This supplement provides information on selection of the comparison group. Because all KMHS patients are considered intervention participants, we identified all patients who received services at KMHS as intervention group members and patients of other mental health treatment facilities in the state of Washington as the potential pool of comparison patients. Then, from within the comparison pool, we identified individuals most closely matched to KMHS patients to include in the comparison population. Constructing the matched comparison group involved several steps, which we detail below.

Step 1a: Identify facilities similar to KMHS in Washington State. Using the Substance Abuse and Mental Health Services Administration's mental health treatment facility locator, we identified all mental health treatment facilities in Washington State in 2014 with the following characteristics:

- Provides outpatient care

- Serves patients with Medicaid and Medicare

- Privately owned

- Serves adults

- Allows psychiatric emergency walk-in clients

Based on this set of characteristics, we identified 24 facilities. We considered requiring facilities to match additional characteristics of KMHS, such as providing multiple levels of care, having special targeted programs,[1] or being in a geographic area of similar size; however, this would reduce the number of facilities from which to identify potential comparison group members to only five and would not allow for a sufficient number of potential comparison clients well-matched to KMHS clients. The current analysis period includes calendar years 2010 through June 2015. Of the 24 facilities initially identified, we excluded 7 facilities because they did not serve Medicare clients in all five and a half analysis years. We excluded one additional facility because multiple locations used the same National Provider Identifier (NPI), preventing us from identifying those services provided at the location that met the facility selection criteria. Thus, 16 comparison facilities were used in the analysis.

Step 1b: Identify additional facilities treating patients with dementia. When we compared the diagnoses reported on claims for KMHS patients to those for patients served by comparison facilities, we found substantial numbers of KMHS clients had a diagnosis of dementia; however, few of the patients at the comparison facilities had a dementia diagnosis. Thus, in order to assure a sufficient number of comparison pool members well-matched to the KMHS clients with dementia, we identified additional facilities in the state that served at least 100 patients with a diagnosis of dementia on a psychiatric service claim. We included patients with dementia from these additional facilities in the pool of potential comparison group members, and only matched these patients with treatment group members with dementia.

Step 2: Identify treatment and potential comparison group members. Using Medicare data for calendar years 2010 through June 2015, we initially identified all individuals who received a mental health service at KMHS or one of the potential comparison facilities.[2] We used Current Procedural Terminology (CPT) and International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes to identify mental health services. Individuals with a claim meeting any one of the three mental health service category definitions were selected for our initial analysis population. It should be noted that on January 1, 2013, the CPT codes used to bill psychiatric services changed. Providers began using new psychiatric visit codes 90791, 90792, and 90785 on that date. The psychiatric medication management code 90862 was not allowable beginning January 1, 2013. After this date, providers billed

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[1] KMHS provides multiple levels of care, including residential and hospital care. KMHS also has special programs for individuals with severe mental illness and for individuals with mental health and substance abuse disorders.

[2] We include individuals with limited exposure to KMHS in both the pre- and post-period to reflect the general population treated at KMHS. The intervention may also increase the number of visits at KMHS, and therefore we did not want to include the number of visits as a selection criteria.

appropriate evaluation and management codes with a mental health primary diagnosis. Each individual who received a mental health service was assigned to an intervention or comparison group based on the facility in which they initially received treatment.[3]

Codes used to identify mental health services

Service category	CPT codes and additional requirements
1. Psychiatric visit	CPT-code = 90801 through 90899, 90791, 90792, and 90785 (psychiatric visit)
2. E&M visit with psych primary diagnosis	CPT-code = any outpatient E&M visit (CPT=99201-99205, 99211-99215) with a mental health primary diagnosis code.
3. Psychiatric medication management visit	CPT-Code=M0064[a]

Source: Mathematica review of Current Procedural Terminology, Healthcare Common Procedure Coding System.

[a] M0064 was deleted from the HCPCS system December 31, 2014. Thus, this code was in use through the end of the period we used to identify patients for this analysis.

CPT= Current Procedural Terminology; E&M=Evaluation and management; HCPCS= Healthcare Common Procedure Coding System.

Medicare enrollment and claims data for January 2009 through June 2015 were extracted for this population and used to develop measures of enrollment history, demographics, health conditions, and HCC score. Health conditions and HCC score were measured in the 12-month period prior to the month of the initial mental health visit at KMHS or a comparison facility in January 2010 or later. Mental health diagnosis at treatment initiation (in a category listed in table below) was measured in the initial month of mental health treatment and the two subsequent months. We allowed the two subsequent months because facilities commonly used a 799.9 (unknown or unspecified cause of morbidity) code during initial visits until they had specified a diagnosis.

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[3] Eighteen individuals were excluded because they were observed to receive services at more than one facility in their initial treatment month and could not be attributed to only one facility.

ICD-9 Mental health diagnosis codes

Diagnosis group	ICD-9 Diagnosis code value
Schizophrenic disorders	295.xx including 295.00
Bipolar disorders	296.00, 296.01, 296.02, 296.03, 296.04, 296.05,296.06, 296.10, 296.11, 296.12, 296.13, 296.14,296.15, 296.16, 296.40, 296.41, 296.42, 296.43,296.44, 296.45, 296.46, 296.50, 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.7, 296.80, 296.81, 296.82, 296.89, 296.90, 296.99
Depressive disorders	296.20, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.32, 296.33, 296.34, 296.35, 296.36, 311
Persistent mental disorders due to conditions classified elsewhere	294.8x, 294.9x
Dementia	290.xx, 294.1x
Other psychotic disorders	297.xx-298.xx
Anxiety, dissociative, and somatoform	300.xx
Adjustment reaction	309.xx
Drug and alcohol indicator	292, 292.0, 292.1, 292.2, 292.8, 292.9, 304, 304.0, 304.1, 304.2, 304.3, 304.4, 304.5, 304.6, 304.7, 304.8, 304.9, 305, 305.2, 305.3, 305.4, 305.5, 305.6, 305.7, 305.8, 305.9 291, 291.0, 291.1, 291.2, 291.3, 291.4, 291.5, 291.8, 291.9, 303, 303.0, 303.9, 305.0
Other diagnosis not listed above	Everything not above (293.83, V62.84, V62.85, E950, E951, E952, E953, E954, E955, E956, E957, E958, E959, 301.0 to 301.9, 307.40 to 307.49, 312.0 to 312.23, 312.4 to 312.89, 313.81, 312.30 to 312.39, 302.0 to 302.9, 299.00 to 299.91, 307.1, 307.5, 307.51, 314.00 to 314.01, 307.20 to 307.3, 313.0 to 313.3, 313.82 to 316, 648.4, V65.2, V71.09, 780.09, V15.41, V15.42, V15.81, V17.0, V60.0, V62.29, V62.4, V62.81, V62.89) and all other codes in the range of 290.0-299.91 and 300.00-316 Also include 7999 in this category.
Any 294 diagnosis	294.xx

Source: ICD-9 diagnosis codes, version 32
(https://www.cms.gov/medicare/coding/ICD9providerdiagnosticcodes/codes.html).
ICD-9 = International Classification of Diseases, Ninth Revision.

We restricted the analysis population to those residing in the local area of the analysis facilities to assure the patients had the potential to consistently access the facilities during the analysis period. We excluded individuals from the KMHS treatment group if they did not reside in Kitsap County or a contiguous county based on the most recent Medicare enrollment data available at the time they received their initial mental health service at KMHS. Potential comparison group members were similarly excluded if they did not reside in the county or a contiguous county for the mental health facility at which they initially received services.

Next, because of the limitations of the available Medicare data and to assure consistency in the expenditures observable for the analysis population, we required that during the full analysis period, the individual (1) not be enrolled in Medicare Advantage (because we do not have access to managed care encounters), (2) have Medicare as their primary payer, and (3) be enrolled in Medicare Parts A and B (to ensure that we capture both inpatient and outpatient services). Applying these restrictions in a step-wise fashion resulted in the exclusion of 15 percent, 2 percent, and 1 percent of the analysis population, respectively. We also required that the individual have a value for the hierarchical behavioral health diagnosis variable; we excluded another four individuals due to this requirement.

When this step was complete, the analysis population included 1,116 KMHS intervention participants and a pool of 12,017 individuals who received mental health services from comparison facilities.

Step 3: Match treatment participants at the individual level. The next step involved creating a matched comparison group. The matching process used metrics of individual-level characteristics identified based on pre-period Medicare data to select a subset of comparison pool members who were as similar as possible to the intervention group on observable characteristics. The matching algorithm first exact matched on the year an individual began treatment at KMHS or comparison mental health facility and a hierarchical variable of behavioral health diagnosis in the first three months of mental health treatment. The hierarchical variable included the following categories: dementia, schizophrenia, bipolar disorder, depression, or other condition. Then, within these cells, we used optimal matching. Optimal matching aims to find the intervention and comparison group member pairs with the smallest averaged absolute distance across all the matched pairs. The values in the distance matrix reflect the degree of similarity between the treatment and comparison group member characteristics. Considering that there are categorical covariates, Gower's method was utilized to generate the distances. The algorithm used the distance matrix to search for the optimal matched pairs allowing each intervention group member to be matched with up to 5 members of the comparison pool. The characteristics in the matching algorithm were: age group (18–44, 45–54, 55–64, 65+), gender, disability status, the year treatment began at KMHS or comparison mental health facility, whether the beneficiary was enrolled in Medicare for a full 12 months prior to receiving mental health treatment at KMHS or a comparison facility, Medicare/Medicaid dual enrollment status, flags for psychiatric conditions,[4] and HCC score.[5]

When this step was complete, the analysis population included 1,116 KMHS intervention participants and 4,003 individuals in the comparison group. The reduction in the size of the comparison population relative to the previous step was due to individuals who were not matched to an individual attributed to KMHS on the exact matching variables.

Step 4: Assess the quality of the match. The following tests and procedures were used to verify that the treatment and comparison groups are similar or balanced. After we conducted matching, we examined the number of comparison beneficiaries matched to each treatment beneficiary. A large number of 1:1 matches, or a large number of comparison beneficiaries that were excluded, could indicate that the matching was problematic. In this case, we examined the balance diagnostics described below to determine which variable(s) may be causing the difficulty. The number of 1:1 matches is generally related to the small number of potential comparison group members in a given exact matching cell with the same hierarchical behavioral health diagnosis. Although requiring an exact match on diagnosis category increased the number of pairwise matches, we believed it was important that the treatment and associated comparison group member match on this characteristic.

Frequency table of ratio of treatment beneficiaries to comparison beneficiaries for each matched set

Ratio of treatment to comparison beneficiaries	1:1	1:2	1:3	1:4	1:5
Number of matched sets	292	81	56	54	633

Source: Mathematica analysis of Medicare administrative data for July 2010–June 2015.

[4] We created flags to indicate that the patient had a diagnosis code for various conditions in the first three months of their claims during the intervention period. The diagnosis-related flags that we included in the matching included those for persistent mental disorder due to conditions classified elsewhere; dementia; anxiety, dissociative, or somatoform disorder; adjustment reaction disorder; alcohol- or drug-related diagnosis; "other" psychotic disorder; and "other" diagnosis.

[5] HCC score was used only for individuals enrolled in Medicare for 12 months prior to receiving a treatment at KMHS or a comparison facility because 12 months of claims history are required to calculate the score based on medical conditions.

Note: Each cell indicates the number of treatment beneficiaries matched to the number of comparison beneficiaries indicated for that column. In this example, most of the treatment beneficiaries (633) were matched to 5 comparison beneficiaries.

Next, we examined the overall balance of the matched sample. We used an omnibus test that checks for covariate balance across the individuals in the treatment and matched comparison group (Hansen and Bowers 2008). The omnibus test is based on the differences between the individuals in the treatment and matched group across the matching variables; these differences are standardized by their variances and covariances and aggregated into a single number, a weighted mean. Standardization in this way implies that a matching variable whose difference across matched sets has a small variance is given more weight and that a matching variable whose difference across sets is highly correlated with other differences is given less weight. The advantages of the omnibus test are: (1) it generates a single probability statement through one p-value; (2) its distribution is roughly chi-square, which facilities the calculation of the p-value; and (3) it assesses balance on all linear combinations of the matching variables. However, a significant result from this chi-square test may be driven by a large sample rather than substantive differences between treatment and matched comparison groups. Alternatively, it could indicate that there may be some imbalance between the two groups on at least one of the matching variables. The results of this test were a chi-square statistic of 93.5 and a p-value of < 0.01, indicating that an imbalance exists.

To further investigate imbalance between treatment and matched comparison groups, we evaluated how matching affected the balance on all matching variables by comparing the absolute and standardized difference between the treatment and control groups for each variable before and after matching. The standardized difference measures the difference in means in *units* of the pooled standard deviation of treatment group and comparison group. The standardized difference measure is advantageous in that it allows us to compare all variables on the same scale. We compared the standardized differences using plots with dashed lines at +/- 0.15 standardized differences to visually inspect whether we obtained good balance for each variable, and using a balance table that shows both absolute and standardized differences between treatment and comparison groups before and after matching. Number of hospitalizations, ED visits and total Medicare expenditures were not included in the matching algorithm but are included in the matching diagnostics reported below.

Balance plot comparing the standardized difference for each matching variable before and after matching
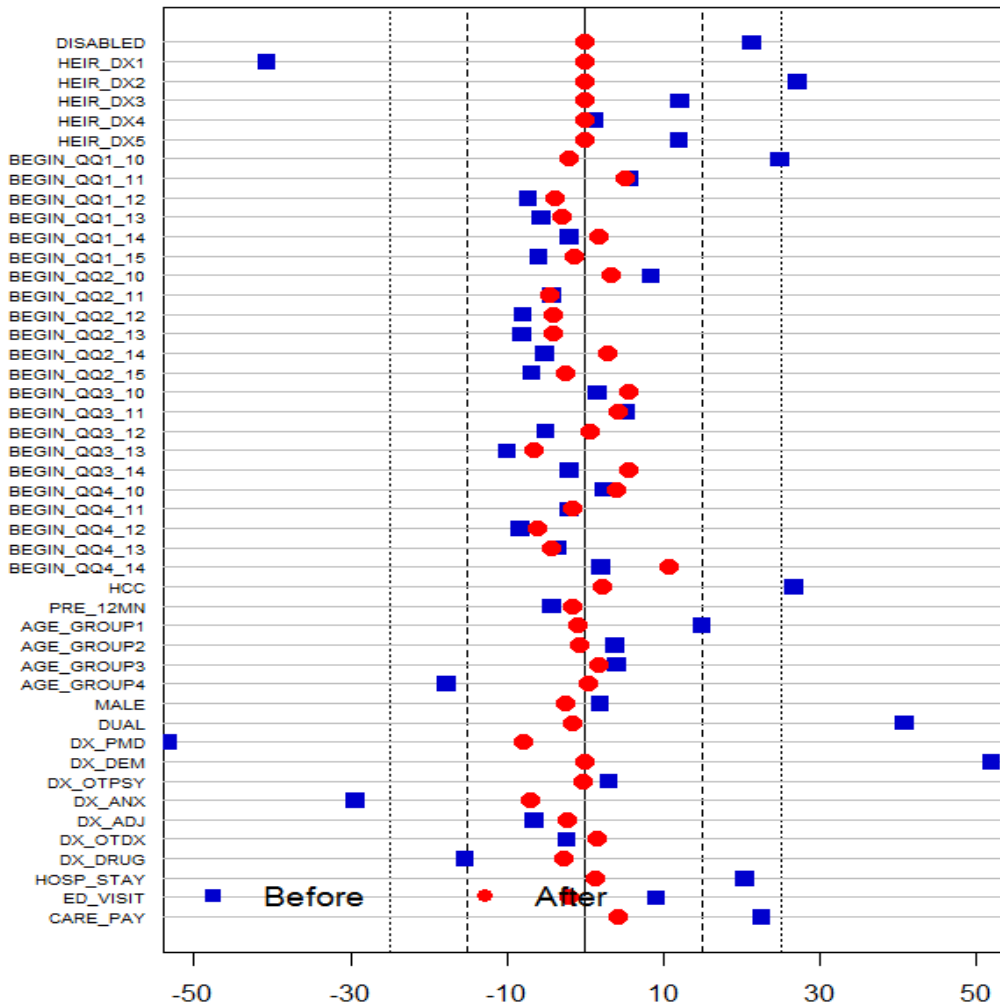
Source: Mathematica analysis of Medicare administrative data for July 2010–June 2015.

Note: Blue markers show the standardized difference before matching; red markers show the standardized difference after exact matching and propensity score modeling. See Table below for descriptions of the variables included in this figure.

We provide more detail on the means and adjusted and standardized difference for the matching variables in the table below.

Balance table before and after matching

Variable Name	Variable description	Before matching					After matching				
		Comparison	Treatment	adj.diff	std.diff	P	Comparison	Treatment	adj.diff	std.diff	p
DISABLED	Disability status	0.5811	0.6855	0.1044	0.2126	0	0.6855	0.6855	0	0	1
HEIR_DX1	Hierarchical variable of behavioral health diagnosis: dementia	0.3434	0.1532	-0.1902	-0.408	0	0.1532	0.1532	0	0	1
HEIR_DX2	Hierarchical variable of behavioral health diagnosis: schizophrenia	0.1673	0.2697	0.1025	0.2698	0	0.2697	0.2697	0	0	1
HEIR_DX3	Hierarchical variable of behavioral health diagnosis: bipolar disorder	0.136	0.1774	0.0414	0.1197	0.0001	0.1774	0.1774	0	0	1
HEIR_DX4	Hierarchical variable of behavioral health diagnosis: depression	0.2092	0.2133	0.0041	0.01	0.75	0.2133	0.2133	0	0	1
HEIR_DX5	Hierarchical variable of behavioral health diagnosis: other condition	0.1441	0.1864	0.0423	0.1191	0.0001	0.1864	0.1864	0	0	1
BEGIN_QQ1_10	Began treatment at KMHS or comparison mental health facility in first quarter of 2010	0.229	0.3342	0.1052	0.2477	0	0.3448	0.3342	-0.0106	-0.0217	0.2921
BEGIN_QQ1_11	Began treatment at KMHS or comparison mental health facility in first quarter of 2011	0.0352	0.0457	0.0105	0.0563	0.0721	0.0358	0.0457	0.0099	0.0515	0.0948
BEGIN_QQ1_12	Began treatment at KMHS or comparison mental health facility in first quarter of 2012	0.0349	0.0215	-0.0134	-0.074	0.018	0.0275	0.0215	-0.006	-0.0386	0.2471
BEGIN_QQ1_13	Began treatment at KMHS or comparison mental health facility in first quarter of 2013	0.0387	0.0278	-0.0109	-0.0573	0.0672	0.0325	0.0278	-0.0048	-0.0292	0.4061
BEGIN_QQ1_14	Began treatment at KMHS or comparison mental health facility in first quarter of 2014	0.0353	0.0314	-0.0039	-0.0214	0.4951	0.0286	0.0314	0.0028	0.0171	0.6185
BEGIN_QQ1_15	Began treatment at KMHS or comparison mental health facility in first quarter of 2015	0.0341	0.0233	-0.0108	-0.0604	0.0536	0.0256	0.0233	-0.0023	-0.0151	0.678
BEGIN_QQ2_10	Began treatment at KMHS or comparison mental health facility in second quarter of 2010	0.0582	0.078	0.0198	0.0834	0.0077	0.0695	0.078	0.0084	0.0332	0.2314
BEGIN_QQ2_11	Began treatment at KMHS or comparison mental health facility in second quarter of 2011	0.0318	0.0242	-0.0076	-0.0437	0.1624	0.0314	0.0242	-0.0072	-0.0448	0.1898
BEGIN_QQ2_12	Began treatment at KMHS or comparison mental health facility in second quarter of 2012	0.0364	0.0215	-0.0149	-0.0808	0.0099	0.0277	0.0215	-0.0062	-0.0423	0.2171
BEGIN_QQ2_13	Began treatment at KMHS or comparison mental health facility in second quarter of 2013	0.0387	0.0233	-0.0154	-0.0812	0.0095	0.03	0.0233	-0.0067	-0.0404	0.2196
BEGIN_QQ2_14	Began treatment at KMHS or comparison mental health facility in second quarter of 2014	0.0376	0.0278	-0.0098	-0.0523	0.0949	0.0236	0.0278	0.0042	0.0274	0.403

Variable Name	Variable description	Before matching					After matching				
		Comparison	Treatment	adj.diff	std.diff	P	Comparison	Treatment	adj.diff	std.diff	p
BEGIN_QQ2_15	Began treatment at KMHS or comparison mental health facility in second quarter of 2015	0.0393	0.026	-0.0133	-0.0694	0.0266	0.03	0.026	-0.004	-0.0254	0.4304
BEGIN_QQ3_10	Began treatment at KMHS or comparison mental health facility in third quarter of 2010	0.0409	0.0439	0.003	0.0153	0.6238	0.0339	0.0439	0.0101	0.0543	0.0643
BEGIN_QQ3_11	Began treatment at KMHS or comparison mental health facility in third quarter of 2011	0.0328	0.0421	0.0093	0.0518	0.098	0.0346	0.0421	0.0075	0.0424	0.1867
BEGIN_QQ3_12	Began treatment at KMHS or comparison mental health facility in third quarter of 2012	0.0334	0.0242	-0.0092	-0.0517	0.0987	0.0234	0.0242	0.0008	0.0056	0.8805
BEGIN_QQ3_13	Began treatment at KMHS or comparison mental health facility in third quarter of 2013	0.0327	0.0152	-0.0175	-0.1005	0.0013	0.0248	0.0152	-0.0096	-0.0669	0.0607
BEGIN_QQ3_14	Began treatment at KMHS or comparison mental health facility in third quarter of 2014	0.0389	0.0349	-0.004	-0.0208	0.5072	0.0257	0.0349	0.0092	0.056	0.1053
BEGIN_QQ4_10	Began treatment at KMHS or comparison mental health facility in fourth quarter of 2010	0.0384	0.043	0.0046	0.0236	0.4502	0.0356	0.043	0.0074	0.04	0.1992
BEGIN_QQ4_11	Began treatment at KMHS or comparison mental health facility in fourth quarter of 2011	0.0334	0.0296	-0.0038	-0.0213	0.497	0.0324	0.0296	-0.0029	-0.0168	0.6064
BEGIN_QQ4_12	Began treatment at KMHS or comparison mental health facility in fourth quarter of 2012	0.0325	0.0179	-0.0146	-0.084	0.0073	0.0264	0.0179	-0.0085	-0.0605	0.0852
BEGIN_QQ4_13	Began treatment at KMHS or comparison mental health facility in fourth quarter of 2013	0.0354	0.0287	-0.0068	-0.0369	0.2379	0.036	0.0287	-0.0073	-0.0424	0.224
BEGIN_QQ4_14	Began treatment at KMHS or comparison mental health facility in fourth quarter of 2014	0.0325	0.0358	0.0034	0.019	0.5429	0.02	0.0358	0.0158	0.106	0.0037
HCC	HCC score	1.3122	1.5982	0.286	0.2664	0	1.5759	1.5982	0.0223	0.0226	0
PRE_12MN	Beneficiary was enrolled in Medicare for a full 12 months prior to receiving mental health treatment at KMHS or a comparison facility	0.8332	0.8172	-0.016	-0.0429	0.1707	0.824	0.8172	-0.0068	-0.0172	0.0547
AGE_GROUP1	Age group 18-44	0.2162	0.2778	0.0616	0.1484	0	0.2826	0.2778	-0.0048	-0.0102	0.2994
AGE_GROUP2	Age group 45-54	0.1663	0.1801	0.0138	0.0368	0.239	0.1831	0.1801	-0.003	-0.0074	0.5472
AGE_GROUP3	Age group 55-64	0.1292	0.1425	0.0132	0.0393	0.2089	0.1361	0.1425	0.0063	0.0177	0.2678
AGE_GROUP4	Age group 65+	0.4882	0.3996	-0.0886	-0.1775	0	0.3982	0.3996	0.0015	0.0032	0.7651
MALE	Gender	0.4372	0.4462	0.009	0.0182	0.5612	0.4587	0.4462	-0.0125	-0.025	0.076
DUAL	Medicare/Medicaid dual enrollment status	0.5476	0.7482	0.2007	0.4073	0	0.7549	0.7482	-0.0066	-0.0161	0.3613

Variable Name	Variable description	Before matching					After matching				
		Comparison	Treatment	adj.diff	std.diff	P	Comparison	Treatment	adj.diff	std.diff	p
DX_PMD	Diagnosis of persistent mental disorders due to conditions classified elsewhere	0.2155	0.0054	-0.2102	-0.5335	0	0.0132	0.0054	-0.0078	-0.0799	0.0032
DX_DEM	Diagnosis of dementia	0.0448	0.1613	0.1165	0.5178	0	0.1613	0.1613	0	0	1
DX_OTPSY	Diagnosis of other psychotic disorder	0.0517	0.0582	0.0066	0.0295	0.3456	0.059	0.0582	-0.0007	-0.0033	0.8091
DX_ANX	Diagnosis of anxiety, dissociative, or somatoform disorder	0.1108	0.0215	-0.0893	-0.2944	0	0.032	0.0215	-0.0105	-0.0697	0.0016
DX_ADJ	Diagnosis of adjustment reaction disorder	0.0875	0.069	-0.0185	-0.0662	0.0345	0.0751	0.069	-0.0061	-0.0238	0.0172
DX_OTDX	Other behavioral health diagnosis	0.0492	0.0439	-0.0053	-0.0245	0.4338	0.0414	0.0439	0.0025	0.0144	0.3193
DX_DRUG	Drug and/or alcohol-related diagnosis	0.0312	0.0054	-0.0258	-0.154	0	0.0076	0.0054	-0.0022	-0.0278	0.3734
HOSP_STAY	Hospitalizations utilization outcome measure	0.3948	0.5923	0.1975	0.2029	0	0.5808	0.5923	0.0115	0.0116	0.7635
ED_VISIT	ED visits utilization outcome measure	1.2451	1.517	0.272	0.0897	0.0042	1.7656	1.6998	-0.0658	-0.0205	0.6159
CARE_PAY	Total expenditures outcome measure	10,855	15,700	4,845	0.2241	0	14,695	15,601	906	0.0413	0.2298

Source: Mathematica analysis of Medicare administrative data for July 2010–June 2015.

HCC = Hierarchical Condition Category; adj.diff = The adjusted mean difference (adj. diff.) is the difference between weight-adjusted means for the treatment and comparison groups. 'Before matching' each treatment and comparison group member has equal weights in the mean calculation for their group. 'After matching' the members of the treatment group still have equal weight in their group mean, but the individuals in the comparison group are weighted based on one divided by the number of treatment group member to whom they are matched. Comparison group members who are not matched to a treatment group member are given a weight of zero; std.diff = The standardized difference (std. diff.) is the difference in weight-adjusted means between the treatment and comparison groups divided by the pooled standard deviation of treatment and matched comparison groups of the variable. This method places the mean difference between the treatment and comparison groups on the same scale (percentage) as the variance for each variable