

Risk Adjustment for Cost Analyses: The Comparative Effectiveness of Two Systems

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Outline

- Introduction
 - Aim 1: How do the computed risk scores compare?
 - Aim 2: What is gained by recalibrating the risk models to fit VA?
 - Limitations
 - Findings
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What is risk adjustment?

- Statistical method to adjust for the observable differences between patients
 - Classify patients into homogeneous clinical categories
 - Calculate a single dimension risk score using clinical categories

Why Risk Adjust?

- Limited research budget and limited time require the use of administrative data to
 - Comparative Effectiveness
 - Improving the delivery of high value care
- Risk adjustment is necessary to address these questions

Risk adjustment at VA

- Used by operations and research to:
 - Assess medical center efficiency and productivity
 - Health services research (e.g., hospital readmissions)
- VA contracts with Verisk to obtain calculate risk scores for VA data

Verisk Versions

- Risk Smart algorithm create 184 hierarchical condition categories (HCC) and risk scores
- Verisk is phasing out Risk Smart and moving to Risk Solutions, which creates 394 HCCs and risk scores
- We focused on the latter, more recent version (Risk Solution)

DxCG Risk Solutions

- Hereafter DxCG refers to Risk Solution model
- Model produces 3 risk scores
 - Medicare prospective risk without Rx
 - Medicare concurrent risk without Rx
 - Medicaid prospective risk with Rx

Operation Question

- Given the transition from Risk Smart to Risk Solutions, should VA continue to contract with Verisk?

Other Risk Adjustment Systems

- Charlson co-morbidity index
- CAN score
- Adjusted Clinical Groups (ACGs)
- Chronic Illness & Disability Payment System (CDPS)
- CMS Risk Adjustment Model (V21)

CMS PACE Version 21

- Generates 189 HCCs
 - Produces 3 prospective risk scores
 - Community
 - Institution
 - New enrollee
 - No concurrent risk score
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Aims

- How do the DxCG and V21 risk scores compare?
- What is gained by adding variables and recalibrating the risk scores to fit VA?

Aim 1:

How do the computed
risk scores compare?

Six Study Samples

1. General sample
 2. High cost Veterans
 3. Veterans with mental health/substance use disorder (MH-SUD)
 4. Veterans over age 65
 5. Veterans with multi-morbidity
 6. Healthy Veterans
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Samples

- General sample: 2 million randomly selected Veterans
- High Cost Users: most costly 5% VA users. Most costly was based on HERC national costs to remove geographic wage variation

Samples (cont)

- MH-SUD: All patients with a MH or SUD diagnosis in VA. We used diagnostic codes from MHO.
- Over 65: Veterans ≥ 65
- Multi-morbidity and healthy used the AHRQ body indicator

Body System Indicator

- 1 = Infectious and parasitic disease
 - 2 = Neoplasms
 - 3 = Endocrine, nutritional, and metabolic diseases and immunity disorders
 - 4 = Diseases of blood and blood-forming organs
 - 5 = Mental disorders
 - 6 = Diseases of the nervous system and sense organs
 - 7 = Diseases of the circulatory system
 - 8 = Diseases of the respiratory system
 - 9 = Diseases of the digestive system
 - 10 = Diseases of the genitourinary system
 - 11 = Complications of pregnancy, childbirth, and the puerperium
 - 12 = Diseases of the skin and subcutaneous tissue
 - 13 = Diseases of the musculoskeletal system
 - 14 = Congenital anomalies
 - 15 = Certain conditions originating in the perinatal period
 - 16 = Symptoms, signs, and ill-defined conditions
 - 17 = Injury and poisoning
 - 18 = Factors influencing health status and contact with health services
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Samples (cont)

- Multi-morbid: 2 or more Body System Indicators
- Healthy:
 - not multi-morbid
 - just one body system indicator
 - Had a V code for a physical
V70x, V71x, V72x

Outcomes

- Total costs in current year (FY10) and prospective year (FY11)
 - VA inpatient (DSS)
 - VA outpatient (DSS)
 - VA pharmacy (DSS)
 - Fee Basis (purchased care)

Data

- VA care (utilization, cost, diagnostic information)
 - NPCD
 - PTF
 - DSS
 - HERC Average Cost data
- Non-VA care
 - Fee Basis

Descriptive Statistics

	General	Over 65	High cost	MH-SUD	Multi-morbid	Healthy
N	1,995,620	644,524	261,487	830,832	817,951	78,032
Age (SD)	62.0 (15.9)	81.4 (4.6)	62.5 (13.4)	56.9 (15.2)	62.2 (13.8)	48.2 (17.4)
Male	94%	98%	95%	91%	94%	86%
Total Costs*						
Mean	8,819	8,067	76,920	15,067	21,345	2,435
Median	2,563	1,908	52,954	5,637	9,337	1,093
SD	24,976	25,624	76,697	33,560	40,603	5,203
Maximum	1,660,240	1,597,986	2,979,525	2,476,373	2,979,525	275,166

- *Total Costs include inpatient, outpatient, pharmacy and Fee Basis care
- Veterans whose DSS Rx costs exceed \$50,000 were excluded from these analyses.
 - Negative DSS VA in/out costs and DSS Rx costs were also replaced with zeros.
 - High cost sample developed using HERC average costs, not DSS costs

Comparing Risk Scores: regression models

- Ordinary least squares (OLS)
- Log-OLS
- Square-root OLS
- Generalized linear model (GLM) with gamma distribution and log-link
- GLM with gamma distribution and square root link
- Covariates: age, age-squared, gender

Average Risk Scores

	CMS V21	DxCG Medicare		DxCG Medicaid
	<i>Prospective without Rx</i>	<i>Prospective without Rx</i>	<i>Concurrent without Rx</i>	<i>Prospective with Rx</i>
General	0.756 (0.730)	0.661 (0.698)	0.497 (0.879)	1.756 (2.126)
Over 65	1.065 (0.750)	0.921 (0.656)	0.504 (0.874)	2.020 (2.267)
High cost	2.234 (1.580)	2.077 (1.628)	2.684 (2.243)	7.228 (4.323)
MH-SUD	0.893 (0.850)	0.802 (0.802)	0.770 (1.092)	2.487 (2.708)
Multi-morbid	1.160 (1.024)	1.044 (1.002)	1.004 (1.343)	3.146 (3.027)
Healthy	0.295 (0.234)	0.236 (0.219)	0.152 (0.244)	0.708 (0.708)

Mean (SD)

How do Risk Scores Fit the VA Data?

- R-squared
- Root mean squared error
- Mean absolute error
- Hosmer-Lemeshow goodness of fit

R-squared

	CMS V21	DCG Medicare		DCG Medicaid
	<i>Prospective without Rx</i>	<i>Prospective without Rx</i>	<i>Concurrent without Rx</i>	<i>Prospective with Rx</i>
General	0.4287	0.4308	0.5122	0.5682
Over 65	0.4108	0.3876	0.4802	0.5907
MH-SUD	0.3985	0.4191	0.4876	0.5738
High cost	0.1920	0.1999	0.2650	0.3779
Multi-morbid	0.3910	0.3906	0.4790	0.5377
Healthy	0.1646	0.1966	0.2694	0.2701

Results shown were from an Square root OLS model

Root Mean Squared Error

	CMS V21	DCG Medicare		DCG Medicaid
	<i>Prospective without Rx</i>	<i>Prospective without Rx</i>	<i>Concurrent without Rx</i>	<i>Prospective with Rx</i>
General	20,576	21,829	22,060	17,884
Over 65	22,018	23,377	23,761	18,464
MH-SUD	27,942	29,215	28,865	23,895
High cost	70,312	70,003	67,206	62,716
Multi-morbid	34,035	35,043	33,708	29,888
Healthy	4,945	5,045	4,782	4,605

Results shown were from an Square root OLS model

Mean Absolute Error

	CMS V21	DCG Medicare		DCG Medicaid
	<i>Prospective without Rx</i>	<i>Prospective without Rx</i>	<i>Concurrent without Rx</i>	<i>Prospective with Rx</i>
General	7,415	7,423	6,783	6,398
Over 65	7,320	7,552	6,812	6,077
MH-SUD	11,843	11,607	10,774	9,942
High cost	41,640	41,266	39,120	36,720
Multi-morbid	15,225	15,236	13,868	13,234
Healthy	2,087	2,035	1,937	1,941

Results shown were from an Square root OLS model

Hosmer-Lemeshow Tests

	CMS V21 prospective	DCG Medicare prospective without Rx	concurrent without Rx	DCG Medicaid prospective with Rx
Deciles				
General Sample				
1	-1,651	-2,530	-2,561	-1,286
2	-1,464	-2,187	-2,455	-1,287
3	-1,432	-2,059	-2,300	-1,296
4	-1,431	-1,954	-2,035	-1,636
5	-1,495	-1,701	-1,542	-1,234
6	-1,415	-1,493	-867	-335
7	-730	-567	188	179
8	301	1,014	1,115	1,049
9	2,694	3,579	4,479	1,199
10	6,645	7,922	6,000	4,663

Findings

- Concurrent risk:
 - DxCG offers concurrent risk scores; CMS V21 does not
 - Concurrent risk models tend to produce better fit statistics than prospective risk models
 - Prospective risk:
 - DxCG and V21 produce similar results across a range of samples and regression specifications
 - Prospective risk with pharmacy:
 - DxCG offers better fit than V21, which does not include pharmacy
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Aim 2

What is gained by adding variables and recalibrating the risk models to fit VA?

Recalibration

- Added more covariates
 - Race, Marital status, Other health insurance, Veteran priority level status
 - Exposure registry (e.g., Agent Orange)
 - 46 psychiatric condition categories (Rosen)
 - Pharmacy
 - Re-ran analytic models from Aim 1, and estimated new risk score for each patient
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Pharmacy

- Prior year's pharmacy spending
- Any use of medication in 26 drug class categories

Drug Class

- PBM maintains an alphanumeric list of 580 drug types within 29 drug classes.
- Three classes were rarely used, resulting in the final list of 26

<u>Abbreviation</u>	<u>Description</u>
AM	Antimicrobials
CN	Central nervous system agents
DX	Diagnostic agents
RS	Rectal solutions
VT	Vitamins

R-squared

	CMS V21		DxCG Medicare		DxCG Medicaid
	<i>Prospective without Rx</i>	<i>Prospective with VA drug class indicators</i>	<i>Prospective without Rx</i>	<i>Concurrent without Rx</i>	<i>Prospective with Rx</i>
General	0.5793	0.6924	0.5819	0.6274	0.6351
Over 65	0.5728	0.6772	0.5677	0.6233	0.6397
MH-SUD	0.5820	0.6810	0.5896	0.6268	0.6509
High cost	0.3559	0.4281	0.3544	0.4244	0.4241
Multi-morbid	0.5350	0.6331	0.5326	0.5957	0.5943
Healthy	0.2922	0.4573	0.3113	0.3508	0.3778

Hosmer-Lemeshow

Deciles	Recalibrated V21		DCG Medicare		DCG Medicaid
	prospective	prospective with VA drug class	prospective without Rx	concurrent without Rx	prospective with Rx
General Sample					
1	-1,056	-650	-1,349	-1,244	-1,066
2	-1,050	-742	-1,379	-1,251	-1,149
3	-1,037	-623	-1,322	-1,282	-1,064
4	-944	-624	-1,210	-1,138	-950
5	-796	-670	-1,017	-981	-755
6	-570	-686	-678	-659	-343
7	-312	-746	-160	-71	96
8	12	-740	468	590	612
9	693	-211	1,883	2,149	659
10	5,072	5,707	4,776	3,897	3,968

Predicting Risk

- Use regression model to predict person's costs, then divide by average predicted costs
- Split-sample validation

Predicted Risk Scores

Sample	n	Mean	Std. Dev	Min	Max
General	1,988,053	1.00	1.62	0.14	41.26
Over 65	641,048	0.91	1.56	0.14	40.75
MH-SUD	819,707	1.64	2.19	0.14	44.02
High cost	255,661	5.58	3.92	0.16	45.92
Multi-morbid	815,088	2.06	2.48	0.14	45.92
Healthy	77,357	0.38	0.36	0.15	11.20

Results

■ Model matters

	CMS V21		DCG Medicare		DCG Medicaid
	prospective	with pharmacy	prospective without Rx	concurrent without Rx	prospective with Rx
OLS	0.3141	NA	0.3371	0.4373	0.4441
SQRT OLS	0.4287	NA	0.4308	0.5122	0.5682

Results

- Notable gain from Pharmacy

	CMS V21	with	DCG Medicare	concurrent	DCG
	prospective	pharmacy	prospective	without Rx	Medicaid
			without Rx		prospective
					with Rx
OLS	0.3141	NA	0.3371	0.4373	0.4441
SQRT OLS	0.4287	NA	0.4308	0.5122	0.5682

Results

- Recalibration is possible and yields improved fit

	CMS V21		DCG Medicare		DCG Medicaid
	prospective	with pharmacy	prospective without Rx	concurrent without Rx	prospective with Rx
Basic	0.4287	NA	0.4308	0.5122	0.5682
<i>Recalibrated</i>	0.5793	0.6924	0.5819	0.6274	0.6351

The table shows that the recalibrated model achieves higher DCG scores across all categories compared to the basic model. A red arrow points from the basic DCG Medicare prospective without Rx score (0.4308) down to the recalibrated score (0.5819). Another red arrow points from the basic DCG Medicaid prospective with Rx score (0.5682) down to the recalibrated score (0.6351). A red arrow also points from the recalibrated CMS V21 with pharmacy score (0.6924) up to the recalibrated DCG Medicare concurrent without Rx score (0.6274).

Limitations

- Comparison of only 2 systems
 - Risk adjustment systems are concerned with gaming
 - VERA (Veterans Equitable Resource Allocation)
 - These risk models would not be used for payments
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References

- Ettner SL, Frank RG, Mark T, Smith MW. Risk adjustment of capitation payments to behavioral health care carve-outs: how well do existing methodologies account for psychiatric disability? *Health Care Manag Sci. Feb 2000;3(2):159-169.*
- Fishman PA, Goodman MJ, Hornbrook MC, Meenan RT, Bachman DJ, Rosetti MCOK. Risk Adjustment Using Automated Ambulatory Pharmacy Data: The RxRisk Model. *Medical Care. 2003;41(1):84-99.*
- Montez-Rath M, Christiansen CL, Ettner SL, Loveland S, Rosen AK. Performance of statistical models to predict mental health and substance abuse cost. *BMC medical research methodology. 2006;6:53.*
- Pope GC, Kautter J, Ellis RP, et al. Risk adjustment of Medicare capitation payments using the CMS-HCC model. *Health Care Financ Rev. Summer 2004;25(4):119-141.*
- Pope GC, Kautter J, Ingber MJ, Freeman S, Sekar R, Newhart C. *Evaluation of the CMS-HCC Risk Adjustment Model. 2011.*
- Sloan KL, Montez-Rath ME, Spiro A, 3rd, et al. Development and validation of a psychiatric case-mix system. *Med Care. Jun 2006;44(6):568-580.*

Questions?

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