

## Appendix

Appendix Table 1. The Twelve RXCs Included in the 2018 HHS-HCC Model.

Prescription Drug Category (RXC)	Use	Condition
Anti-HIV agents	Imputation and severity	HIV
Anti-hepatitis c (HCV) agents	Imputation and severity	Hepatitis C
Antiarrhythmics	Imputation and severity	Heart arrhythmia
Phosphate binders	Imputation and severity	Chronic kidney disease
Inflammatory bowel disease agents	Imputation and severity	Inflammatory bowel disease
Insulin	Imputation and severity	Diabetes
Anti-diabetic agents, except insulin and metformin	Imputation and severity	Diabetes
Multiple sclerosis agents	Imputation and severity	Multiple Sclerosis
Immune suppressants and immunomodulators	Imputation and severity	Inflammatory bowel disease, rheumatoid arthritis, and lupus
Cystic fibrosis agents	Imputation and severity	Cystic fibrosis
Ammonia detoxicants	Severity-only	N/A
Diuretics, loop and select potassium-sparing	Severity-only	N/A

Source: HHS Notice of Benefit and Payment Parameters for 2018 (CMS, 2016c).

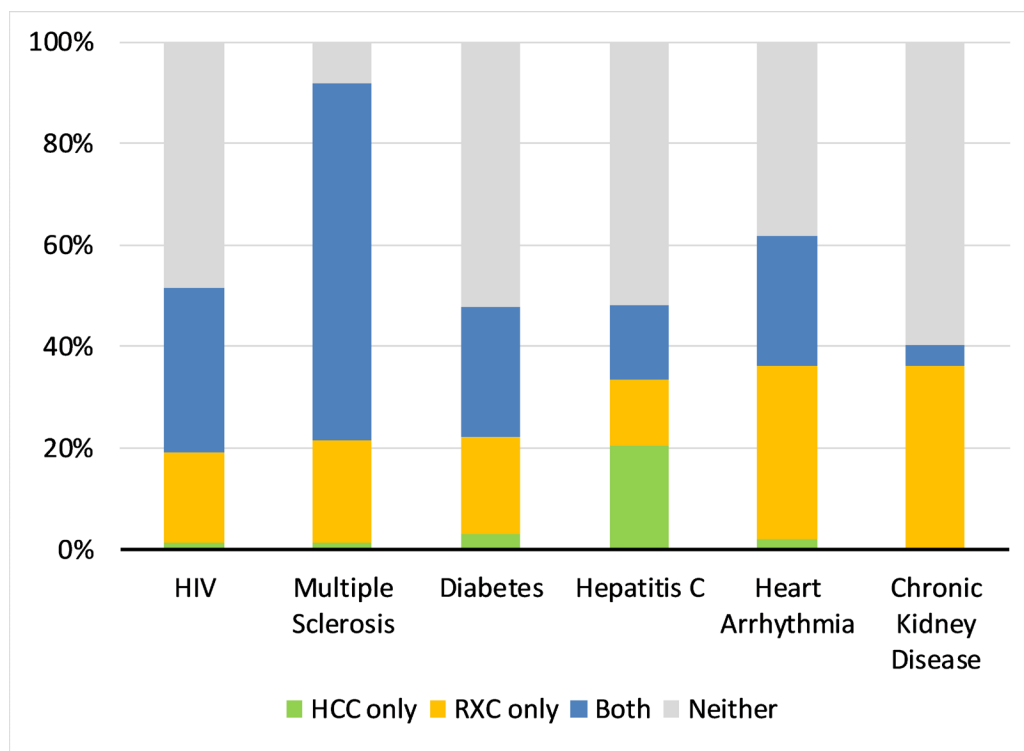
Notes: The last two RXCs were excluded from our analyses.

Appendix Table 2. Comparison of Risk Score Increases under the 2017 and the 2018 HHS-HCC Models for an Enrollee in Various Scenarios.

	HIV		Multiple Sclerosis	
	2017 Model	2018 Model	2017 Model	2018 Model
HCC only	8.450	0.409	13.194	6.087
RXC only	N/A	6.050	N/A	16.192
Both HCC and RXC	8.450	8.862	13.194	19.105

Source: HHS Notices of benefit and payment parameters for benefit years 2017 and 2018 (CMS, 2016b; CMS, 2016c).

Notes: This table uses HIV and multiple sclerosis as two examples to illustrate risk score increases in various scenarios for a gold plan enrollee. Under the 2018 HHS-HCC model, an individual with both the HCC and the RXC receives an additional interaction term, whose coefficient can be either positive or negative. In the case of HIV, the score of the interaction term is 2.403, and thus under the 2018 model, an individual with both the HCC and the RXC receives a score of 8.862 ( $0.409+6.050+2.403$ ). The case of multiple sclerosis is similar, except that the interaction term has a negative coefficient ( $-3.174$ ).



Appendix Figure 1. RXC-only patients' status in the previous year (2016).

Source: Authors' analysis of the 2016 and 2017 member information file, medical claims, and pharmacy claims from the Optum data.

Notes: The sample includes enrollees with any of the six conditions who in 2017 only had the associated prescription drug categories (RXC) and who continuously enrolled in plans offered by the insurer in both 2016 and 2017. HCC stands for hierarchical condition category.

Appendix Table 3. Partial-year Enrollees Who Would Have Received RXCs and Who Would Not under the 2018 HHS-HCC Model.

	Months Enrolled				Full-Year Enrollees
	1-3	4-6	7-9	10-11	
0 HCCs	93.15%	87.33%	81.96%	82.24%	79.62%
0 HCC and only unassociated RXC(s)	0.79%	0.58%	0.45%	0.36%	0.34%
1 HCC	4.12%	7.87%	10.81%	10.98%	12.39%
1 HCC and only associated RXC(s)	0.80%	1.75%	2.75%	2.27%	2.83%
1 HCC and only unassociated RXC(s)	0.04%	0.07%	0.10%	0.10%	0.12%
2 HCCs	0.57%	1.20%	1.86%	1.99%	2.31%
2 HCCs and only associated RXC(s)	0.17%	0.42%	0.78%	0.67%	0.87%
2 HCCs and only unassociated RXC(s)	0.01%	0.01%	0.02%	0.02%	0.03%
3+ HCCs	0.25%	0.51%	0.77%	0.86%	0.92%
3+ HCCs and only associated RXC(s)	0.08%	0.23%	0.46%	0.46%	0.52%
3+ HCCs and only unassociated RXC(s)	0.00%	0.01%	0.02%	0.02%	0.02%
N	1,147,274	1,018,063	1,117,051	454,150	5,162,983

Source: Authors' analysis of the 2017 member information file, medical claims, and pharmacy claims from the Optum data.

Notes: The sample includes commercially insured partial-year enrollees ages 21 to 64 that did not switch plans in 2017. A hierarchical condition category (HCC) Group was counted as one single HCC. The two severity-only prescription drug categories (RXC(s)) were excluded from the analysis. Individuals with “associated RXC(s)” were those taking medications in RXC(s) associated with the HCC(s) they already had. Individuals with “unassociated RXC(s)” were those taking medications in RXC(s) not associated with the HCC(s) they had. By definition, individuals with zero HCCs did not receive associated RXCs. Enrollee subgroups with both associated and unassociated RXCs were excluded due to small group size.

Appendix Table 4. Mean Age by Level of Plan Spending of Enrollees with 0 HCCs Only under the 2018 HHS-HCC Model.

	Men	Women	N	% Women
Plan spending=0	38.0	39.9	1,032,168	30%
Plan spending between 0 and \$500	40.8	40.6	1,292,949	41%
Plan spending between \$500 and \$2,000	43.6	42.1	948,027	62%
Plan spending greater than \$2,000	45.5	44.3	837,731	58%

Source: Authors' analysis of the 2017 member information file, medical claims, and pharmacy claims from the Optum data.

Notes: The sample includes enrollees with 0 HCCs only under the 2018 HHS-HCC Model. All spending is in 2017 dollars.

Appendix Table 5. Top 15 Diagnoses by Share of Patients for Enrollees with 0 HCCs Only under the 2018 HHS-HCC Model.

All Enrollees with 0 HCCs Only			Enrollees with 0 HCCs Only and with Plan Spending >\$2,000		
Diagnosis	ICD-10	% With this Dx	Diagnosis	ICD-10	% With this Dx
No diagnosis (includes those with no medical claims)	N/A	28%	Encounter for general adult medical examination without abnormal findings	Z0000	33%
Encounter for general adult medical examination without abnormal findings	Z0000	22%	Encounter for gynecological examination (general) (routine) without abnormal findings	Z01419	24%
Encounter for gynecological examination (general) (routine) without abnormal findings	Z01419	14%	Essential (primary) hypertension	I10	22%
Essential (primary) hypertension	I10	11%	Encounter for immunization	Z23	15%
Encounter for immunization	Z23	9%	Lower back pain	M545	14%
Lower back pain	M545	6%	Encounter for screening for malignant neoplasm of colon	Z1211	13%
Acute upper respiratory infection, unspecified	J069	6%	Hyperlipidemia, unspecified	E785	11%
Hyperlipidemia, unspecified	E785	5%	Gastro-esophageal reflux disease without esophagitis	K219	11%
Acute pharyngitis, unspecified	J029	5%	Neck pain	M542	10%
Cough	R05	5%	Anxiety disorder, unspecified	F419	9%
Encounter for screening for malignant neoplasm of colon	Z1211	4%	Acute upper respiratory infection, unspecified	J069	9%
Other fatigue	R5383	4%	Cough	R05	9%
Anxiety disorder, unspecified	F419	4%	Other fatigue	R5383	9%
Gastro-esophageal reflux disease without esophagitis	K219	4%	Vitamin D deficiency, unspecified	E559	8%
Vitamin D deficiency, unspecified	E559	4%	Acute pharyngitis, unspecified	J029	8%

Source: Authors' analysis of the 2017 member information file, medical claims, and pharmacy claims from the Optum data.

Notes: The sample includes enrollees with 0 HCCs only under the 2018 HHS-HCC Model.

Appendix Table 6. Comparison of Sample Characteristics of the Study Sample and the Adult Calibration Sample for the 2014 HHS-HCC Model.

	Study Sample	Calibration Sample
Men 21 to 24	4.2%	3.8%
Men 25 to 29	5.4%	4.3%
Men 30 to 34	6.2%	4.8%
Men 35 to 39	6.4%	5.2%
Men 40 to 44	6.0%	5.6%
Men 45 to 49	6.3%	6.0%
Men 50 to 54	6.1%	6.2%
Men 55 to 59	5.9%	5.8%
Men 60+	4.8%	5.8%
Women 21 to 24	3.9%	4.0%
Women 25 to 29	4.9%	4.7%
Women 30 to 34	5.7%	5.3%
Women 35 to 39	6.0%	5.6%
Women 40 to 44	5.6%	6.1%
Women 45 to 49	6.0%	6.7%
Women 50 to 54	5.9%	7.0%
Women 55 to 59	5.8%	6.5%
Women 60+	4.6%	6.5%
With 0 HCCs	80.0%	80.8%
With 1 HCC	15.3%	15.2%
With 2+ HCCs	4.7%	4.0%
N	5,162,983	14,220,503

Source: The study sample column is from authors' analysis of the 2017 member information file, medical claims, and pharmacy claims from the Optum data. The calibration sample column is reported in Kautter et al. (2014).

Notes: The sample includes commercially insured enrollees ages 21 to 64 that enrolled for the full year and did not switch plans in 2017. A hierarchical condition category (HCC) Group was counted as one single HCC.