ONLINE SUPPLEMENT A. Procedure and Diagnostic Codes

Mental Health Diagnosis
Mental Health Diagnosis was defined as having at least two uniquely dated claims with one of the following diagnosis codes: Schizophrenia: ICD-9 295.0-295.X, ICD-10 F20.x, F25.x; Bipolar Disorder: ICD-9 296.0x-296.1x, 296.4x-296.8x, ICD-10 F30.x-F31.x; Major Depressive Disorder: ICD-9 296.2x-296.3x; ICD-10 F32.x-F33.x; Anxiety/PTSD: ICD-9 300.x, 309.81, ICD-10 F40.x, F41.x, F42.x F44.x, F45.0x, F45.1x, F45.2x, F48.x, F43.1x; Other Serious Psychiatric Condition: ICD-9 296.82, 296.90, 296.99, 298.0-298.x, 297.0-297.x, 301.22, 301.83, ICD-10 F32.8, F33.8, F34.8, F23.x, F22.x, F24.x, F21.x, F60.3. These categories are not mutually exclusive.

Substance use disorder diagnosis is defined as having at least one visit with a diagnosis code from the HEDIS Chemical Dependency Value Set or one of the following diagnosis codes: ICD-9: 965.x 967.x 968.x 970.x 977.x, 969.4x, 969.5x, 969.6x, 969.7x, 969.8x, 969.9x, E85.0x, E85.1x, E85.2x, E85.3x, E85.4x, E85.5x, E85.6x, E85.7x, E85.8x, E98.00, E98.01, E98.02, E98.03, E98.04, E98.05; ICD-10: T39, T40, T41, T43.6x, T43.8x, T43.9x, X40, X41, X42, X43, X44, Y10, Y11, Y12, Y13, Y14.

Primary Care Utilization
Primary care utilization was defined by having uniquely dated claim with provider specialty code (7, 16, 28-30, 49, 171) and type of care delivered (2, 20, 23, 31, 33-38) delivered.

Screening mammograms
Screening mammograms were identified through CPT 76092, 77057, G0202, any GG modifier, G0203/05. Not coded as screening if included diagnostic mammogram code with CPT 76090, 76091, 77055, 77056, G0204, G0206, or if mammogram occurred within prior 9 months.

Exclusions during entire study period
• Breast cancer: ICD-9 code 174x, 233.0, V103, 611.72; ICD-10 code C50, D05, Z85.3, N63x.

Cervical Cancer Screening
Pap smears were identified through CPT codes: 88142-88155, 88164-88167, 88174, 88175, G0123, G0124, G0141, G0143, G0144, G0145, G0147, G0148, P3000, P3001, Q0091), ICD-9 codes (91.46, V76.2, V72.31, V72.32), or ICD-10 codes (Z12.4, Z01.411, Z01.419, Z01.42)

Exclusions during entire study period
• Cervical cancer: ICD-9 180, 180.0, 180.1, 180.8, 180.9; ICD-10 C53.0, C53.1, C53.8, C53.9
• Endometrial cancer: ICD-9: 182.0, 182.1; ICD-10: C54.1, C54.2, C54.3, C54.9

Colorectal Cancer Screening
Colonoscopy: CPT 45378 45380, 45382, 45383, 45384, 45385, HCPCS codes G0105, G0121; ICD-9 45.23, 45.25, 45.27, 45.41, 45.42, 45.43; ICD-10 0JD8ZZ, Z12.11, Z12.12.
Sigmoidoscopy: CPT 45300, 45303, 45305, 45308, 45309, 45315, 45320, 45330, 45331, 45332, 45333, 45334, 45337, 45338, 45339; HCPCS code G0104
Fecal occult blood test: CPT 82270, 82272, 82273, 82274, and HCPCS code G0107, G0328

Exclusions during entire study period
• Colorectal cancer: ICD-9 153.0, 153.1, 153.2, 153.3, 153.4, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, 230.3, 230.4, V10.05, V10.06; ICD-10 (C18.3, C18.4, C18.6, C18.7, C18.0, C18.2, C18.5, C18.8, C18.9, C19, C20, D01.0, D01.1, D01.2, Z85.038, Z85.048)

Exclusions within prior 3 months of testing
- Inflammatory bowel diseases: ICD-9 555.0, 555.1, 555.2, 555.9., 556.0, 556.1, 556.4, 556.9, 556.2, 556.6. 556.8, 556.5; ICD-10 (K50.00, K50.10, K50.80, K50.90, K51.80, K51.80, K51.40, K51.90, K51.2, K51.00, K51.80, K51.50
- Other conditions where colonoscopy might be plausibly be indicated: ICD-9 260x, 261x, 262x, 263x, 558.1, 560.2, 560.30, 560.39, 793.4, 783.21, 569.82, 558.1, 569.2, 569.41, 569.61, 569.62, 569.69, 569.81, 569.82, 596.1, 710.3, 863.44, 863.45, 936, 997.4, V44.3, V45.3, V55.3, V58.42, V58.49, V58.75, V67.0, V67.1, V67.9; ICD-10 E40x, E41, E43, E43, E44.0, E44.1, E45, E46, K52.0, K56.2, K56.49, R93.3, R63.4, K63.3, K52.0, K62.4, K62.6, K94.02 K94.12, K94.03, K94.13, K94.09, K94.19, K63.2, K63.3, N32.1, M33.90, S36.503A, S36.60XA, T18.3XXA, T18.4XXA, Z93.3, Z98.0, Z43.3, Z48.3, Z48.03, Z48.89, Z48.814, Z48.815, Z08, Z09
- Anemia: ICD-9 280.0, 280.1, 280.8, 280.9, 281.0, 281.8, 281.9, 285.1, 285.2, 285.9; ICD-10 (D50.0, D50.8, D50.1, D50.9, D51.0, D53.2, D53.8, D53.9, D62, D64.9
- Gastrointestinal bleeding: ICD-9 286.5, 459.0, 562.02, 562.03, 562.12, 562.13, 569.3, 569.84, 569.85, 569.86, 578.1, 578.9, 792.1, 998.11; ICD-10 R58, K57.11, K57.13, K57.31, K57.33, K62.5, K55.20, K55.21, K63.81, K92.1, K92.2, R19.5, D78.01, D78.02, D78.21, D78.22, E36.01, E36.02, E89.810, E89.811, G97.31, G97.32, G97.51, G97.52, H59.111, H59.112, H59.113, H59.119, H59.121, H59.122, H59.123, H59.129, H59.311, H59.312, H59.313, H59.319, H59.321, H59.322, H59.323, H59.329, H95.21, H95.22, H95.41, H95.42, I97.410, I97.411, I97.418, I97.42, I97.610, I97.611, I97.618, I97.620, J95.61, J95.62, J95.830, J95.831, K91.61, K91.62, K91.840, K91.841, L76.01, L76.02, L76.21, L76.22, M96.810, M96.811, M96.830, M96.831, N99.61, N99.62, N99.820, N99.821
- Constipation: ICD-9 (564.0, 564.00, 564.09, 564.01, 564.02; ICD-10 K59.00, K59.03, K59.04, K59.09, K59.01, K59.02
- Diarrhea: ICD-9 008.42, 008.43, 008.45, 008.5, 008.8, 009.0-009.3, 558.2, 558.3, 558.9, 564.4, 564.5, 564.8, 564.9, 787.91; ICD-10 A04.8, A04.5, A04.71, A04.72, A04.9, A08.8, A09, K52.1, K52.22, K52.29, K52.23, K52.89, K52.9, K91.89, K59.1, K59.9, R19.7
- Abdominal pain: ICD-9 789.0, 787.3, 789.4, 789.6; ICD-10 R14.0, R14.1, R14.2, R14.3
- Ischemic bowel disease: ICD-9 557.0, 557.1, 557.9; ICD-10 K55.011, K55.012, K55.019, K55.021, K55.022, K55.029, K55.031, K55.032, K55.039, K55.041, K55.042, K55.049, K55.051, K55.052, K55.059, K55.061, K55.062, K55.069, K55.30, K55.31, K55.32, K55.33, K55.1, K55.9
- Irritated bowel syndrome: ICD-9 564.1; ICD-10 K58.1, K58.2, K58.8, K58.9
- Bowel habits change: ICD-9 787.99; ICD-10 R19.4, R19.8
- Hemorrhoids: ICD-9 455x; ICD-10 K64.8, K64.4, K64.5, K64.9, K64.8
- Weight loss: ICD-9 783.2, 783.7; ICD-10 R62.7
- Diverticulitis: ICD-9 562.11; ICD-10 K57.32
- Barium enema: CPT codes 74270, 74280, HCPCS codes G0106, G0120, G0122; ICD-9-CM 87.64; ICD-10 PCS BD14YZZ, BD14ZZZ
- Abdominal computerized tomographic scan: CPT codes 72191, 72192, 72193, 72194, 74150, 74160, 74170, 74175, 75635, 74261, 74262, 74263; ICD-9-CM procedure codes 88.01, 88.02; ICD-10 BW2000Z, BW200ZZ, BW2010Z, BW201ZZ, BW20Y0Z, BW20YZZ, BW20ZZZ

Procedure and diagnostic codes were obtained from
- Fenton, J.J., et al., *Distinguishing screening from diagnostic mammograms using Medicare claims data.* Med Care, 2014. **52**(7): p. e44-51.
- Maroongroge, S. and J.B. Yu, *Medicare Cancer Screening in the Context of Clinical Guidelines: 2000 to 2012.* Am J Clin Oncol, 2018. **41**(4): p. 339-347.
- 13. Halpern, M.T., et al., *Impact of state-specific Medicaid reimbursement and eligibility policies on receipt of cancer screening.* Cancer, 2014. **120**(19): p. 3016-24.

Online Supplement B. Weight Calculations

Treatment Weights

At each person-year observation, the estimated treatment weight was calculated as such: Let A_{ij} denote an individual *i's* treatment assignment (BHH enrollment) at time period *j (A_ij=1 indicates individual i is enrolled at time j, and A_ij=0 otherwise)*. Let L_{ij} denote the vector of time-invariant and time-varying confounders observed for subject *i* at time period *j*. Let $\bar{L}_{ij}$ and $\bar{A}_{ij}$ represent the *i*th individual's observed covariate and treatment history up through time *j*. The weight for each person 1-year observation was defined as:

$$TW_i(t) =$$
$$\left(\prod_i(j=1)^t t\cong [\![P_{ij}(A_{1ij}\dashv\!\mid A^\neg_1(i,j-1))]\!]\right)/\left(\prod_i(j=1)^t t\cong [\![P_{ij}(A_{1ij}\dashv\!\mid A^\neg_1(i,j-1), \quad L^\neg_{1ij})]\!]\right)$$

Each term in the numerator was the conditional probability of the *i*th individual receiving their assigned treatment (BHH enrollment or not), given past treatment assignment. Each term in the denominator was the conditional probability of the *i*th individual receiving their assigned treatment, given past treatment assignment and the observed time-invariant and time-varying covariates up until time j.

Censoring Weights

At each person-year observation, the estimated censoring weight was calculated as such: Let C_{ij} denote if individual i is censored in time period j+1 *(C_ij=1 indicates individual i is censored in time period j+1, and A_ij=0 otherwise)*. Let L_{ij} denote the vector of time-invariant and time-varying confounders observed for subject *i* at time period *j*. Let $\bar{L}_{ij}$ and $\bar{A}_{ij}$ represent the *i*th individual's observed covariate and censoring history up through time *j*. The weight for each person 1-year observation was defined as:

$$CW_i(t) =$$
$$\left(\prod_i(j=1)^t t\cong [\![P_{ij}(C_{1ij}\dashv\!\mid C^\neg_1(i,j-1))]\!]\right)/\left(\prod_i(j=1)^t t\cong [\![P_{ij}(C_{1ij}\dashv\!\mid C^\neg_1(i,j-1), \quad L^\neg_{1ij})]\!]\right)$$

Each term in the numerator was the conditional probability of the *i*th individual receiving their assigned censoring status, given past censoring. Each term in the denominator was the conditional probability of the *i*th individual receiving their assigned censoring status given past censoring and the observed time-invariant and time-varying covariates up until time j.

Confounders

Observed time-invariant confounders in both treatment and censoring weights included: i) baseline age, ii) sex, iii) race/ethnicity, iv) psychiatric diagnosis, v) population size of psychiatric rehabilitation program where the individual received the plurality of their psychiatric rehabilitation services, vi) region of residence, and vii) indicator for enrollment in one of eight possible Medicaid managed care organizations. Observed time-varying variables included: i) eligibility for Medicaid via disability, ii) substance use disorder diagnosis, iii) co-morbidity (measured via Charlson index), iv) number of psychiatric rehabilitation services received, vii) number of psychiatric and substance use hospital admissions, viii) number of somatic hospital admissions, ix) number of primary care visits, and x) receipt of cancer screening during baseline. Time-varying variables were measured in the pre-intervention period (October 2012 -September 2013) and during each one year period throughout the study. To ensure these variables were measured prior to the outcomes and exposure of a given time period they were lagged by one time-period.

Final Weights

The final weight for any given person year observation was the product of the censoring and treatment weight.

STATA code was adapted from Fewell, Z., et al., *Controlling for Time-dependent Confounding using Marginal Structural Models.* 2004. **4**(4): p. 402-420.

Online Supplement C. Unweighted demographic characteristics of BHH and comparison participants

Table C1: Unweighted baseline demographics for cancer screening study populations, stratified by health home enrollment status

	Full Sample (n=12,176)		Cervical Cancer Screening Study Population (n=6,811)		Breast Cancer Screening Study Population (n=1,658)		Colorectal Cancer Screening Study Population (n=3,430)	
	Enrolled in HH (n=3,298)	*Not Enrolled in HH (n=8,878)*	*Enrolled in HH (n=1,456)*	*Not Enrolled in HH (n=5,355)*	*Enrolled in HH (n=517)*	*Not Enrolled in HH (n=1,141)*	*Enrolled in HH (n=1,181)*	*Not Enrolled in HH (N=2,249)*
Mean age, years (SD)	43.7 (11.2)	40.5(11.2)**	44.4 (10.8)	39.6 (11.1)**	54.4 (3.1)	54.1 (3.1)*	54.4 (3.0)	54.1 (3.0)*
Female, %	44.9	60.9**	---	---	---	---	46.1	54.9**
Race, %								
Black	45.6	59.6**	44.8	63.2**	42.9	59.5**	44.5	57.2**
White	47.3	35.5**	48.2	33.0**	50.1	37.0**	50.2	38.8**
Other	7.1	4.9**	7.0	3.8**	7.0	3.5*	5.2	4.0
Charlson Index (SE)	.9 (.02)	.8 (.01)*	1.1 (0.02)	0.9 (0.01)**	1.4 (0.04)	1.3 (0.03)	1.2 (0.02)	1.2 (0.01)
Primary Psych Diagnosis, %								
Schizophrenia	63.6	36.4**	50.1	26.4**	53.4	37.5**	66.3	44.4**
Bipolar disorder	23.8	36.2**	31.9	41.8**	25.7	30.4**	18.3	27.7**
Major depressive disorder	11.8	26.4**	17.5	31.0**	20.3	31.4**	14.6	27.0**
Substance Use Disorder	21.7	27.6**	21.8	25.2*	19.5	25.7*	20.8	29.0**
Medicaid Disability, %	86.2	58.2**	79.0	47.0**	88.0	71.8**	90.9	73.7**
MD Residence, %								
Baltimore City	21.1	42.4**	21.7	44.6**	19.5	42.3**	21.4	43.3**
Baltimore Surrounding	31.1	23.4**	32.4	23.7**	34.0	21.9**	32.6	22.1**
Northwest	9.9	7.3**	9.0	6.9*	7.7	6.7	8.0	6.0*
National Capitol Area	18.0	16.1*	13.3	14.5*	13.0	17.8*	17.0	17.7
Other	19.9	10.8**	23.6	10.3**	25.8	11.3**	21.0	10.9**
Health System Utilization								
Psychiatric admissions (SE)	.25 (.01)	.16 (.005)**	.22 (.01)	.14 (.004)**	.15 (.01)	.13 (.008)	.14 (.01)	.15 (.01)
Somatic admissions (SE)	.15 (.01)	.15 (.004)	.19 (.01)	.17 (.004)	.21 (.01)	.22 (.01)	.19 (.01)	.22 (.01)*
PRP services received (SE)	9.8 (.07)	5.1 (.04)**	8.6 (0.09)	4.6 (0.04)**	9.6 (0.14)	6.2 (0.09) **	10.4 (0.07)	6.5 (0.06)**
Primary care visits (SE)	5.1 (.07)	5.4 (.05)**	6.6 (0.10)	6.2 (0.05) *	6.5 (0.15)	6.6 (0.11)	5.4 (0.07)	6.2 (0.06)*

Wald chi-square tests were used to compare differences in groups with * p<0.05, **p<0.001.

Table C2: Baseline characteristics of individuals, stratified by whether PRP implemented BHH and whether consumer enrolled n BHH

	Intervention	Control	
	Enrolled in PRP that implemented BHH and enrolled in HH	**Enrolled in PRP that implemented BHH but never enrolled in BHH**	**Enrolled in PRP that did not implement BHH; never enrolled in BHH**
	N=3298	N=3040	N=5838
Mean age, years (SD)	43.6 (11.2)**	41.1 (11.3)	40.0 (11.2)
Female, %	44.5**	52.1	65.3
Race, %			
Black	46.0**	50.4	64.6
White	46.9**	43.1	31.4
Other	7.1	6.5	4.0
Charlson Index (SE)	.89 (.01)**	.78 (.01)	.87 (.01)
Primary Psych Diagnosis, %			
Schizophrenia	63.5**	47.9	30.6
Bipolar disorder	23.9**	31.3	38.3
Major depressive disorder	11.9*	19.2	29.7
Substance Use Disorder	21.7*	20.4	31.3
Medicaid Disability, %	86.2**	72.0	51.2
Health System Utilization			
Psychiatric admissions (SE)	.25 (.009)**	.17 (.007)	.16 (.006)
Somatic admissions (SE)	.15 (.006)*	.12 (.005)	.17 (.006)
PRP services received (SE)	9.9 (.07)**	7.4 (.07)	4.04 (.04)
Primary care visits (SE)	4.2 (.06)*	4.3 (.06)	4.8 (.05)

Wald chi-square tests were used to compare differences in the groups enrolled in a PRP that implemented PRP (enrolled in BHH vs not enrolled in BHH) with * $p<0.05$, **$p<0.001$.


Table C3: Differences in size of PRP that implemented behavioral health homes compared with those that did not implement behavioral health homes.

	Total psychiatric rehabilitation programs		Psychiatric rehabilitation program that implemented BHH		Psychiatric rehabilitation program that did NOT implement BHH	
	N=145	%	N=53	%	N=92	%
Size of PRP by quartiles						
Small (5-290 clients)	100	69.0	18	34.0	82	89.2
Medium (298-523 clients)	25	17.2	20	37.7	5	5.4
Large (532-1039 clients)	13	9.0	8	15.1	5	5.4
Very Large (1099-1726 clients)	7	4.8	7	13.2	0	0.0

Figure C1: Absolute standardized mean difference in baseline covariates between BHH and non-BHH participants in the weighted and unweighted cervical cancer study population, averaged over one year intervals.
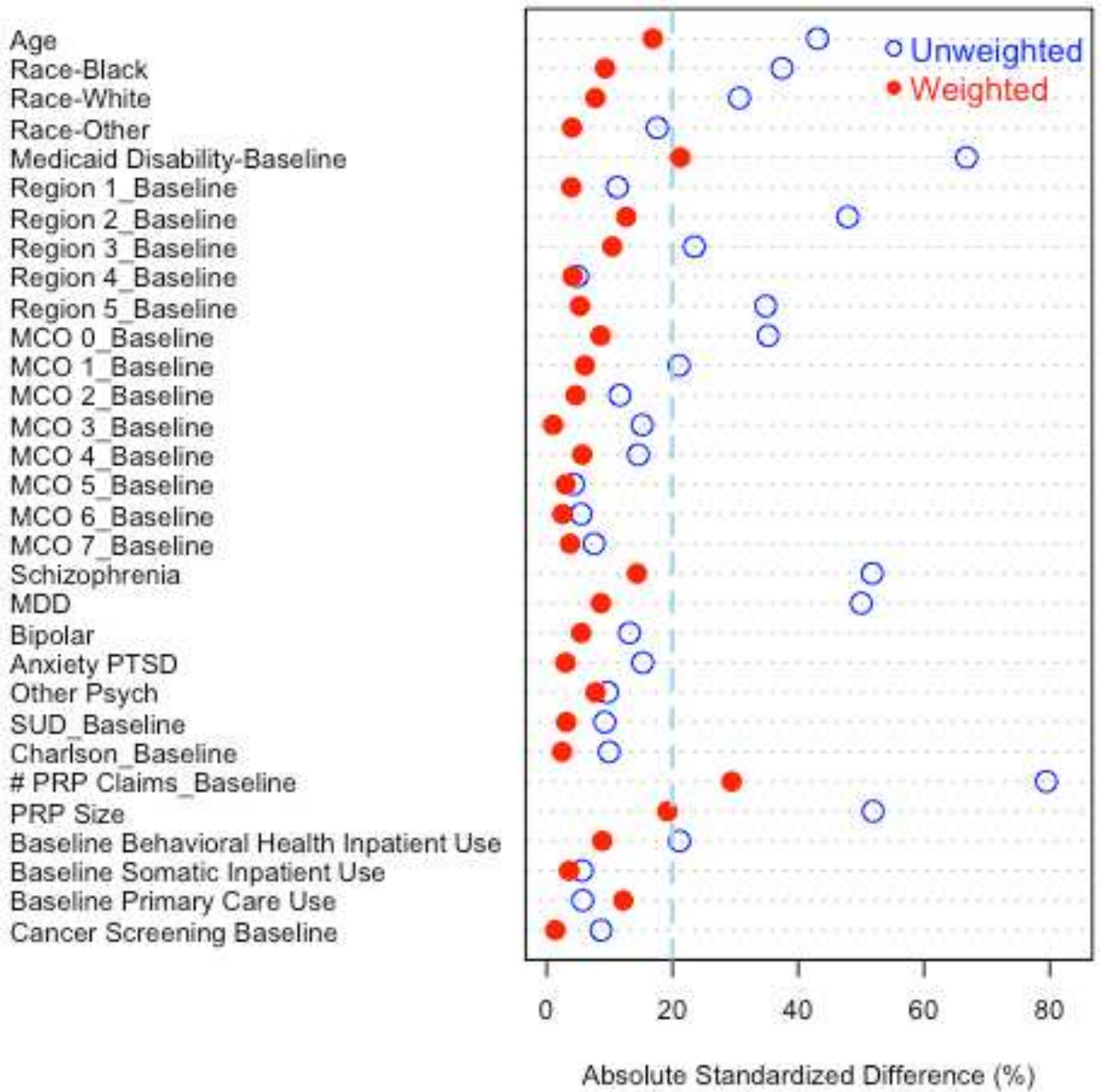
Figure C2: Absolute standardized mean difference in baseline covariates between BHH and non-BHH participants in the weighted and unweighted breast cancer study population, averaged over one year intervals.
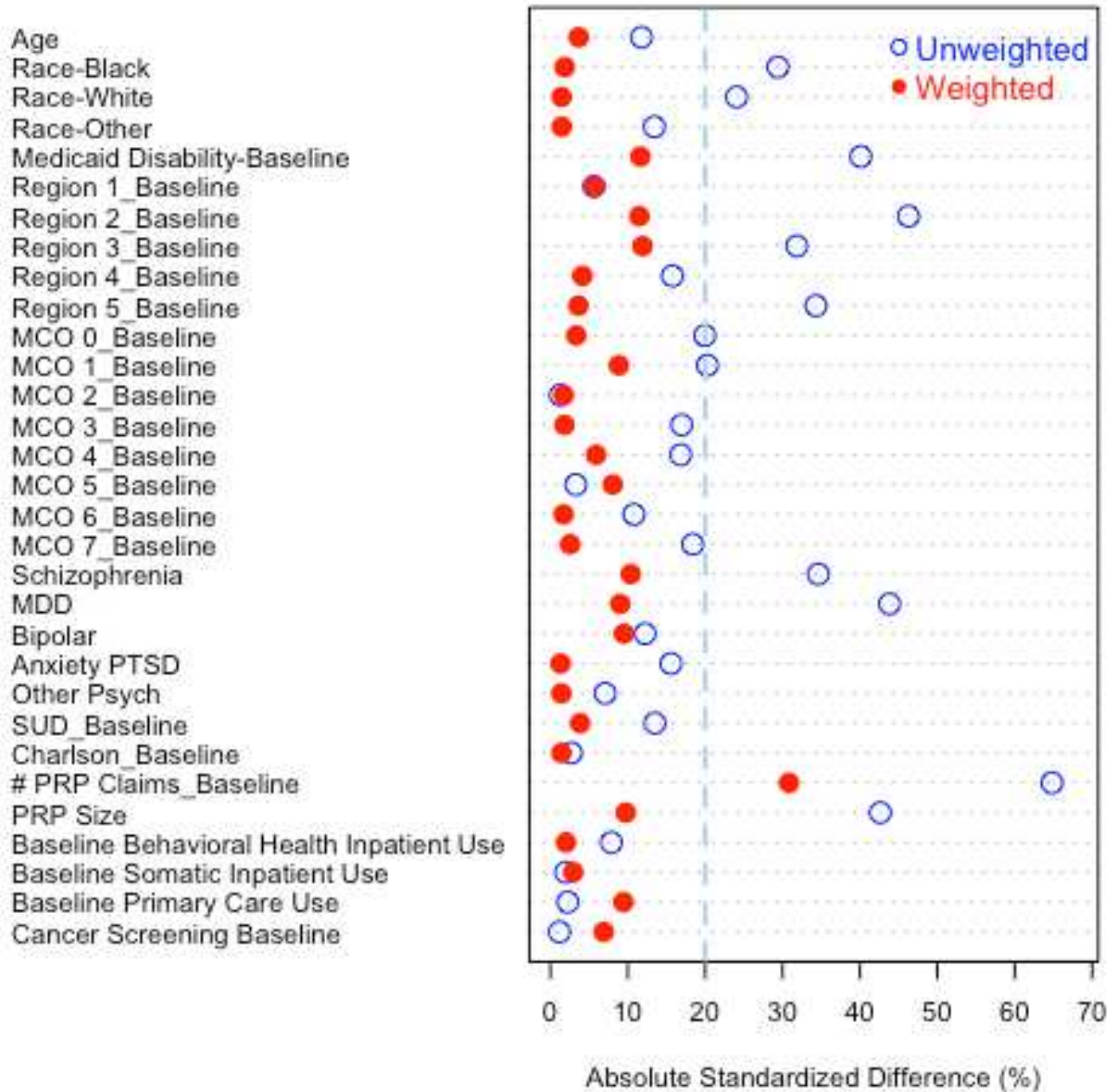
Figure C3: Absolute standardized mean difference in baseline covariates between BHH and non-BHH participants in the weighted and unweighted colorectal cancer study population, averaged over one year intervals.
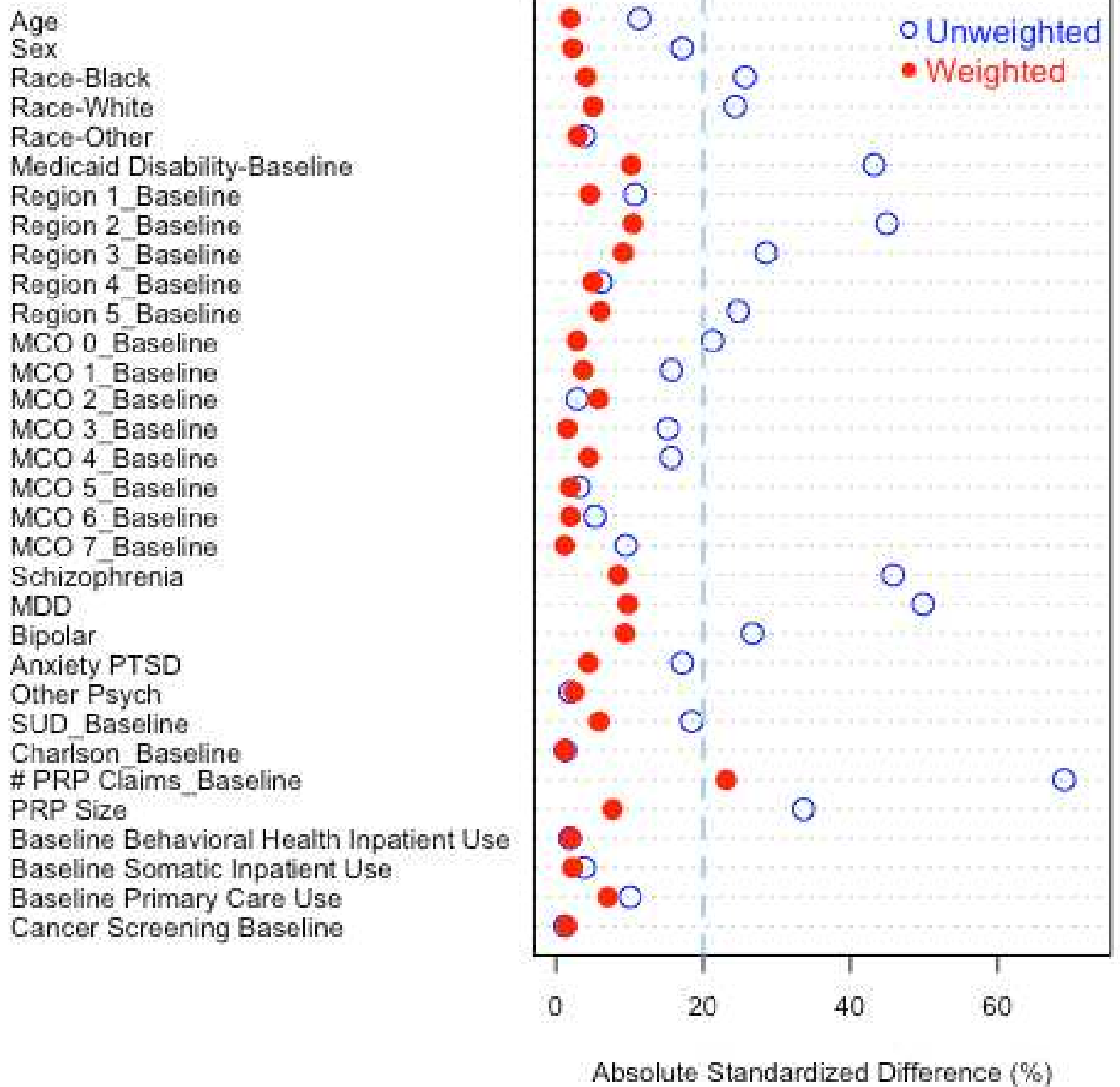
Online Supplement D: Sensitivity Analyses

Table D1: Beta coefficient and p-values to test for interaction between enrollment in behavioral health home status and participant characteristics.

	Beta coefficient	95% CI	p-value
Cervical Cancer			
Primary psychiatric diagnosis			
Schizophrenia	-.003	-.05-.05	.89
Bipolar disorder	.009	-.04-.06	.74
Major depressive disorder	.0006	-.06-.06	.98
Substance use disorder, baseline	.03	-.03-.09	.28
Health system utilization			
PRP utilization (high vs low)	**-.07**	**-.12- -.03**	**.003**
PCP visits (high vs low)	.0008	-.05-.05	0.98
PRP size (>500 clients vs ≤500 clients)	0.000003	-.05-.05	1.00
Breast Cancer			
Primary psychiatric diagnosis			
Schizophrenia	**-.095**	**-.17- -.02**	**.02**
Bipolar disorder	.07	-.02-.17	.12
Major depressive disorder	.04	-.05-.13	.42
Substance use disorder, baseline	-.04	-.12-.06	.46
Health system utilization			
PRP utilization (high vs low)	-.0002	-.08-.08	.99
PCP visits (high vs low),	.01	-.06-.09	.76
PRP size (>500 clients vs ≤500 clients)	.0003	-.08-.08	1.00
Colorectal Cancer			
Sex (Female vs male)	-.005	-.04-.03	.76
Primary psychiatric diagnosis			
Schizophrenia	.005	-.03-.04	.76
Bipolar disorder	.03	-.01-.07	.19
Major depressive disorder	-.03	-.07-.01	.14
Substance use disorder	**.06**	**.03-.10**	**.001**
Health system utilization			
PRP utilization (high vs low)	-.03	-.06-.01	.18
PCP visits (high vs low)	.02	-.009-.05	.16
PRP size (>500 clients vs ≤500 clients)	.004	-.03-.04	.79

Table D2: Predicted cancer screening rates with adjustment for participant and psychiatric rehabilitation program characteristics for participants where testing may not have been for routine screening and over multi-year intervals.

	Enrolled in BHH versus Not enrolled in BHH			Enrolled in BHH		Not enrolled in BHH	
	Odds Ratio	*95% CI*	*p-value*	*Predicted Annual Rate*	*95% CI*	*Predicted Annual Rate*	*95% CI*
Cervical Cancer							
Inclusion of women with history of cervical or endometrial cancer,	1.21	1.08-1.37	**.001**	31.2	28.9-33.5	27.2	26.4-28.0*
Had any pap test within 3 year interval (2014-2016)	1.18	1.02-1.37	**.03**	59.2	55.9-62.6	55.1	53.7-56.4*
Breast Cancer							
Inclusion of women with history of breast cancer	1.35	1.11-1.63	**.002**	28.8	25.3-32.3	23.1	21.5-24.7*
Had screening within 2 year interval (2015-2016)	1.32	1.02-1.69	**.03**	43.2	37.8-48.7	36.7	33.9-39.5*
Colorectal Cancer							
Inclusion of individuals with history of colorectal cancer or warning signs	.96	.82-1.11	.56	12.4	11.0-13.8	12.9	12.0-13.8
Colonoscopy	1.08	.93-1.26	.32	11.3	10.0-12.6	10.6	9.8-11.3
Sigmoidoscopy	1.73	.46-6.56	.42	.2	.0-.5	.1	.0-.2
Fecal occult blood test	1.06	.77-1.44	.74	3.6	2.7-4.6	3.4	2.9-4.0)
Had CRC test within 3 year interval (2014-2016)	.94	.79-1.12	.53	29.4	26.3-32.6	30.6	28.7-32.6
Colonoscopy	1.03	.86-1.23	.74	27.8	24.7-30.9	27.2	25.4-29.1
Sigmoidoscopy	1.10	.24-4.83	.92	.4	.0-1.1	.4	.2-.7

Effects of behavioral health home (BHH) enrollment were estimated using marginal structural models. Results of logistic regression analysis are at the person-year level, with Pr(Outcome Event$_{ij}$)= B$_0$ + B$_1$(HealthHome$_{ij}$) + B$_2$(year), where HealthHome$_{ij}$ represents any BHH enrollment in a given person-year period. Wald chi-square tests were used to compare differences in groups with * p<0.05.