improve risk adjustment for comorbid disease in studies using other administrative data collections that lack the present on admission indicator

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