Mathematica
Progress Together

Why Dually Eligible Beneficiaries Stay or Leave Integrated Care Plans

Appendix A:

Technical appendix for quantitative analyses

January 15, 2021

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1. Medicare Advantage quality and experience of care measure selection

We obtained Medicare Advantage (MA) quality and experience of care performance data for contracts operating from 2015 to 2018 from the Centers for Medicare & Medicaid Services' (CMS') Part C and D Star Ratings data tables (final spring release versions for 2017, 2018, 2019, and preliminary fall release version for 2020, the latest available data when we constructed the analytic file). To select quality and experience measures for descriptive and regression analyses, we selected measures that met most or all of the following criteria:

1. They were used in the Star Ratings program in all four years.
2. They had fewer than 20 observations with missing data among the Dual Eligible Special Needs Plan (D-SNP) dominant MA contracts.
3. They were not highly correlated with other measures in the same domain, which we determined based on a correlation coefficient of 0.5 or greater, indicating strong correlation. Limiting the measures to those that were not highly correlated reduces the risk of multicollinearity, which would result in imprecise estimates of effect sizes and unreliable *p*-values for affected variables. Allowing for multicollinearity would make it difficult to interpret which variables have the largest and most significant impact on the voluntary disenrollment rate (VDR).
4. They were not topped out. We defined topped out as a minimum rate greater than 75 percent and a mean of 85 percent or higher. Excluding measures that met both criteria ensured that there would be sufficient information to distinguish high-performing contracts from low-performing contracts when determining the association of quality performance with VDR.
5. They had sufficient variation in rates, indicated by a ratio of the standard deviation to the mean of at least 1. This level of variation indicates that there is sufficient heterogeneity in performance across contracts.

When possible, we strove to include at least one or two measures from a majority of the Star Ratings measure domains to capture a variety of factors that are important to Medicare beneficiaries.

Exhibit A.1. Medicare Part C and Part D Star Ratings measures used in descriptive and regression analyses

	Measure developer	Data source	Measure definition
HD1: Staying Healthy: Screenings, Tests and Vaccines			
Breast Cancer Screening	NCQA/HEDIS	Administrative	Percent of female plan members aged 52-74 who had a mammogram during the past 2 years. Data reflect services provided two calendar years prior to the Star Ratings year.
Annual Flu Vaccine	NCQA/HEDIS	CAHPS survey	Percent of sampled Medicare enrollees (denominator) who received an influenza vaccination prior to the flu season during the measurement year (numerator). Survey data are based on the four-month period when the survey was fielded (for the 2018 measurement period, between March 1, 2017 and June 30, 2017).
HD2: Managing Chronic (Long Term) Conditions			
Care for Older Adults – Functional Status Assessment[a]	NCQA/HEDIS	Hybrid claim/encounter data and medical record documentation	Percent of plan members whose doctor has done a functional status assessment to see how well they are able to do "activities of daily living" (such as dressing, eating, and bathing). This measure is collected only for Special Needs Plans, which may be one of three types: (1) Dual SNPs; (2) Chronic Condition SNPs and (3) Institutional SNPs. Data reflect services provided two calendar years prior to the Star Ratings year.
Diabetes Care – Blood Sugar Controlled	NCQA/HEDIS	Administrative	Percent of plan members with diabetes who had an HbA1c lab test during the year that showed their average blood sugar is under control, as evidenced by an HbA1c level of less than or equal to 9%. Data reflect services provided two calendar years prior to the Star Ratings year.
Plan All-Cause Readmissions[b]	NCQA/HEDIS	Administrative	Percent of senior plan members discharged from a hospital stay who were readmitted to a hospital within 30 days, either for the same condition as their recent hospital stay or for a different reason. Data reflect services provided two calendar years prior to the Star Ratings year.
HD3: Member Experience with Health Plan			
Rating of Health Plan	NCQA/HEDIS	CAHPS survey	Percent of the best possible score the plan earned from members who rated the health plan. This measure is case-mix adjusted, and the score uses the mean of the distribution of responses converted to a scale from 0 to 100.
HD4: Member Complaints and Changes in the Health Plan's Performance			
Complaints about the Health Plan[b]	CMS	Administrative	Rate of complaints about the health plan per 1,000 members, based on complaints logged into the Complaint Tracking Module. Data reflect services provided two calendar years prior to the Star Ratings year.

	Measure developer	Data source	Measure definition
DD1: Drug Plan Customer Service			
Appeals Auto-Forward[b]	CMS	Independent Review Entity	Rate of drug appeal cases auto-forwarded to the Independent Review Entity (IRE) because the plan exceeded decision timeframes for coverage determinations or redeterminations, per 100,000 plan members. Data reflect services provided two calendar years prior to the Star Ratings year.
DD4: Drug Safety and Accuracy of Drug Pricing			
MTM Program Completion Rate for CMR	CMS	Part D Plan Reporting and Medicare Enrollment Database File	Percent of Medication Therapy Management (MTM) program enrollees who received a Comprehensive Medication Review (CMR) during the reporting period. Data reflect services provided two calendar years prior to the Star Ratings year.

Source: Medicare 2018 Part C & D Star Ratings Technical Notes, available at https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovGenIn/Downloads/2018-Star-Ratings-Technical-Notes-2017_09_06.pdf.

[a] This measure is specific to Medicare D-SNPs.

[b] Lower rates indicate better performance.

CAHPS = Consumer Assessment of Healthcare Providers and Systems survey; CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Special Needs Plan; HEDIS = Healthcare Effectiveness Data and Information Set; MA = Medicare Advantage; NCQA = National Committee for Quality Assurance.

2. Definition of regression control variables

This appendix provides details on how we constructed the regression control variables, some of which we also include in descriptive analyses of the characteristics of D-SNP dominant MA contracts in the sample. We also provide the means for regression control variables.

- **Year indicators.** We included contracts that operated in 2015, 2016, 2017 or 2018.
- **Total MA enrollment in the contract greater than or equal to the 75th percentile across contracts (11,841 enrollees).** We obtained these data from the CMS Monthly Enrollment by Plan Reports.
- **Number of D-SNPs in the state per 100,000 dually eligible beneficiaries.** To construct this variable, we obtained the number of D-SNPs per state in each year from the July 2015, 2016, 2017, and 2018 SNP Comprehensive Reports. We divided the number of D-SNPs by the number of dually eligible beneficiaries (in 100,000) per state, which we obtained from the June 2015, 2016, 2017, and 2018 Medicare-Medicaid enrollment snapshots. Using this approach, we obtained one value for each state in each year. Most contracts had enrollees in a single state during a year; for the 11 observations that included multiple states in the same year, we assigned to the observation the value corresponding to the state in which the plurality of the contract's enrollees resided. We included this measure because the number of D-SNPs may indicate how attractive or profitable the market is for D-SNPs in that state. Difficulty attracting D-SNPs may be negatively associated with integration (because states may be reluctant to add integration requirements that could discourage entry of new D-SNPs) and negatively associated with VDR (because there are fewer other D-SNPs for enrollees to choose from).
- **Whether the contract consisted of only D-SNP enrollees.** This reflects whether a D-SNP dominant contract was 100 percent D-SNP or included some non-D-SNP enrollees (70 to 99 percent D-SNP). We rounded to the nearest whole number, so one contract with greater than 69.5 percent D-SNP enrollees is defined as D-SNP dominant. We included this measure because contracts that include some non-D-SNP enrollees may be different in unmeasured ways from contracts that consist solely of D-SNP enrollees in ways that are related to VDR, for example, by enrolling higher shares of Medicare-only (non-dual) beneficiaries who are subject to higher cost-sharing than dual enrollees.
- **Whether the parent organization (owner) of the contract was a for-profit entity.** This variable was based upon the for-profit/nonprofit status of the parent company owner, as extracted from the July 2015, August 2016, July 2017, and July 2018 MA Plan Directories. We included this measure to account for economic incentives in the MA market and how those may translate to quality and experience of care for beneficiaries enrolled in the contract. For example, a for-profit parent organization has a stronger incentive to reduce costs or increase revenues than a nonprofit organization. To reduce costs, the parent organization might restrict access to unprofitable services or drugs, leading to increases in the VDR.
- **Urbanicity.** We defined urbanicity based on the National Center for Health Statistics' (NCHS) county-level urban–rural classification scheme for 2013, which was the latest year available at the time of this report. NCHS identifies the following six types of areas: large central metropolitan area (assigned a value of 1); large fringe metropolitan area; medium metropolitan area; small metropolitan area; micropolitan area; and non-core area (assigned a value of 6). We assigned to each parent organization a single value of urbanicity per year per state based on a weighted average of the urbanicity in counties where the parent organization had enrollment. We rounded the result to 1, 2, 3, 4, 5, or 6. For example, if a parent organization had contracts that totaled 10,000 enrollees in New

Jersey in 2015, and it had 8,000 enrollees in County A that was in a large fringe metropolitan area and 2,000 enrollees in County B that was in a medium metropolitan area, then the value of urbanicity for all contracts owned by that parent organization in New Jersey in 2015 would be (0.8*2) + (0.2*3) = 2.2, which we would have rounded to 2 (large fringe metropolitan area). In the regression, we collapsed the six categories into three: (1) large central or large fringe metropolitan area (65 percent of observations); (2) medium or small metropolitan area (31 percent); and (3) micropolitan or non-core area (4 percent). We included this variable as a measure of the urbanicity of the MA market in the counties where the contract operates and because there may be differences across contracts in enrollees' characteristics or the breadth of the provider network related to urbanicity. We could not include urbanicity as a control variable in the primary regression specification because urbanicity was too highly correlated with the variable measuring whether total MA enrollment was at or above the 75th percentile. As we describe in Appendix A.6, we estimated a sensitivity analysis that used a continuous measure of total MA enrollment, and we included urbanicity as a control variable in that sensitivity analysis.

- **An indicator of whether the contract's parent organization operated in markets where MA enrollment was highly concentrated**, indicated by its Herfindahl-Hirschman Index (HHI) in the year. A highly concentrated market is characterized by a small number of parent organizations enrolling a large share of MA enrollees who live in that market. We included this measure because in markets that are highly concentrated, there are generally fewer MA plans to choose from, which means beneficiaries might have less incentive or fewer opportunities to change to a different MA plan—potentially leading to a lower VDR. For each parent organization, we calculated a single value of the HHI per state per year based on the weighted average of the level of market concentration in counties where the parent organization had enrollees. The HHI measure ranged from 0 to 10,000, where an HHI of 0 indicates no market concentration, 1,500 to 2,499 indicates a moderately concentrated market, 2,500 or larger indicates a highly concentrated market, and an HHI of 10,000 indicates a market monopolized by a single MA Parent Organization (U.S. Department of Justice 2018). The higher the market concentration, in most cases, the lower the competition faced by the parent organization. For the regression, we constructed a variable indicating whether the parent organization of the D-SNP dominant contract had a weighted HHI of 2,500 or larger as follows:

  1. First, based on previous work by Adrion (2019), we calculated the number of MA enrollees per county per year for each parent organization as $MA\ enrollees_{pcst}$ where p indicates the parent organization, c indicates the county, s indicates state, and t indicates the year. We chose the parent organization (rather than the contract) as the level of the firm since there may be economies of scale for a parent organization that has multiple contracts in the same area. Also, we used all MA enrollees rather than limiting to D-SNP enrollees because D-SNPs and non-D-SNPs compete for enrollment among dually eligible beneficiaries.
  2. We then calculated the market size per county per year by counting the total number of MA enrollees for all parent organizations as $MA\ enrollees_{cst}$.
  3. We calculated the market share for each parent organization per county per year as MS_{pcst} by dividing the number of MA enrollees for each parent organization by the market size. MS_{pcst} summed to one for all parent organizations per county per year.

$$MS_{pcst} = \frac{MA\ enrollees_{pcst}}{MA\ enrollees_{cst}}$$

4. We calculated the sum of the squared market share for all parent organizations per county per year (H_{cst}). At this stage, all contracts in a county in a year had the same value of the HHI (H), regardless of the parent organization.

$$H_{cst} = \sum_{p=1}^{n} MS_{pcst}^2$$

5. We calculated the weighted value of the HHI for each contract per county per year (H_{pcst}) by multiplying the sum of the squared market share for all parent organizations with the share of the parent organization's enrollees per state per year that were in a given county.

$$H_{pcst} = H_{cst} \frac{MA\ enrollees_{pcst}}{MA\ enrollees_{pst}}$$

6. We calculated the final measure by summing the weighted value of the HHI across all counties per state per year for each parent organization.

$$H_{pst} = \sum_{c=1}^{n} H_{pcst}$$

7. We created a variable indicating whether the parent organization of the D-SNP dominant contract had a weighted HHI of 2,500 or larger in that state in that year (H_{pst}); this measure had the same value for all contracts owned by a parent organization in a state in a year. For the 11 contract-year observations that included multiple states in the same year, we assigned to the observation the value of the HHI for the state that accounted for the plurality of enrollees. For a regression sensitivity analysis, we created a three-level measure of the extent to which the parent organization operated in markets with high market concentration—that is, where a few firms enroll large shares of MA enrollees. We identified observations where the level of concentration was (1) below the 25th percentile for all observations in the sample (HHI of 1,916), (2) at or above the 25th percentile but below the 75th percentile (HHI of 3,113), and (3) at or above the 75th percentile. About 60 percent of observations in markets with the lowest level of market concentration (below 1,916) had a value of 1,500 or higher, which indicates that the MA parent organization operated in markets that were moderately concentrated; the remaining 40 percent of observations in the lowest level of market concentration had a value of less than 1,500.

Exhibit A.2. Mean values of control variables used in regression for D-SNP dominant MA contracts, 2015 to 2018 (n = 207)

Control variable	Mean
Total MA enrollment	
Total MA enrollment was at or above 75th percentile for all contract-year observations in the sample (11,841)[b]	10.6
D-SNPs per 100,000 dually eligible beneficiaries in the state	5.5
Percentage of contract-year observations in the sample by year	
2015	22.7
2016	23.7
2017	26.1
2018	27.5
Percentage of contract-year observations that consisted of only D-SNP enrollees (100 percent D-SNP)	75.9
Percentage of contract-year observations whose parent organization was for-profit	65.7
Percentage of contract-year observations whose parent organization operated in markets where MA enrollment is highly concentrated	42.0
Percentage of contract-year observations missing Star Ratings measure	
Breast Cancer Screening	3.8
Care for Older Adults – Functional Status Assessment	1.5
Plan All-Cause Readmissions	5.3
Appeals Auto-Forward— Drug plan fails to make timely decisions about appeals	1.0

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Notes: The model also included an interaction term between the level of Medicaid integration and whether the observation had total MA enrollment at or above the 75th percentile of all observations in the sample. We do not report means for urbanicity in this table because we did not include that control variable in the primary regression model.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage.

3. Comparing characteristics of three types of MA contracts

This appendix provides additional exhibits describing characteristics of D-SNP dominant, D-SNP non-dominant, and non-D-SNP contracts.

Exhibit A.3. Mean VDR and number of observations by contract type, 2015 to 2018

	D-SNP dominant		D-SNP non-dominant		No D-SNP enrollees	
	Mean	N	Mean	N	Mean	N
Overall	**11.4**	**223**	**12.6**	**380**	**10.1**	**896**
2015	10.7	51	13.0	98	10.2	219
2016	10.6	53	13.3	96	9.4	221
2017	11.9	58	10.9	90	9.2	210
2018	12.2	61	12.9	96	11.5	246

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = voluntary disenrollment rate

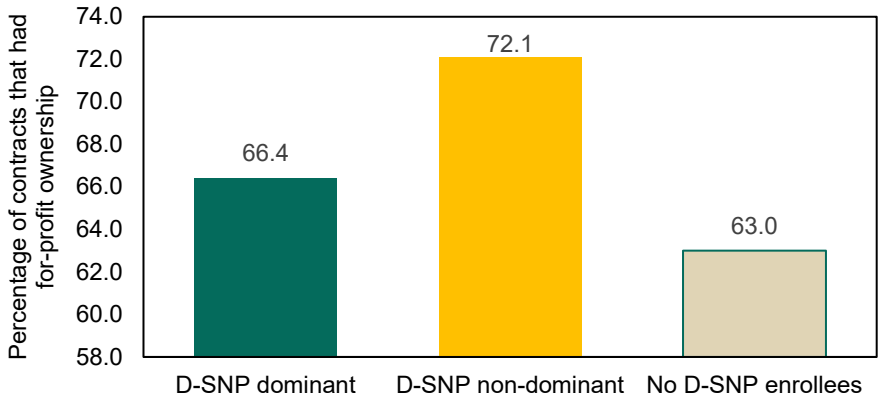
Exhibit A.4. Distribution of enrollment by contract type, 2015 to 2018

	D-SNP dominant	D-SNP non-dominant	No D-SNP enrollees
Minimum	563	801	216
10th percentile	1,174	4,517	1,669
25th percentile	2,146	10,990	4,213
Median	7,016	37,848	14,255
Mean	10,681	74,490	41,736
75th percentile	12,927	90,733	39,064
90th percentile	24,433	166,700	85,622
Maximum	82,781	1,163,885	1,264,670

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage.

Exhibit A.5. Percentage of contracts that had for-profit ownership, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage.

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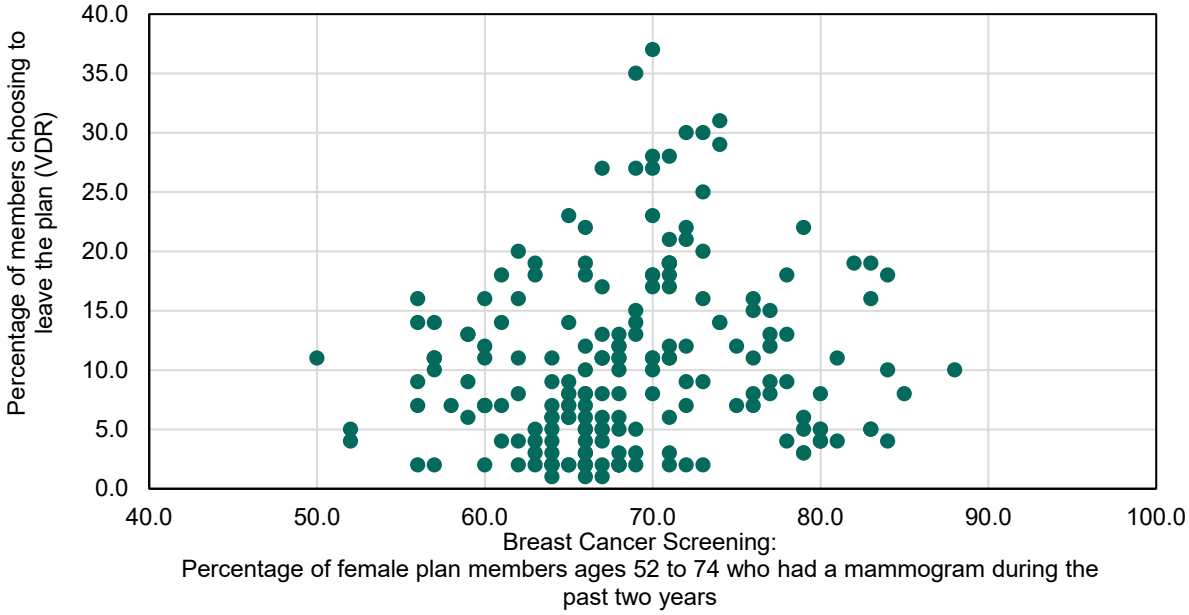
4. Exhibits analyzing D-SNP dominant MA contracts

This appendix provides additional exhibits analyzing D-SNP dominant contracts that we included in regression analyses.

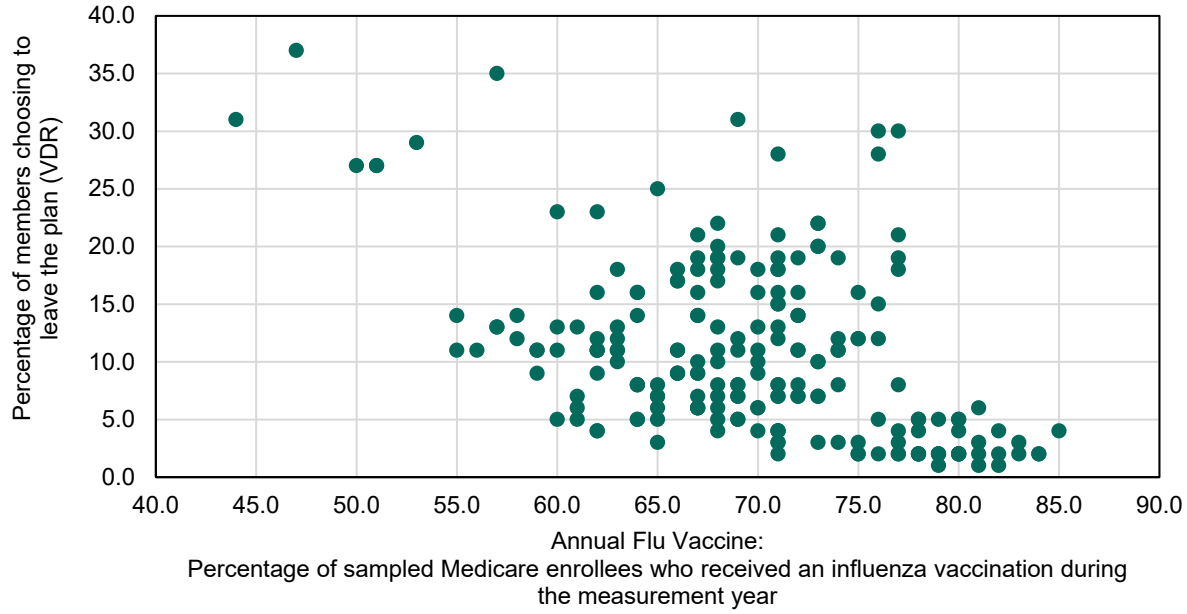
Exhibit A.6. Relationship between VDR and Breast Cancer Screening rate for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

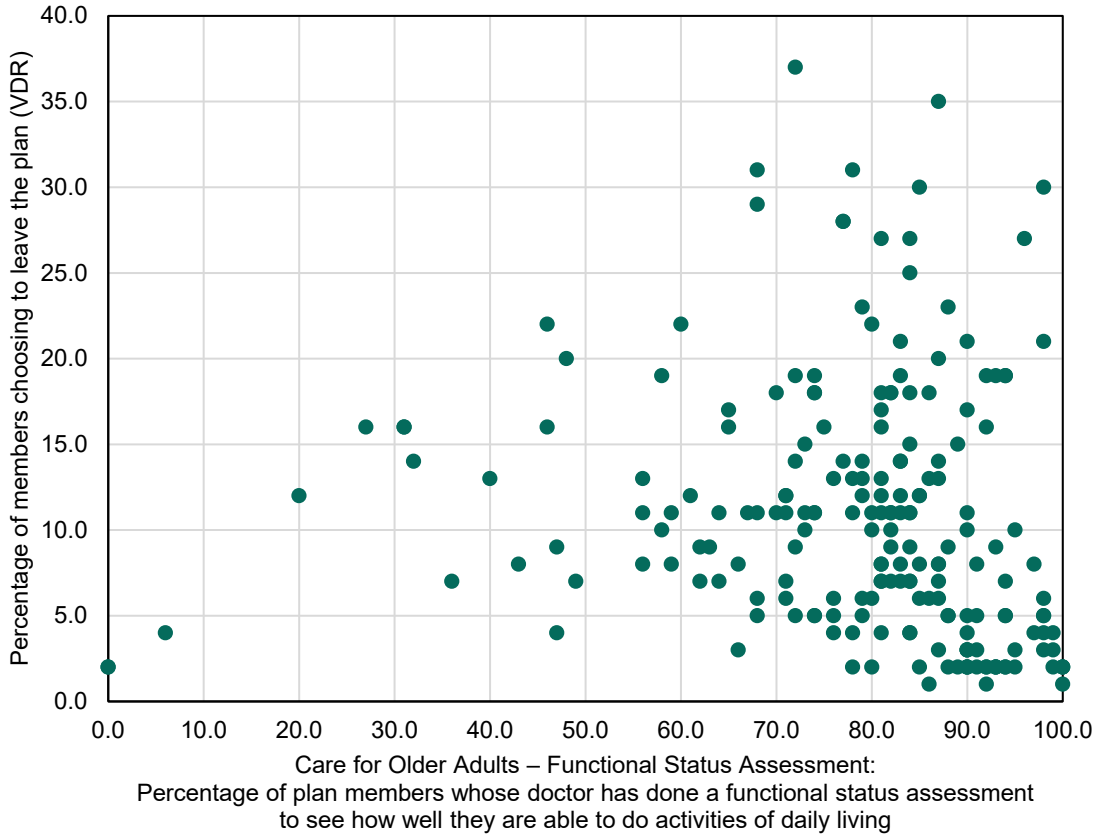
Exhibit A.7. Relationship between VDR and Annual Flu Vaccination rates for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

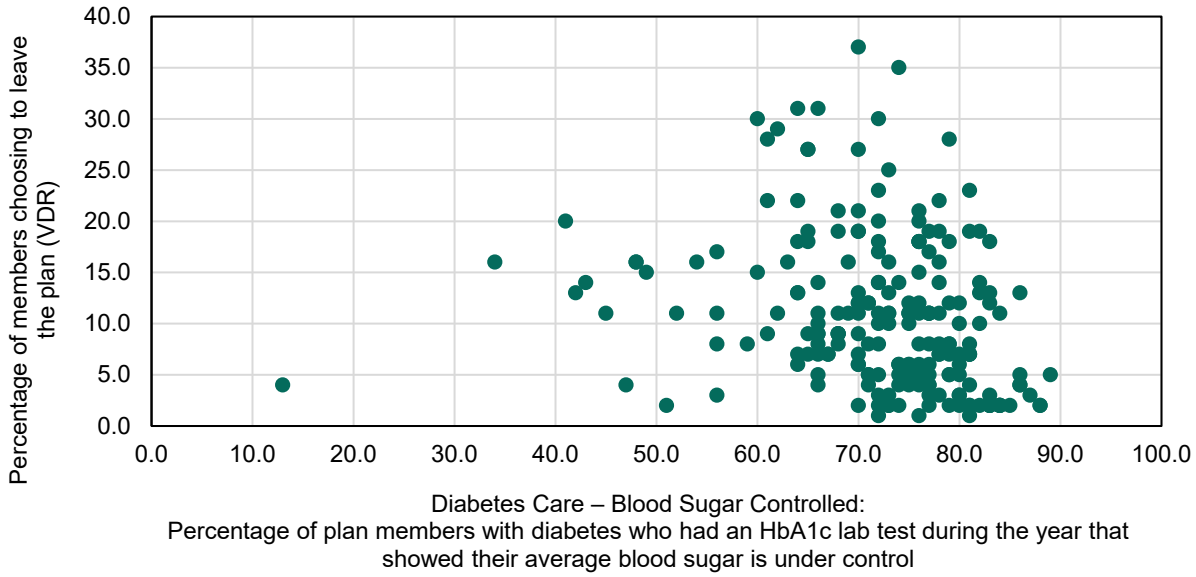
Exhibit A.8. Relationship between VDR and Functional Status Assessment rates for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate.

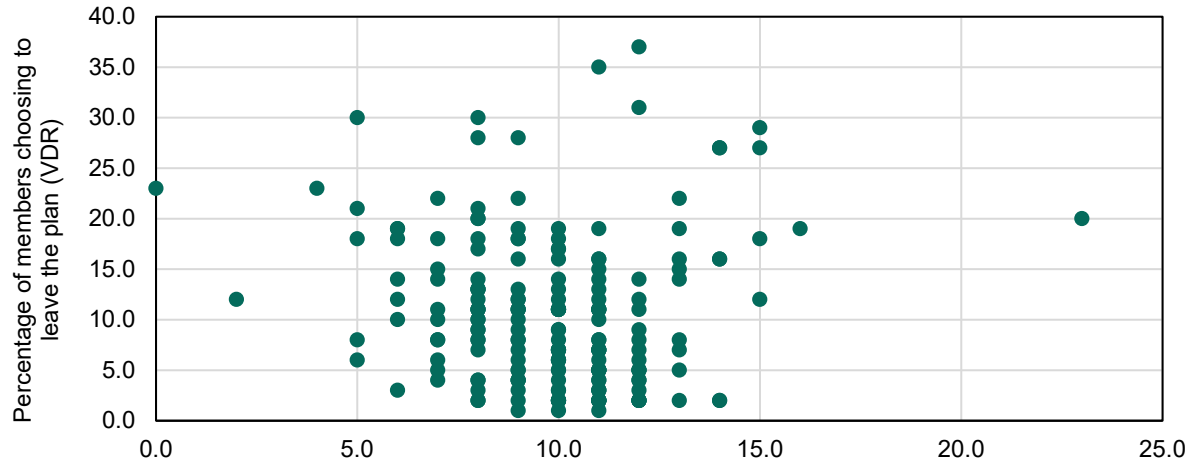
Exhibit A.9. Relationship between VDR and Diabetes Care: Blood Sugar Controlled rates for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate.

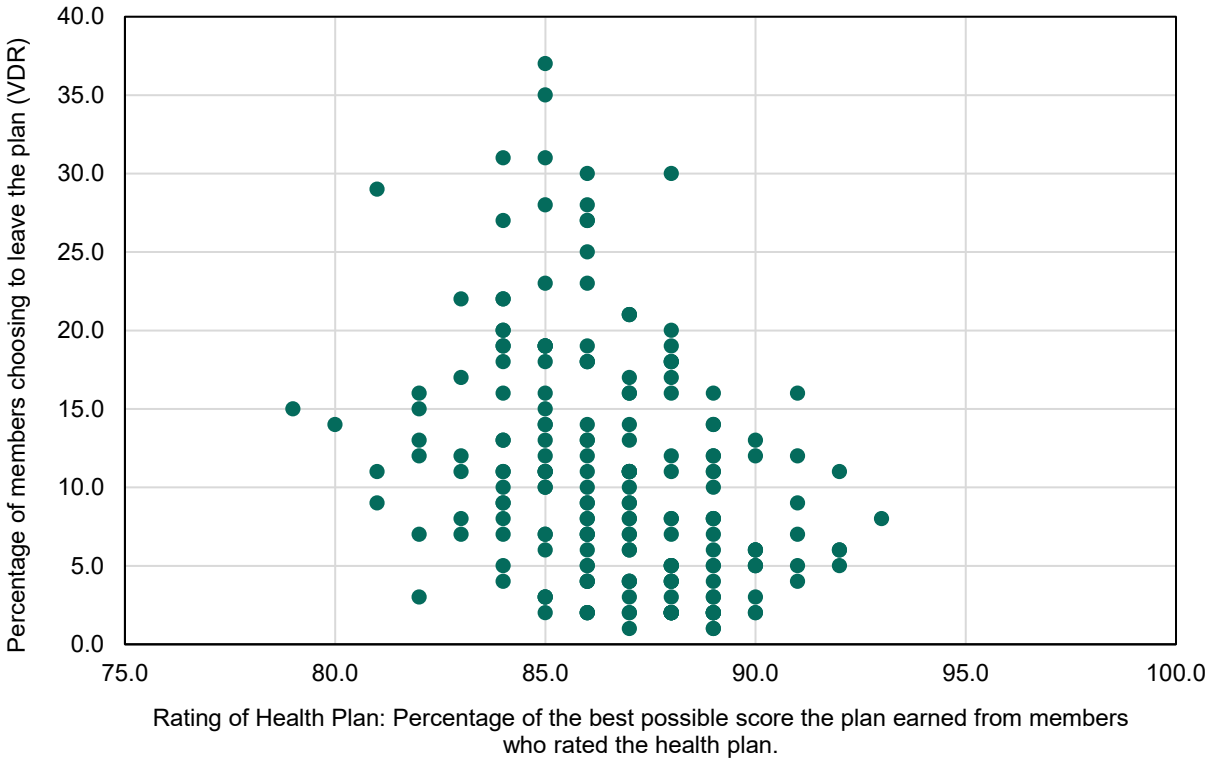
Exhibit A.10. Relationship between VDR and Plan All-Cause Readmission rates for D-SNP-dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

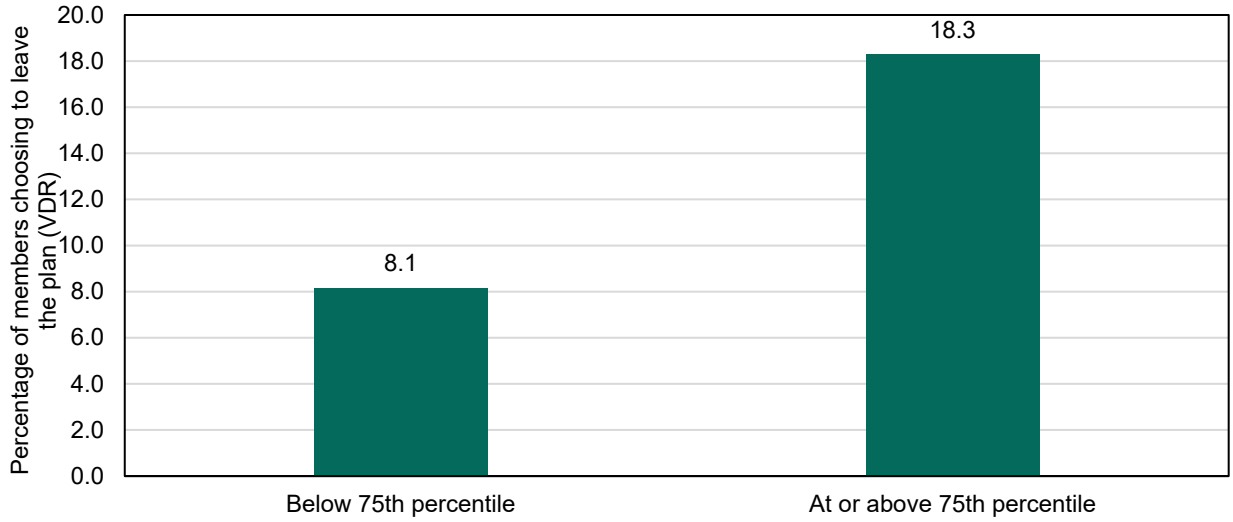
Exhibit A.11. Relationship between VDR and Rating of the Health Plan for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate.

Exhibit A.12. Relationship between VDR and Complaints about the Health Plan for D-SNP dominant MA contracts, 2015 to 2018



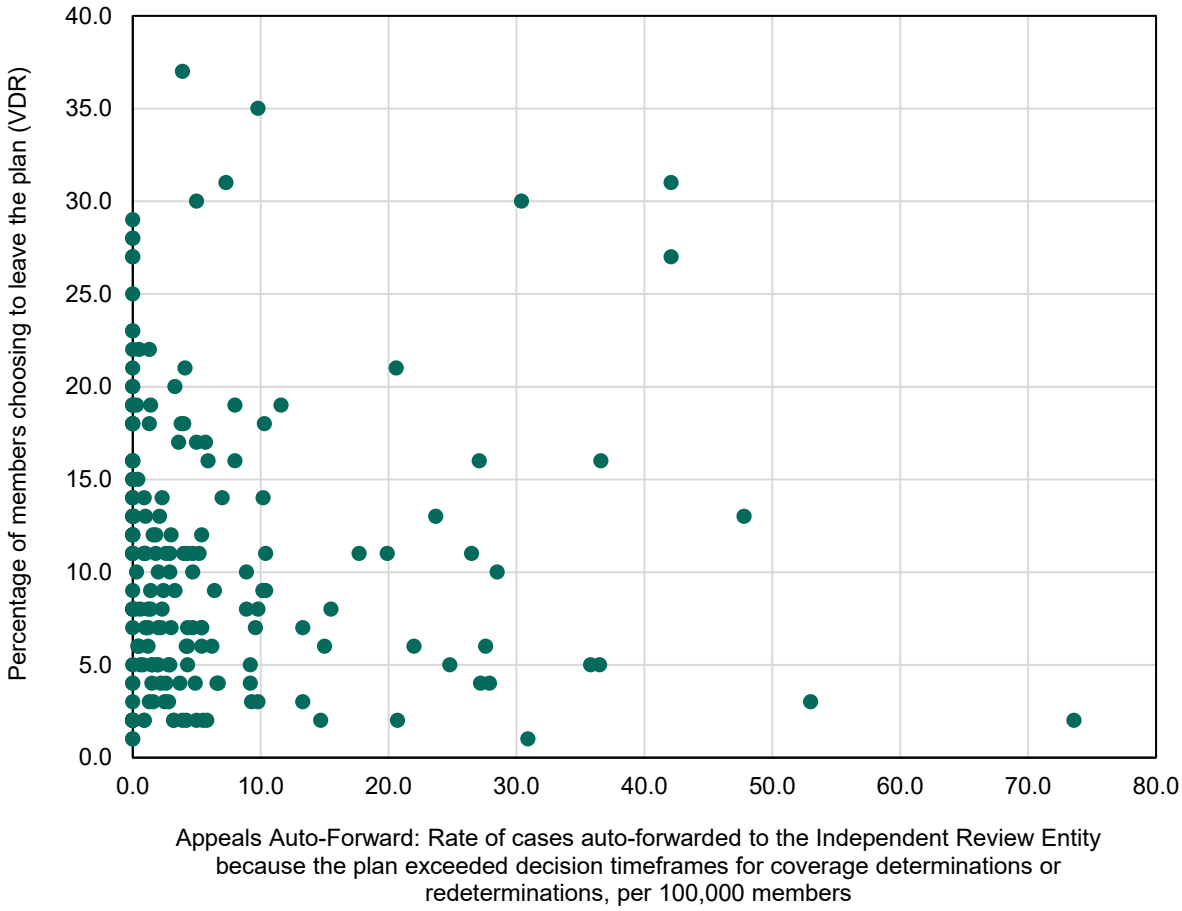
Complaints about the Health Plan: Rate of complaints about the health plan per 1,000 members, based on complaints logged into the Complaint Tracking Module.

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Note: Exhibit shows VDR separately for contract-year observations based on whether they were below 75th percentile for the rate of complaints among the 207 D-SNP dominant contracts we included in the regression analysis. The 75th percentile was 0.2.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

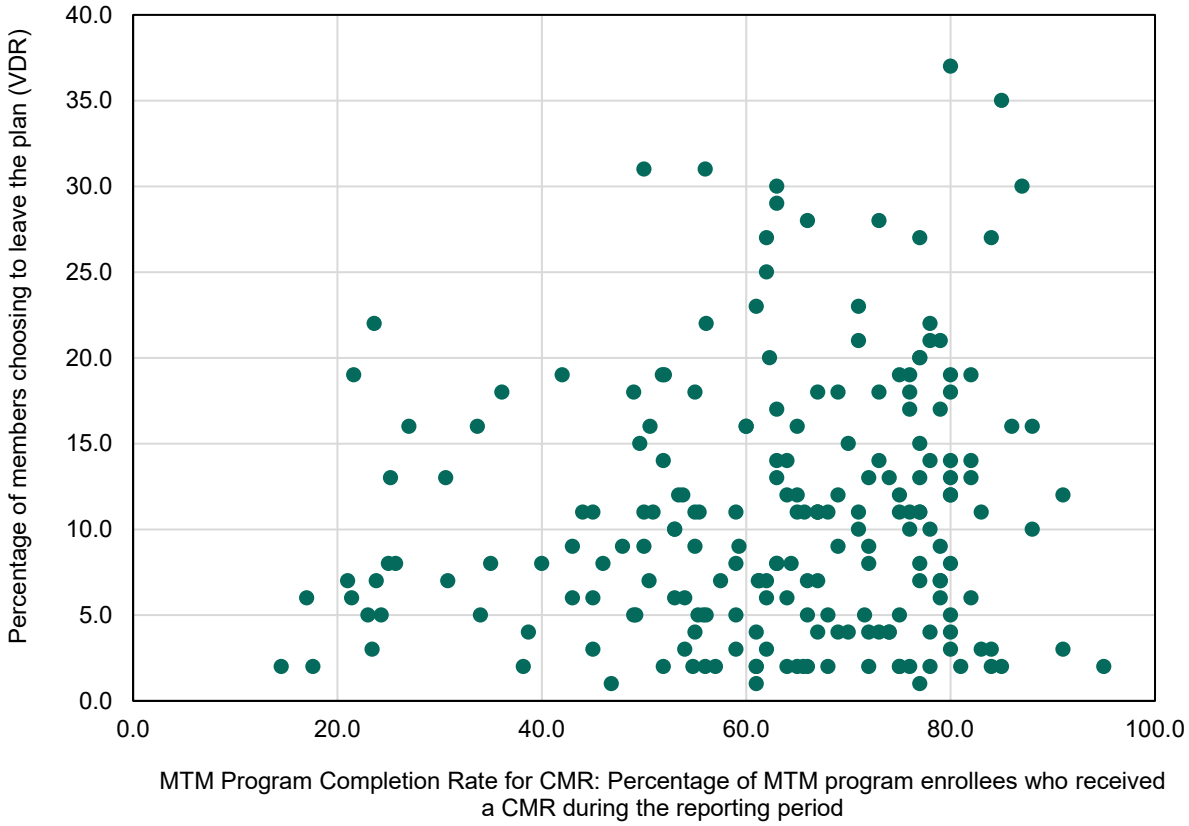
Exhibit A.13. Relationship between VDR and rate of drug plan Appeals Auto-Forwarded to an Independent Review Entity for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

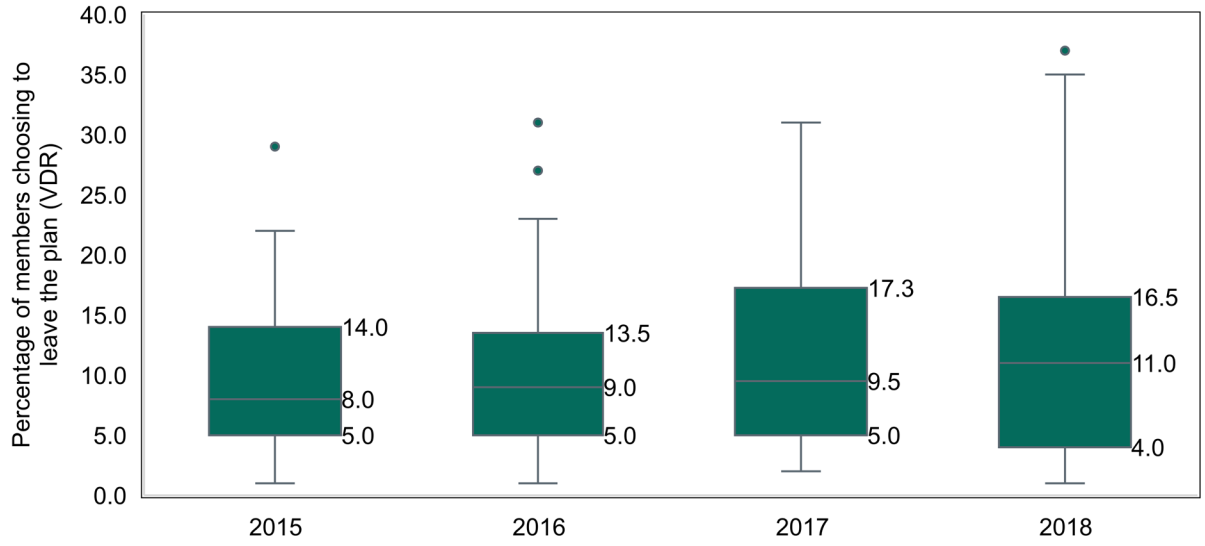
Exhibit A.14. Relationship between VDR and MTM Program Completion Rate for CMR for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMR = Comprehensive Medication Review; CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; MTM = Medication Therapy Management; VDR = Voluntary Disenrollment Rate

Exhibit A.15. Distribution of VDR by year, D-SNP dominant MA contracts, 2015 to 2018

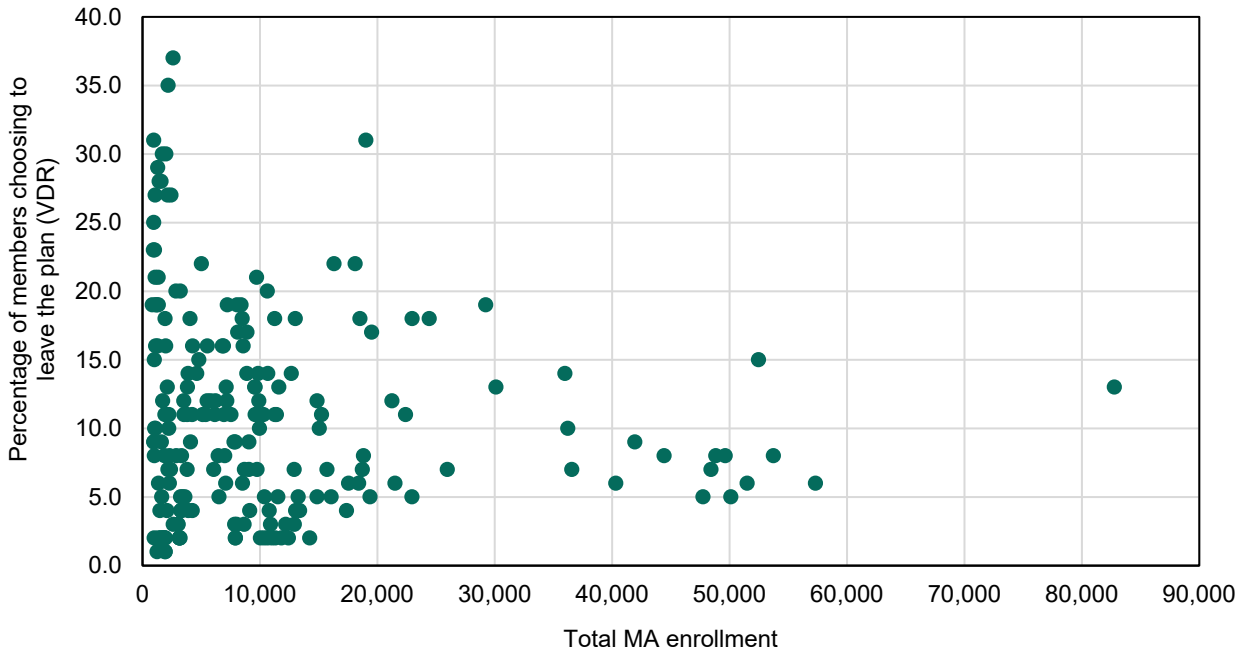


Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Notes: This figure shows the median and the interquartile range for each group of contracts. In some cases, the medians differed from the means. For example, the VDR for several contracts in 2017 was substantially higher than the upper bound of the interquartile range, so the mean VDR for contracts in 2017 was twice as large as the median VDR (11,4 and 9.5 percent, respectively). The low-end whiskers in this plot extend to the minimum VDR for each year, while the high-end whiskers extend to the VDR closest to the third quartile plus 1.5 times the interquartile range. Any VDR greater than the maximum high-end whisker length should be considered an outlier.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

Exhibit A.16. Relationship between VDR and total MA enrollment for D-SNP dominant MA contracts, 2015 to 2018



Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate.

5. Regression model

The regression model used the following equation to test the association:

$$(1) \quad VDR_{ct} = \alpha + X_{ct}\beta + Quality_{ct}\theta + Integration_{ct}\gamma + Integration * HighEnrollment_{\mathrm{ct}}\delta + \varepsilon_{ct}$$

where VDR_{ct} is the VDR of contract *c* in year *t*; X_{ct} includes the control variables described in Appendix A.2 including high enrollment (whether the observation was at or above the 75th percentile of total MA enrollment), $Quality_{ct}$ is a set of the nine measures of quality and experience of care described in Exhibit A.1, $Integration_{ct}$ is a set of multiple indicators – each corresponding to a level of Medicaid integration (low, moderate or high), $Integration * HighEnrollment_{\mathrm{ct}}$ is the set of interactions between each level of Medicaid integration and whether the observation was at or above the 75th percentile of total MA enrollment, and ε_{ct} is a random error term.

To assess the appropriateness of the model specification, we conducted the following diagnostic analyses:

- An *F*-test of the joint significance of quality and experience of care measures, which revealed that the measures were statistically significant predictors of VDR ($p = 0.001$).
- Calculation of correlation coefficients between all variables in the model, which helped us to identify and eliminate any pairs of variables that were highly correlated (as indicated by a correlation coefficient of greater than 0.5). Ensuring that the variables we ultimately included in the regression model were not highly correlated helped us to ensure that our coefficient estimates were stable and resistant to substantive fluctuations when we made minor adjustments to the model.
- Calculation of the variance inflation factor for each variable in the model as another indicator of multicollinearity. Ensuring that the variables we included each had a variance inflation factor of less than 10 helped us to ensure that correlation between variables was not so severe that the variances of one or more model coefficients were severely inflated by the inclusion of a problematic variable in the model. If the variance inflation factor were greater than or equal to 10, that would cause coefficient estimates to be unreliable and highly sensitive to minor adjustments to the model.

Because the sample included some contracts with high enrollment, we weighted each observation in the regression by total MA enrollment for the contract in that year. The sample for the primary regression specification included the 207 observations that met the sample selection criteria discussed above. We used heteroskedasticity robust standard errors.

To assess the appropriateness of the interaction term between contract enrollment and level of Medicaid integration, we examined the following:

- An *F*-test of the joint significance of the interaction terms between the various levels of integration (low, moderate and full) with Medicaid and the indicator for high MA enrollment, which revealed that these interaction terms were statistically significant predictors of VDR ($p = 0.007$).
- The term reflecting the interaction of high enrollment and full integration was statistically significantly different from 0 ($p = 0.003$). The interaction of high enrollment and moderate integration was close to but not statistically significant at the conventional level of $p < 0.05$ ($p = 0.064$). The interaction of high enrollment and low integration was not statistically significant ($p = 0.470$).

6. Sensitivity tests

In addition to the primary model, we ran several sensitivity analyses. Exhibit A.17 summarizes the key differences between the primary specification and the three sensitivity analyses.

Exhibit A.17. Key differences between regression model specifications

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
Weighted using continuous measure of total MA enrollment	Weighted	**Not weighted**	Weighted	Weighted
Measure of total MA enrollment used as a control variable and in an interaction term	≥75th percentile	≥75th percentile	**Continuous**	≥75th percentile
Sample included observations missing data for some quality and experience measures	Yes	Yes	Yes	**No**

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Notes: Bolded entries highlight the difference in model specification between the primary model and each sensitivity analysis.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage.

We present results from three sensitivity analyses in Exhibits A.18 and A.19. Exhibit A.18 presents regression analysis results (that is, estimated associations of each variable with VDR). Because one set of variables of interest—level of integration with Medicaid—was included in an interaction term, the estimated coefficients from the regression cannot be easily interpreted. For example, as shown in Exhibit A.18, contracts at or above the 75th percentile that had moderate integration with Medicaid showed a negative, statistically significant association with VDR, whereas the estimate for moderate integration itself was positive and statistically significant. To facilitate interpretation of the estimates for Medicaid integration, we combined information on the coefficients for Medicaid integration (with or without the interaction with enrollment) to calculate marginal effects using the "margins" command in Stata. Specifically, we calculated the estimated association of Medicaid integration level with VDR at different levels of total MA enrollment and tested whether each estimated association was statistically significantly different from zero (Exhibit A.19). Key results from these three sensitivity analyses include the following:

- **An unweighted model where every contract-year observation had equivalent weight regardless of enrollment.** Results were consistent with the primary model that weighted observations by enrollment.
- **A model that included a continuous enrollment variable.** Most results for this model were consistent with the primary model that used a binary variable indicating whether enrollment in that contract-year observation was at or above the 75th percentile for all observations in the data. However, in this model, the rate of drug-related appeal cases auto-forwarded to the independent review entity was associated with a significant decrease in the VDR. This association was in the unexpected direction, but it was quite small (a decrease of 15 percent in the rate was associated with

an increase of less than 0.1 percentage point in the VDR). In addition, low integration was associated with a significant decrease in the VDR for contract-year observations with lower enrollment (Exhibit A.19). We did not interpret these results as strong evidence of associations with VDR because the estimated associations were small and the evidence on statistical significance was inconsistent across specifications.

- **A model that excluded 17 observations that had a missing value for at least one of the quality and experience measures.** Results were consistent with the primary model where the sample included those 17 observations and the estimation included missing variable flags to identify which Star Ratings measure was missing for each of these 17 observations.

Exhibit A.18. Regression analysis results from primary model and three sensitivity analyses

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
Quality and experience of care measures				
Breast Cancer Screening	0.231*** (0.061)	0.181*** (0.054)	0.199*** (0.061)	0.253*** (0.064)
Annual Flu Vaccine	-0.173* (0.089)	-0.313*** (0.073)	-0.196** (0.084)	-0.180* (0.093)
Care for Older Adults – Functional Status Assessment	-0.015 (0.027)	-0.007 (0.016)	-0.016 (0.026)	-0.013 (0.028)
Diabetes Care – Blood Sugar Controlled	-0.006 (0.051)	-0.021 (0.038)	-0.008 (0.048)	0.000 (0.052)
Plan All-Cause Readmissions[a]	0.332 (0.243)	-0.025 (0.212)	0.218 (0.219)	0.236 (0.263)
Rating of Health Plan	-0.757*** (0.199)	-0.673*** (0.196)	-0.583*** (0.180)	-0.744*** (0.206)
Complaints about the Health Plan at or above the 75th percentile[a]	4.539*** (1.545)	5.461*** (1.208)	4.317*** (1.455)	4.410*** (1.574)
Appeals Auto-Forward[a]	-0.062 (0.039)	-0.043 (0.036)	-0.098*** (0.038)	-0.068 (0.042)
MTM Program Completion Rate for CMR	-0.033 (0.027)	-0.012 (0.026)	-0.023 (0.026)	-0.039 (0.027)
Medicaid integration and interaction with enrollment				
Level of Medicaid integration (reference = no integration)				
Low Integration	-2.465 (1.577)	-3.925** (1.544)	-4.992*** (1.777)	-2.113 (1.576)
Moderate Integration	4.025*** (1.152)	4.162*** (1.264)	3.740*** (1.395)	4.490*** (1.200)
Full Integration	0.183 (1.401)	0.239 (1.348)	3.203 (2.098)	0.538 (1.418)
Total MA enrollment ≥ 75th percentile x level of Medicaid integration (reference = no integration)[b]				

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
Total MA enrollment ≥ 75th percentile x low integration	1.667 (2.303)	1.236 (2.688)		1.384 (2.321)
Total MA enrollment ≥ 75th percentile x moderate integration	-2.815* (1.513)	-4.008** (1.967)		-3.288** (1.556)
Total MA enrollment ≥ 75th percentile x full integration	-5.833*** (1.931)	-5.909** (2.328)		-6.222*** (1.934)
Total MA enrollment in thousands x level of Medicaid integration				
Total MA enrollment x low integration			0.212** (0.106)	
Total MA enrollment x moderate integration			-0.085* (0.044)	
Total MA enrollment x full integration			-0.568*** (0.140)	
Control variables				
Total MA enrollment				
Enrollment ≥ 75th percentile	0.483 (1.370)	0.803 (1.777)		0.619 (1.345)
Enrollment in thousands			-0.036 (0.024)	
D-SNPs per 100,000 dually eligible beneficiaries	-0.405*** (0.123)	-0.632*** (0.144)	-0.407*** (0.113)	-0.408*** (0.124)
Year (reference = 2015)				
2016	0.766 (1.008)	1.369 (0.871)	0.518 (0.981)	0.550 (1.017)
2017	2.214* (1.216)	2.969** (1.238)	2.077 (1.275)	2.136* (1.229)
2018	3.489*** (1.209)	3.941*** (1.264)	3.201** (1.345)	3.231** (1.243)
100% D-SNP enrollment	-1.714* (0.988)	0.312 (0.926)	-1.599* (0.892)	-1.855* (0.980)
For-profit	2.050* (1.219)	0.693 (1.043)	2.267* (1.181)	1.946 (1.233)
Parent organization operated in highly concentrated markets	0.039 (0.812)	-0.673 (0.702)	-0.519 (0.679)	0.181 (0.830)
Indicator for whether quality and experience of care measure was missing				
Breast Cancer Screening	18.360*** (4.660)	13.706*** (4.022)	15.035*** (4.524)	
Care for Older Adults – Functional Status Assessment	-3.888 (3.782)	-4.751* (2.603)	-5.935 (3.941)	
Plan All-Cause Readmissions	5.244* (2.878)	0.477 (2.602)	3.889 (2.534)	
Appeals Auto-Forward	-1.402 (3.445)	4.880 (5.067)	0.318 (2.645)	

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
N	207	207	207	190
Adjusted R^2	0.551	0.610	0.587	0.554
Regression F-statistic	16.396	18.904	17.023	15.401

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Notes: Heteroscedasticity-robust standard errors are shown in parentheses. In this report, when we refer to a result being statistically significant, we are referring to a level of .05 or less.

[a] Lower rates indicate better performance.

[b] An *F*-test of the joint significance of the interaction terms between the various levels of integration with Medicaid and the indicator for high MA enrollment found that these interaction terms were statistically significant predictors of VDR (p=0.007). Also, we tested whether the coefficients on the three interaction terms were equal and found that they were statistically significantly different from each other (p=0.015).

* Significantly different from zero at the .10 level, two-tailed test.

** Significantly different from zero at the .05 level, two-tailed test.

*** Significantly different from zero at the .01 level, two-tailed test.

CMR = Comprehensive Medication Review; CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; MTM = Medication Therapy Management; VDR = Voluntary Disenrollment Rate

Exhibit A.19. Estimated association of integration level with VDR at different levels of total MA enrollment

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
Low integration with Medicaid				
Enrollment < 75th percentile	-2.465 (1.577)	-3.925** (1.544)		-2.112 (1.576)
Enrollment ≥ 75th percentile	-0.798 (1.691)	-2.689 (2.105)		-0.728 (1.736)
Enrollment = 5th percentile			-4.769*** (1.697)	
Enrollment = 25th percentile			-4.517*** (1.611)	
Enrollment = 50th percentile			-3.505*** (1.334)	
Enrollment = 75th percentile			-2.406** (1.213)	
Enrollment = 95th percentile			4.426 (3.621)	
Moderate integration with Medicaid				
Enrollment < 75th percentile	4.025*** (1.151)	4.162*** (1.264)		4.490*** (1.200)

	Primary model	Unweighted model	Continuous measure of total MA enrollment	Sample limited to observations with non-missing data for all quality and experience measures
Enrollment ≥ 75th percentile	1.210 (1.524)	0.153 (1.778)		1.203 (1.565)
Enrollment = 5th percentile			3.651*** (1.366)	
Enrollment = 25th percentile			3.550*** (1.334)	
Enrollment = 50th percentile			3.147*** (1.222)	
Enrollment = 75th percentile			2.708** (1.132)	
Enrollment = 95th percentile			-0.0189 (1.514)	
Full integration with Medicaid				
Enrollment < 75th percentile	0.183 (1.401)	0.239 (1.348)		0.538 (1.418)
Enrollment ≥ 75th percentile	-5.651*** (1.661)	-5.669*** (2.002)		-5.683*** (1.660)
Enrollment = 5th percentile			2.605 (1.981)	
Enrollment = 25th percentile			1.929 (1.854)	
Enrollment = 50th percentile			-0.781 (1.429)	
Enrollment = 75th percentile			-3.726*** (1.243)	
Enrollment = 95th percentile			-22.029*** (4.711)	
N	207	207	207	190

Source: Mathematica's analysis of 2015 to 2018 MA Star Ratings and D-SNP enrollment data, CMS Monthly Enrollment by Plan Reports, SNP Comprehensive Reports, and Medicare Advantage Plan Directories.

Notes: The reference category for this analysis is no integration with Medicaid. Standard errors are shown in parentheses. The values of the percentiles of total MA enrollment are as follows: 5th percentile 1,052; 25th percentile 2,243; 50th percentile 7,016; 75th percentile 12,202; and 95th percentile 44,437.

* Significantly different from zero at the .10 level, two-tailed test.

** Significantly different from zero at the .05 level, two-tailed test.

*** Significantly different from zero at the .01 level, two-tailed test.

CMS = Centers for Medicare & Medicaid Services; D-SNP = Dual Eligible Special Needs Plan; MA = Medicare Advantage; VDR = Voluntary Disenrollment Rate

In addition to the primary model and three sensitivity analyses described in detail above, we ran four additional sensitivity analyses with minor modifications to the variables included in the model.

- **An adaptation of the continuous enrollment model that included a control variable for urbanicity.** As described previously, the data had insufficient variation to allow us to include the measure of urbanicity in a regression with the indicator of enrollment at or above the 75th percentile.

To assess whether excluding the measure of urbanicity was problematic, we estimated the model with a continuous measure of total MA enrollment again, this time including the urbanicity measure. Contract operation in a large or a small/medium metropolitan area (rather than a rural area) was associated with a significant increase in VDR. Importantly, results for the association between level of Medicaid integration and VDR were largely consistent with the continuous enrollment model that did not control for urbanicity and the primary regression model.

- **An adaptation of the primary regression model that incorporated a 75th percentile flag for the Appeals Auto-Forward measure rather than a continuous measure.** Results for this model were broadly comparable to the primary regression model. The estimated association between VDR and the 75th percentile flag for the Appeals Auto-Forward measure was fairly small (-0.9 percentage points) and not statistically significant, as was the case for the estimated association between VDR and the continuous measure of Appeals Auto-Forward (Exhibit III.5). In this adapted model, however, low integration among contracts below the 75th percentile of enrollment was associated with a statistically significant decrease in VDR relative to no integration (estimated association of -4.1 percentage points, $p = 0.01$, compared with estimated association of -2.5, $p = 0.12$, for the primary model).

- **An adaptation of the primary regression model that incorporated a three-level measure of the extent to which the parent organization operated in markets with high concentration**—that is, where a few firms enroll large shares of MA enrollees. This model identified whether the parent organization for each contract-year observation was (1) below the 25th percentile of the HHI for observations in the sample (1,916), (2) at or above the 25th percentile but below the 75th percentile (3,113), or (3) at or above the 75th percentile. We estimated a regression with a three-level measure of the extent to which the parent organization operated in markets with high concentration because some interviewees reported that market competition played a big role in the VDR. Results from this model of the associations between quality and experience measures or the level of integration with Medicaid and VDR were broadly comparable to the primary regression model. We found that having a parent organization that operated in markets where concentration was at or above the 25th percentile but below the 75th percentile might be associated with lower VDR. The association of 2.0 percentage points was not statistically significant at a conventional level ($p = 0.088$), but the result was notably different from the estimated association between level of market concentration and VDR when we used a binary indicator of whether the observation was at or above 2,500 (estimated association of 0.4 percentage points, $p = 0.962$). Still, the association might reflect unmeasured differences across contract-year observations because having a parent organization that operated in markets where concentration was at or above the 75th percentile was not associated with VDR (estimated association of -0.7 percentage points, $p = 0.960$). Therefore, this regression model does not provide strong evidence of an association between level of concentration and VDR.

- **An adaptation of the primary regression model that included contracts operating in Puerto Rico and omitted two variables that were missing for these contracts: level of Medicaid integration and the number of D-SNPs per 100,000 dually eligible beneficiaries.** In most cases, the estimated associations of the quality and experience measures in this model were consistent with the primary regression specification. However, the rate of drug-related appeal cases auto-forwarded to the independent review entity was associated with a significant decrease in the VDR; this association was in an unexpected direction.