



# Comparison of Diagnosis-based and Prescription-based Comorbidity Measures in Predicting Health Service Utilization and Costs

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## BACKGROUND:

- In an observational study, adjustment for the differences in the study population characteristics is often done by controlling for all confounders. Comorbidities are important patient characteristics that are often confounders and must be controlled for better assessment of outcomes such as health service utilization and costs.
- Diagnosis-based comorbidities and prescription-based comorbidities have been developed and validated for predicting outcomes. However, these measures are frequently used to assess outcomes other than those that were used in validation studies.
- The Charlson Comorbidity Index (CCI) was developed based on its ability to predict mortality for hospital patients but has been commonly used in studies assessing outpatient health service utilization. The CCI is calculated based on International Classification of Diseases; Ninth Revision (ICD-9) diagnosis codes. For a patient, a set of ICD-9 codes gives the conditions being treated at that point in time. For many chronic conditions, an ICD-9 code may be included on a claim very infrequently.
- The Rx Risk score is calculated from prescriptions claims. Prescription claims for managing chronic conditions appear regularly. Although identifying comorbidities from outpatient prescription claims might be better for outpatient outcome studies, only a limited number of drugs can be used to identify a specific comorbidity.

## OBJECTIVE:

To compare the performance of CCI (diagnosis-based comorbidity measure) and Rx Risk (prescription-based comorbidity) in prediction of outpatient visits and costs in a Medicaid population.

## METHODS:

Mississippi Medicaid medical and prescription claims data for the years 2010-2011 were analyzed. Both fee-for-service and managed care claims were used. Only beneficiaries who were continuously enrolled in Medicaid from January 2010 to December 2011 were included. The CCI was calculated for each patient based on 2010 medical claims through ICD-9 codes. The 19 chronic conditions were identified, assigned weights and summed up to give a composite score. The Rx Risk score was calculated by identifying the medications using NDC's and classifying them according to drug classes. The total score gives the disease burden for that patient. The predictive ability of each score was measured by looking at the change in  $R^2$  by adding it to a general linear model with outpatient visits, pharmacy visits, outpatient costs and pharmacy costs as outcome variables.

**Table 1: Disease Conditions covered by the two types of Comorbidity measures**

Charlson Comorbidity Index	Rx Risk Score
Cardiovascular disease: Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease	Cardiovascular disease: Arrhythmia, Hypertension Angina, Hypercholesterolemia MI, congestive heart failure, peripheral vascular disease
Dementia	Anxiety, Bipolar, dementia, depression, Other psychosis
Chronic Pulmonary disease	Asthma
Connective Tissue Disease	Osteoporosis, Joint pain
Peptic Ulcer Disease	Peptic ulcer disease
Metabolic disorder: Diabetes Diabetes with chronic complications	Diabetes
Hemiplegia or paraplegia	Neurological disorders: Parkinson's, Epilepsy
Moderate or severe renal disease	ESRD
Liver disease: Mild liver disease, Moderate or severe Liver disease	Liver disease
Cancer: Any tumor Metastatic solid tumor, Leukemia, Lymphoma	Cancer
HIV infection	HIV infection, Hepatitis C
	Other diseases: Hyperkalemia, Psoriasis, Thyroid, Alcohol dependence, Tuberculosis, Transplant, IBS, Allergy, Glaucoma, Gout

**Table 2: Change in predictive ability for each outcome after addition of the comorbidity measure**

Measure	Outpatient visits	Pharmacy visits
	$R^2$	$R^2$
Base model	0.0724	0.23
CCI	0.0834	0.2364
Rx Risk	0.1142	0.4059
Measure	Outpatient costs	Pharmacy costs
	$R^2$	$R^2$
Base model	0.0543	0.1046
CCI	0.0601	0.1132
Rx Risk	0.1049	0.2881

## RESULTS:

Rx Risk adds more to the predictive ability of outcomes as compared to CCI as shown by the increase in  $R^2$  for all outcomes analyzed i.e. outpatient visits, pharmacy visits, outpatient costs and pharmacy costs. The increase in  $R^2$  was greater for Rx Risk than CCI for all outcomes studied and it almost doubled from the  $R^2$  of base model.

## DISCUSSION:

CCI was first developed using medical records in an inpatient setting to predict the risk of mortality. However, it has been more extensively used for assessing other outcomes as compared to Rx Risk. Comparing the disease conditions that are covered by these two scores, Rx Risk score has a more comprehensive list as compared to CCI. Therefore, Rx Risk gives a more accurate measure of disease burden as compared to CCI.

This study found that there is an improvement in predictive ability for utilization and costs by Rx Risk as compared to CCI. This evidence should encourage researchers to consider Rx Risk for future health outcomes assessment. The limitation of Rx risk score is that some of the medications might have more than one indications which is not captured in the composite score calculation giving a biased score. It also might be difficult to calculate Rx Risk in databases that do not capture all of the medications prescribed to patients. Research is needed to develop a comprehensive comorbidity scale using both diagnoses and prescription drugs.

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