

PHM Commercial Program Statistical Analysis

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Abstract

Objective: The purpose of this study is to analyze AultCare's Commercial population risk adjusted allowed amount* and Healthcare Effectiveness Data and Information Set (HEDIS®) measures to determine if significant differences exist between Per Member Per Month** Allowed (PMPM) and measures for the Population Health Management (PHM) Offices versus the non-PHM Offices utilizing statistical hypothesis tests.

Results: AultCare conducted hypothesis tests on risk adjusted PMPMs and HEDIS® measures. According to p-values and 95% confidence intervals, the medical cost of enrollees in the AultCare PHM program were lower than those not part of the PHM program. There was no difference regarding pharmacy costs between the PHM and the non-PHM group. Additionally, the PHM group's HEDIS® measures were consistently better than the non-PHM group.

Introduction

Implemented in 2009, AultCare's Population Health Management Program (PHM) was established around the tenants of the Patient Centered Medical Home National Committee for Quality Assurance (PCMH NCQA) model. At its initiation, the program included seven physicians, an AultCare registered nurse to provide case management and care coordination services, and a required monthly physician meeting

In 2011, the PHM program grew to eight practices and 39 physicians. The focus shifted from participation to an emphasis on quality outcomes for the PrimeTime Health Plan (PTHP), which includes the Medicare Advantage population. In addition, physician practices who achieved PCMH NCQA recognition were incentivized. The Program continued to grow as 24 practices joined in 2014. During this growth, AultCare started to review quality performance for the AultCare Commercial Population, ages 18 and older. As the quality performance was reviewed, AultCare saw positive results in quality for both Commercial and Medicare Advantage populations. In an effort to keep developing the program, AultCare focused its attention on the influence of cost and utilization. By 2016, AultCare added cost and utilization metrics and expended to 57 provider practices.

Currently, AultCare's PHM Program includes over 170 engaged physicians in 70 practices. The program is made up of 77% of the Medicare Advantage population, 54% of the commercial population, and 17% of the pediatric population.

*Allowed amount is amount on which payment is based to a provider for a covered health care service. It is the patients' portion plus the plans portion.

**PMPM: The average amount per month for subscribing enrollees cost for AultCare.



Methodology

I. Data Preprocessing

Risk Adjusted Per Member Per Month (PMPM) Analysis

Data Source: Claims, enrollees' information, and risk score (Collected from AultCare claims database)

Provider Attribution: AultCare reviewed Commercial enrollees each year to assign the enrollees a Primary Care Physician (PCP). For each year, AultCare went back 15 months and assigned the provider that had the most office visits as the PCP. If there was a tie, then the most recent of the tie was assigned. If there was none within 15 months, then the most recent post 15 months' office visit was assigned. If an enrollee had no PCP office visits, the provider was chosen based on the information given by the enrollee. Next, AultCare grouped enrollees into a PHM Office or non-PHM Office. Enrollees not meeting any of these criteria were grouped into non-PCP. This ensures AultCare was consistent with identifying populations. In this study, AultCare was focusing on comparing PHM versus non-PHM.

Medical and Pharmacy Expenses: Claims with a Date of Service (DOS) from 2015 to 2018 were collected from the AultCare Claims Database. Records where AultCare was not primary were excluded. **Member Months:** The number of months an AultCare member was active for medical and pharmacy benefits were counted. Records where AultCare was not primary were excluded. **Risk Adjustment:** To normalize the populations' different health statuses, AultCare assigned a risk score per enrollee per year. The commercial population used the most recent MARA Concurrent Risk Score for that year.

Defining PHM vs non-PHM offices: AultCare updated an office's PHM status based upon when the office joined the PHM program. PHM status requires the office be in the PHM program as of January 1 of that year. An office joining the PHM program mid-year will be assigned as PHM in the following year.

PMPM Calculation: AultCare calculated the enrollees PMPM by taking the total allowed amount for both Medical and Pharmacy expenses and dividing it by the total member months for that year.

Risk Adjusted PMPM: AultCare calculated the risk adjusted PMPM by using the regular PMPM and dividing it by the enrollees' risk score.

Quality Analysis

Data Source: Data submitted for HEDIS® quality data in 2017 was used. Data was collected from QSI MRR sample profile and flowchart. Two types of measures were used: hybrid measures and non-hybrid measures. Hybrid measures combine claims data and supplemental data, and non-hybrid measures only include claims data. Colorectal Cancer Screening, Controlling High BP and four Comprehensive Diabetes Care are all examples of hybrid measures.

Provider Attribution: Enrollees were reviewed and assigned a PCP. For 2017, AultCare went back 15 months and assigned enrollees the provider that had the most office visits as the PCP. If there was a tie, then the most recent of the tie was assigned. If there were no PCP visits within the last 15 months, then the most recent post 15 months office visit was assigned. If an enrollee did not have any PCP office visits, the enrollee's indicated was selected as the PCP. Next, AultCare grouped enrollees into a PHM Office or non-PHM Office categories. If enrollees did not meet the specified criteria, enrollees were grouped into the non-PCP category. Such measures were taken to ensure AultCare was consistent with identifying populations. In this study, AultCare were focusing on comparing PHM versus non-PHM.

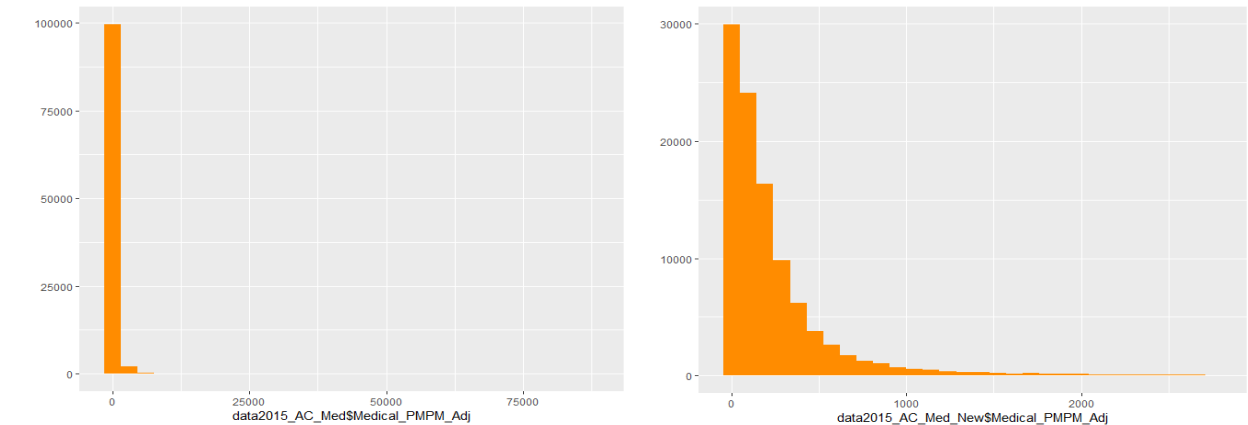
Defining PHM vs non-PHM offices: An office's PHM status is based upon when the office joined the PHM program. For each office group, the number of compliant enrollees was the numerator and the total number of eligible enrollees was the denominator. AultCare used these divisions to determine if there were significant differences between PHM and non-PHM groups.

II. Statistical Analysis

Risk Adjusted Per Member Per Month (PMPM) Analysis

Identification and Removal of Outliers: Risk adjusted PMPM distributions for each year were extremely skewed to right, indicating there were several high dollar enrollees in the data. Even though the ANOVA test is still robust with respect to data not distributed evenly, these extreme values will increase the data scale and variance, which will affect the test's credibility. To alleviate outliers influence while not losing important data features, AultCare removed the top 1% highest risk Adjusted PMPM. All statistical analysis was conducted using R 3.5.2. Figure 1 shows 2015 medical risk adjusted PMPM distributions before and after removing outliers.

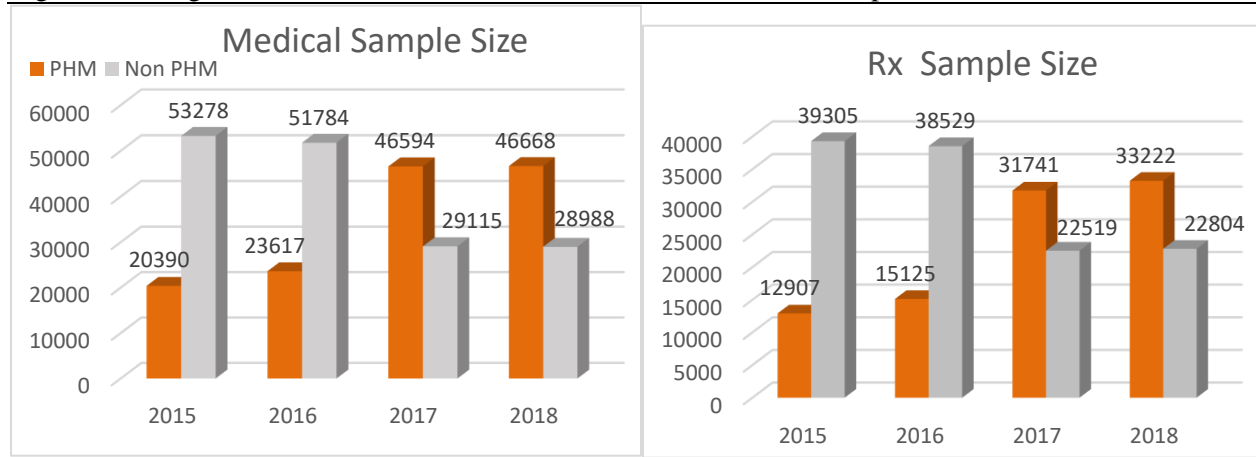
Figure 1. 2015 Medical Risk Adjusted PMPM original distribution and distribution after outliers removed



Before removing outliers, it is hard to determine the data distribution from the left plot. However, from the right plot, the distribution is much clearer after removing the outliers.

Sample size: Due to a PHM program expansion, the PHM sample increased from 2016 to 2017 in Figure 2.

Figure 2. Histogram of PHM and non-PHM Medical and Rx PMPM Sample Size



One-Way ANOVA test: AultCare conducted ANOVA tests and used p-values to determine if there was difference among PHM, non-PHM, and non-PCP risk adjusted PMPMs. The null hypothesis states there was no difference among these three groups. The p-value is the probability of obtaining an effect at least as extreme as the one in sample data, assuming the truth of the null hypothesis. Small p-values lead to reject the null hypothesis and vice versa. The criteria to compare p-values is alpha, which is the probability of rejecting the null hypothesis when it is true. AultCare chose 0.05 (most commonly used in industry), which indicates a 5% risk of concluding that a difference exists when there is no actual difference. The ANOVA test is significant when the p-value is smaller than 0.05.

All Commercial medical and Rx Risk Adjusted PMPM ANOVA tests are significant in the analysis. Table 1 shows the test statistics for the 2015 Commercial medical Risk Adjusted

PMPM ANOVA test. The p-value is extremely small, meaning there is a difference among PHM, non-PHM, and non-PCP Groups.

Table 1. 2015 Commercial medical PMPM ANOVA test

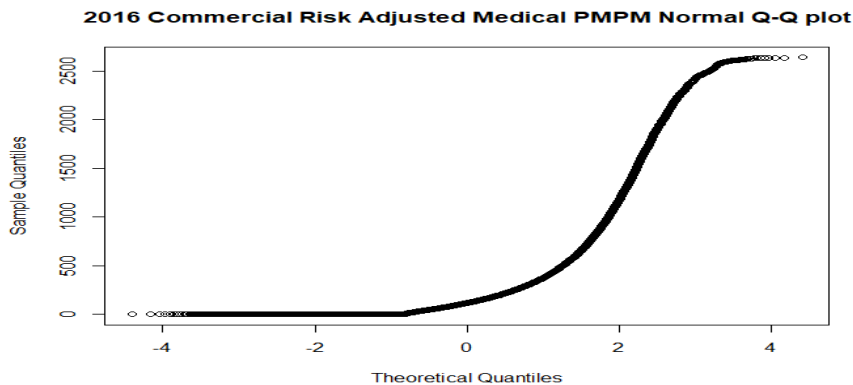
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Offices	2	3.030e+08	151491100	1441	<2e-16 ***
Residuals	101111	1.063e+10	105117		

ANOVA Test Assumptions Checking:

Independent samples: The PHM and non-PHM groups’ data are independent from each other, since AultCare conducted comparison tests under each year. This important ANOVA test assumption is satisfied for all ANOVA tests.

Anderson-Darling Test: As indicated in Figure 3, the 2016 Commercial risk adjusted PMPM data does not follow a straight line, which indicates the test data may not follow a normal distribution. AultCare also conducted Anderson-Darling tests to check normality assumptions. For commercial medical and Rx risk adjusted PMPM, all Anderson-Darling tests are significant. However, ANOVA tests are still appropriate due to the large sample sizes.

Figure 3. 2016 Risk Adjusted Medical PMPM Q-Q plot



Levene’s Test: AultCare used Levene’s Test to determine whether groups’ variances are equal or not. The null hypothesis is equal variance. For commercial medical and Rx risk adjusted PMPM, equal variance assumptions are not met for all eight Levene’s tests. Considering the data is not normal and equal variance is also violated, AultCare conducted a Kruskal – Wallis test (KW) to confirm ANOVA credibility.

Kruskal – Wallis rank sum Test: KW tests results are significant and match with ANOVA tests. Therefore, ANOVA tests are appropriate.

Post hoc tests:

Tukey Multiple Comparison Procedures: AultCare conducted this step to evaluate the differences for each pair of groups after ANOVA and Kruskal –Wallis rank sum tests. To match with tests significance levels, the difference range is 95% confidence intervals.

Table 2. Table of PHM and non-PHM Medical PMPM Tukey Procedure Summary

Year	PHM – non-PHM Medical PMPM		
	P-value(2 decimals)	95% CI Lower Bound	95% CI Upper Bound
2015	0.00	-32.6	-20.1
2016	0.00	-32.4	-21.1
2017	0.00	-47.1	-36.6
2018	0.00	-45.3	-31.8

From Table 2, p-values are extremely small and 95% Confidence intervals are negative ranging from -20 to -47. This indicates that PHM medical PMPM is lower than non-PHM by approximately 20 to 47 dollars.

Table 3. Table of PHM and non-PHM Rx PMPM Tukey Procedure Summary

Year	PHM - non-PHM Rx PMPM		
	P-value(2 decimals)	95% CI Lower Bound	95% CI Upper Bound
2015	0.78	-2.2	4.0
2016	0.39	-1.3	4.4
2017	0.57	-4.0	1.6
2018	0.34	-4.5	1.1

From Table 3, p-values are larger than 0.05 (alpha) and 95% confidence intervals contain zero. Therefore, AultCare can conclude there is no statistical evidence to show a Rx PMPM difference between PHM and non-PHM.

Quality Analysis

Assumptions: There are two assumptions for hypothesis tests: random sample and large sample size. For hybrid measures, enrollees are randomly selected from the Commercial population and sample sizes are large enough to conduct statistical tests. For non-hybrid measures, AultCare collected the whole population’s data and tested directly on everyone. By doing this, the large sample size assumptions are also met. From Table 4, all PHM measures percentages are better than non-PHM.

Table 4. Table of PHM and non-PHM HEDIS Measures Sample Numerators and Denominators

Measure Name	PHM			Non-PHM		
	Numer	Denom	Percent	Numer	Denom	Percent
Breast Cancer Screening	7673	9563	80.2%	2147	3927	54.7%
Cervical Cancer Screening	12101	16325	74.1%	4951	8749	56.6%
Colorectal Cancer Screening	670	855	78.4%	158	338	46.7%
Controlling high BP	639	845	75.6%	175	262	66.8%
A1C < 7	167	346	48.3%	55	147	37.4%
BP < 140/90	377	482	78.2%	135	197	68.5%
Med Att for Neph	453	482	94.0%	175	197	88.8%
Retinal Eye	343	482	71.2%	92	197	46.7%
Readmits*	110	1423	7.7%	82	738	11.1%

*Inverse measure, meaning the lower the percentage better.

One-side proportion tests: The null hypothesis states there is no difference between the PHM and non-PHM groups. The test significant is 0.05 and a small p-value rejects the null hypothesis. Table 5 shows the test results.

Table 5. Table of PHM and non-PHM HEDIS Measures Statistics Summary (P-values keep two digits)

Measure Name	PHM	Non-PHM	95% CI Lower bound	95% CI High bound	P-value
Breast Cancer Screening	80.2%	54.7%	24.1%	27.0%	0.00
Cervical Cancer Screening	74.1%	56.6%	16.5%	18.6%	0.00
Colorectal Cancer Screening	75.7%	46.7%	23.9%	34.0%	0.00
Controlling high BP	75.6%	66.8%	3.4%	14.2%	0.00
A1C < 7	48.3%	37.4%	2.9%	18.8%	0.01
BP < 140/90	78.2%	68.5%	3.4%	16.0%	0.00
Med Attention for Neph	94.0%	88.8%	1.0%	9.3%	0.01
Retinal Eye	71.2%	46.7%	17.8%	31.4%	0.00
Readmits	7.7%	11.1%	-5.6%	-1.1%	0.00

Small p-values indicate tests are significant. 95% confidence intervals also indicate the PHM group is better than non-PHM for all nine measures.

Results and Summary

Commercial Medical PMPM: The p-values in Tukey Multiple Comparison Procedures are all extremely small. This provides strong statistical evidence to show the PHM medical risk adjusted PMPM is consistently and significantly lower than non-PHM from 2015 to 2018. Based on the test statistics, AultCare is 95% confident to conclude that PHM medical PMPM is lower than non-PHM by approximately 20 to 47 dollars.



Commercial Rx PMPM: The p-values in Tukey Procedures are too large to prove a difference. Also, 95% confidence intervals all contain zero. Therefore, there is not enough evidence to show there is a difference between PHM and non-PHM Rx risk adjusted PMPM.

Quality Analysis: The significant proportion tests strongly prove the PHM offices are better than non-PHM offices in all nine measures.

Overall, the PHM program is extremely competitive in lower costs and better quality outcomes.

Limitations

This study has several limitations. First, the PCP attribution process assigned PCPs based on the enrollees' assigned PCP as of December 31 of that year. This process would not handle the situation when an enrollee had visited both PHM and non-PHM offices during the same year. Essentially, the enrollee would have been grouped into PHM population if that enrollee had visited a non-PHM office earlier in the year and visited a PHM office later in the year. Secondly, the PHM group identification methodology that an office joining the PHM program mid-year would be assigned as PHM in the following year, might slightly affect the number of enrollees in PHM and non-PHM groups. Thirdly, AultCare conducted tests on the whole population for PMPM and non-hybrid quality data instead of on a random sample. However, this did not affect hypothesis tests. Instead of making an inference to the whole population from random sample tests, AultCare could make conclusions directly on test results as well as avoiding sample selection bias.