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Multifaceted interventions improve medication adherence and reduce acute hospitalization rates in medicaid patients prescribed asthma controllers

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ABSTRACT

Objective: To measure the effectiveness of managed care-led interventions in Medicaid subjects with asthma on medication adherence and acute hospitalization in Pennsylvania. **Methods:** A total of 3589 members (age range, 5–64 years) served by two Pennsylvania-based Medicaid managed care plans (southeastern Pennsylvania [SEPA] and Lehigh-Capital/New West Pennsylvania [LCNWPA]) with low adherence rates (proportion of days covered [PDC]; 20%–67%) for asthma controller prescription fills in 2012 were guided through a care continuum by a comprehensive asthma strategy, consisting of adherence-improvement interventions (grouped as general intervention [GI] or personalized intervention [PI] for higher-risk subjects). Medication adherence and acute hospitalization rates (emergency department [ED] and inpatient [IP]) were compared at baseline versus one-year post-intervention using paired t-test or signed-rank tests. Repeated measures analysis of variances detected the interaction effect of time by intervention group after controlling for sociodemographic covariates. **Results:** Member profiles in SEPA ($n = 2\,796$) and LCNWPA ($n = 793$) were racially and ethnically distinct. Both cohorts experienced statistically significant improvements in mean PDC rate (+4.9% and +7.2%; $p = 0.01$ and $p = 0.03$, respectively), accompanied by significant reductions in ED visits (asthma-related: –23.0% and –17.5%, respectively; $p < 0.01$), and IP admissions (asthma-related: –37.1% and –40.0%, respectively; $p < 0.01$). The PI subcohorts showed significantly greater improvements in mean PDC versus GI subcohorts ($p \leq 0.04$), whereas acute hospitalization rates were statistically comparable in the SEPA cohort, despite its greater asthma burden. **Conclusions:** Managed care-led interventions can effectively improve medication adherence and reduce acute hospitalizations in high-risk Medicaid populations.

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Emergency department visits; inpatient admissions; managed care; proportion of days covered

Introduction

An estimated 24 million people, including 6.3 million children (<18 years), currently have asthma in the United States, with more than 10.7 million asthma attacks reported (1). In Pennsylvania, the asthma prevalence rate is even higher than the national rate in both adults (9.8% vs. 8.9%) and children (10.8% vs. 9.2%) (2). Existing healthcare and environmental and social determinant disparities contribute to higher-than-average asthma-related hospitalization rates among males under the age of 15, females 15 years and older, and minorities, especially those residing in urban environments (3,4).

Up to three-quarters of the total cost burden of asthma is reportedly a consequence of uncontrolled disease (5). Patients with asthma require instruction from their provider on proper inhaler technique and when to use

fast-acting rescue medication versus prophylactic asthma controller medication and self-management skills they will continue to employ for the life of their condition. Medicaid status, an independent risk factor associated with lack of asthma self-management skills and poor asthma outcomes (6), has been investigated in the published literature to a limited extent. The National Center for Health Statistics reported that 63% of fee-for-service (FFS) Medicaid and Children's Health Insurance Program (CHIP) beneficiaries had discontinued their asthma medication after 90 days from the initiation date, but by 190 days, only 15% of beneficiaries were still taking their medications (7). A study of 24,000 Kentucky Medicaid recipients with asthma found that fewer than 40% were prescribed a rescue medication and fewer than 10% were regular users of inhaled corticosteroids over a one-year

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period (8). Few patients with severe or difficult-to-treat asthma have their condition well controlled, resulting in more school and work absences and acute hospitalizations (9). In a multistate study of 123,066 Medicaid subjects with asthma, more than 15% reportedly had one or more asthma-related inpatient (IP) hospitalization or emergency department (ED) events in the prior year (10). Patient populations with low medication adherence rates who do not use rescue and/or controller therapies according to recommended guidelines demonstrate higher rates of repeat exacerbations, leading to acute re-hospitalizations (8,11–18). Children with asthma seen in the ED have low rates of inhaled controller use (14–16). Forty-to- fifty percent of low-income African-American children with persistent asthma receive less than half of their prescribed inhaled controller medication, and 15% demonstrate improper inhaler techniques suggestive of no medication delivery (19). Conversely, patients with higher medication adherence and post-discharge fill rates had lower odds of having a subsequent asthma exacerbation and were less likely to have acute hospitalizations (13,17,20–22).

Medicaid, the primary payer for asthma-related acute hospitalizations in Pennsylvania, comprised 38.8% of all ED visits and 39.2% of all inpatient (IP) admissions from 2009 to 2013 (3). Children with Medicaid insurance were more likely to have poorly controlled asthma and lower medication adherence rates (21,23), and higher rates of repeat exacerbation and acute (re)admissions (17,21,24), compared to children covered under commercial plans and even CHIP beneficiaries (22). However, low-income Medicaid and CHIP beneficiaries still had higher mean daily adherence rates of inhaled corticosteroids than low-income populations not covered under these programs (19). Moreover, members of FFS plans were at 18% higher risk for failure to refill asthma controller medication than managed care plans (25).

In 2013, AmeriHealth Caritas, a Medicaid managed care organization (MCO), implemented a multifaceted comprehensive asthma management strategy combining evidence-based interventions in two distinct Medicaid service areas in Pennsylvania. The residents of these sociodemographically diverse areas include rural western Pennsylvania and urban areas of southeastern Pennsylvania (SEPA), including West and Northwest Philadelphia, where one out of four children has physician-diagnosed asthma or is admitted to the hospital for wheezing (26). Philadelphia poses a particularly acute challenge, ranked as the third worst city in the nation for asthma in 2015 (27), with 16,000 resident children making asthma-related visits to the ED each year (11,000 of whom make multiple visits) (28). Asthma consistently ranks in the top 10 primary diagnoses for non-urgent ED visits throughout Pennsylvania, and has been among the most

frequently treated conditions in Pennsylvania-based, high-volume Medicaid practices (internal claims data, 2014–2015). Our strategy targeted asthma morbidity in low- and high-risk asthma populations who were poorly adherent in taking their prescribed asthma controller medications (proportion of days covered [PDC]; 20%–67%) in 2012 with the dual aims of improving medication adherence and reducing rates of acute hospitalization in the member population. Baseline medication adherence rates in these Medicaid populations averaged at slightly more than 40% (internal claims data, 2014–2015). Subjects of the high-risk population were identified by their high risk scores based on diagnosed persistent asthma with prior-year asthma-related acute hospitalization, unstable medical and behavioral health status, and low asthma controller-to-rescue medication fill ratios based on pharmacy claims. A two-tier intervention model focused on members, network primary care providers, and/or MCO-based staff, was implemented for addressing short-term needs of the low-risk population with general interventions (GIs) (e.g., member mailings and automated messaging), as well as the long-term chronic needs of the high-risk population requiring more intensive personal interventions (e.g., telephonic care management).

Methods

Study design and population stratification

The study protocol and ethics review was approved by an internal steering committee of medical directors and care managers. The study design consists of a two-arm, one-year follow-up analysis of Medicaid members (age range, 5–64 years) served by two Pennsylvania-based AmeriHealth Caritas MCOs (SEPA and Lehigh-Capital/New West Pennsylvania [LCNWPA]) with at least two claims that have a primary diagnosis of asthma (ICD-9, 493.xx) and prescription fills for asthma controllers (i.e., topical and orally inhaled glucocorticoids; glucocorticoid/beta-adrenergic combination therapy) from January 1, 2012, to December 31, 2012. Subjects included in the analysis had low medication adherence rates (PDC; range, 20%–67%). Subjects were excluded from the analysis if they were identified as having claims for additional prescription fills for antihypertensives, hypoglycemics, and statins (although relatively small in number and their inclusion in the analysis did not dramatically affect outcomes; unpublished observations). The existing methodologies identified high-risk members with asthma, including those diagnosed with persistent asthma and: 1) ≥ 1 IP or ED visit in 12 months or a 23-hour observation stay; 2) an unstable medical, behavioral health or support situation; 3) pregnant status with an asthma-related inpatient admission; 4) no available pharmacy data for

controller medications; and/or 5) four or more rescue medication fills within a four-month period. In addition, a cluster analysis based on 2012 baseline PDC adherence and risk scoring (Verisk Analytics; Jersey City, NJ) was performed on the asthma population to incorporate predictive modeling techniques in conjunction with existing experience-based methodologies based on member claim data and care management assessments. A four-quadrant model was applied: 1) low PDC and high-risk score; 2) low PDC and low-risk score; 3) high PDC and high-risk score; and 4) high PDC and low-risk score. Care managers then used the sorted list to identify and target high-risk members for managed care-led interventions.

Asthma initiatives

Non-clinical interventions focused on members, network providers, and MCO-based staff, categorized as GIs and personalized interventions (PIs) for low-risk and high-risk subjects, respectively, were implemented to improve 2013 adherence (Figure 1). High-risk members were identified from the combination of the existing method and cluster analysis that included baseline PDC (2012) and risk score. High-risk members were targeted for PI services: MCO-led telephonic care management or coor-

dination/engagement with components including implementation of an individual care plan based on assessment findings and member services, medication adherence assessments, care gap surveys, drug therapy management and other pharmacy engagement processes, assistance in navigating and connecting with external health care services and available community supports, self-management coaching and motivational interviewing. Low-risk members were targeted for GI services, including community education programs; automated message reminders for health monitoring and medication refills; assistance in coordinating follow-up care and connection to community resources; and asthma self-management and medication adherence-related educational content in member and provider mailings (Table 1).

Outcomes measured

The primary outcome measures reported were calculated at baseline (2012) and at one-year post-intervention period (2013) and included medication adherence rates (reported as “PDC rate”) and acute hospitalization rates (utilization per thousand members per year [PKPY]). PDC is the quotient value of the covered days of asthma medication divided by the days in the measurement period. PDC adherence measurements, generated from

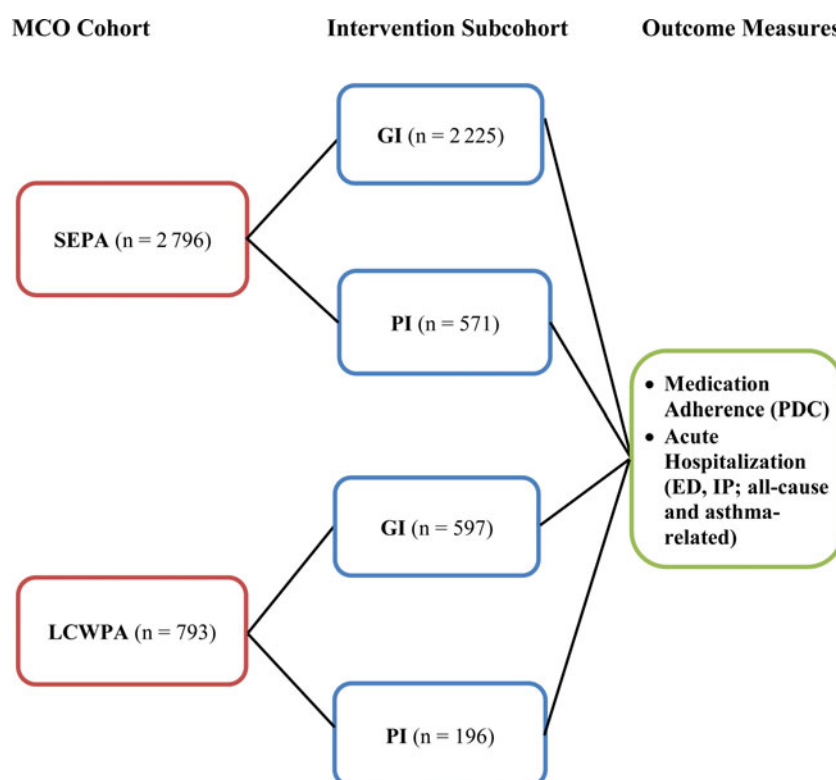


Figure 1. Study schematic of cohorts and primary outcomes. Members of MCO cohorts SEPA and LCWPA (left side) were sub-classified into intervention subcohorts receiving PI or GI services (center). Primary outcome measures (right side), both all-cause and asthma-related, were analyzed for every cohort and subcohort.

ED, Emergency department visits; GI, General intervention; IP, Inpatient admissions; LCNWPA, Lehigh/Capital-New West Pennsylvania; MCO, Managed care organization; PDC, Proportion of days covered; PI, Personalized intervention; SEPA, southeastern Pennsylvania.

Table 1. Study interventions.

General interventions (GIs)		Personal interventions (PIs)
MCO staff/Members/Providers Medication adherence-focused corporate strategic communication plan.		
MCO staff-focused - Enhanced medical management platform with pop-up widget on member interventions supported. - Communications educating staff on medication adherence and motivation strategies. - Education program for CM and Rapid Response staff on medication adherence, behavioral and motivational interviewing techniques. - Education program on medication adherence for other medical management staff. - Updated community education programs to include medication adherence (<i>4 Your Kids Care and Health Empowerment Tour: 40-Day Journey to Better Health</i> programs). - Medication adherence care gap alerts (triggered by overdue refills) and member clinical summaries delivered to and medical management platform.	Provider-focused - Provider-oriented material on medication adherence and MCO adherence strategy. - Expanded provider referral of members to MCO-led CM services (<i>Let Us Know</i> program) to promote medication adherence and how to use care gap information. - Medication adherence flyer to assist providers in discussing and addressing member barriers and MCO-supported solutions in depth. - Provider survey regarding effectiveness of medication adherence programs and improvements for subsequent year. - Added HEDIS[®]-based medication adherence measures to primary care provider shared savings (<i>PCP Quality Enhancement</i>) program. - Free continuing medical education program for providers on medication adherence based on national guidelines and cultural competency training. - In-person MCO network management outreach to inform high-volume providers about generic prescribing, MCO-supported asthma programs, etc. - Participation with a large children's hospital on a feasibility study for electronic monitoring of inhaler use.¹ - Point-of-care dispensing of asthma medication and supplies (<i>Breathe Easy. Start Today.</i>[®] — <i>BEST asthma</i> program). - Medication adherence care gap alerts (triggered by overdue refills) and member clinical summaries delivered to provider portal.	High-risk member-focused - MCO-supported telephonic CM, especially for members identified 1) with prescriptions filled at multiple pharmacies; 2) with split refill dates; 3) with medications prescribed in more than one of selected drug classes; and/or 4) who consistently missed refills. - Post-discharge engagement to overcome discharge barriers by examining medication requirements and status at discharge using outpatient management checklist. - Automated messaging for refills due/overdue with options to transfer directly to the pharmacy or plan representative. - Drug therapy management program. - Pharmacy engagement, including 1) implementing refill date-linking for members on multiple medications with different refill dates so all medications are refilled at the same time; 2) collaborating with pharmacies having many members with low medication adherence to coordinate member outreach; and 3) helping members transfer their prescriptions to mail order pharmacies or pharmacies with home delivery service.
Member-focused - Removal of copay requirement for asthma inhalers. - Promotional and educational material on medication adherence (<i>Every Day Matters</i> campaign with seven-day pill box giveaways). - On-hold messaging for generic medication reminders. - Member survey on medication adherence. - Pill station program.		

¹Kenyon CC, Chang JC, Wynter SA, et al. Feasibility and Acceptability of an Electronic Adherence Monitoring Intervention in High-Risk Pediatric Asthma Patients, JMIR Res Protoc. 2016; 5(2): e132.CM, care management; HEDIS[®], Healthcare Effectiveness Data and Information Set; MCO, managed care organization; PCP, primary care provider.

the internal portal of AmeriHealth Caritas' pharmacy benefit manager Perform Rx (a URAC-certified corporation), provide a more conservative estimate of medication adherence than measures like medication possession ratio when multiple medications are used concomitantly, and also avoids double-counting days of medication coverage (i.e., a day is only counted if all medications are available on that day) (29).

Acute hospitalizations, including IP admissions and ED visits, were classified "all cause" or "asthma-related" (PKPY = total admissions in the measurement year/total member years × 1000). Asthma-related hospitalizations were based on the appropriate International Classification of Diseases (ICD-9) codes (493, 493.0, 493.00–493.02, 493.1, 493.10–493.12, 493.8, 493.81–493.82, 493.9, and 493.90–493.92).

Statistical analysis

Chi-square tests and Mann–Whitney U-tests were performed to respectively compare sociodemographic differences and risk-score differences between the PI

versus GI subcohorts. Paired t-test or signed-rank tests were performed to compare overall year-to-year changes of PDC and hospital utilization. The Kruskal–Wallis test by ranks was used to test the differences of changes of clinical outcomes from 2012 to 2013 among PDC rate classes (PDC increased, then had no change, and finally decreased from 2012 to 2013). Additionally, repeated measures analysis of variances were performed to detect the interaction effect of time by intervention subcohort (to compare whether changes from 2012 to 2013 differed between the two groups) after controlling for sociodemographic covariates such as age, gender, race, language, aid category, and risk scores (see **Supplemental Table 1** for baseline PDC adherence data, accounted for as confounding factors in the multivariate analyses). Specifically, the PROC MIXED procedure with an unstructured correlation structure was used. The Kenward–Roger option was used to obtain the correct denominator degrees of freedom for the F-tests. All analyses were performed using SAS Enterprise Guide 7.1 (Cary, NC, USA). P-values (*p*) of less than 0.05 were considered statistically significant.

Table 2. Study demographics by intervention group and MCO.

Variable	Category	SEPA				LCNWPA			
		Total N (%)	GI	PI	<i>p</i> ^a	Total N (%)	GI	PI	<i>p</i> ^a
Age	5–17	1725 (61.7%)	1367 (61.4%)	358 (62.7%)	0.01	381 (48.1%)	349 (58.5%)	32 (16.3%)	<0.01
	18–39	378 (13.5%)	321 (14.4%)	57 (10.0%)		124 (15.6%)	96 (16.1%)	28 (14.3%)	
	40–64	693 (24.8%)	537 (24.1%)	156 (27.3%)		288 (36.3%)	152 (25.4%)	136 (69.4%)	
Gender	Female	1557 (55.7%)	1235 (55.5%)	322 (56.4%)	0.7	492 (62.0%)	340 (56.9%)	152 (77.5%)	<0.01
	Male	1239 (44.3%)	990 (44.5%)	249 (43.6%)		301 (38.0%)	257 (43.1%)	44 (22.5%)	
Language	English	2212 (79.1%)	1751 (78.7%)	461 (80.7%)	0.36	566 (71.4%)	453 (75.9%)	113 (57.7%)	<0.01
	Spanish	63 (2.3%)	54 (2.4%)	9 (1.6%)		83 (10.5%)	52 (8.7%)	31 (15.8%)	
	Other	521 (18.6%)	420 (18.9%)	101 (17.7%)		144 (18.1%)	92 (15.4%)	52 (26.5%)	
Race	Black	1861 (66.6%)	1457 (65.5%)	404 (70.8%)	0.05	87 (11.0%)	74 (12.4%)	13 (6.6%)	0.01
	Caucasian	378 (13.5%)	308 (14.2%)	72 (12.6%)		374 (47.1%)	288 (48.2%)	86 (43.9%)	
	Other	555 (19.9%)	460 (20.7%)	95 (16.6%)		332 (41.9%)	235 (39.4%)	97 (49.5%)	
Aid category	SSI	1280 (45.8%)	1007 (45.3%)	273 (47.8%)	0.27	396 (50.0%)	251 (42.1%)	145 (74.0%)	<0.01
	Non-SSI	1516 (54.2%)	1218 (54.7%)	298 (52.2%)		396 (50.0%)	345 (57.9%)	51 (26.0%)	
Risk score	Median (IQR)	80 (35–227)	77 (35–221)	91 (36–262)	0.03	137 (53–313)	103 (46–238)	297 (143–546)	<0.01

Note. ^a*p* values < 0.05 were considered statistically significant.

GI, General intervention; IQR, Interquartile range; LCNWPA, Lehigh/Capital-New West Pennsylvania (service area); MCO, Managed care organization; PI, Personalized intervention; SEPA, southeastern Pennsylvania (service area); SSI, Supplemental Security Income; STD, Standard deviation.

Results

Member demographics

Population demographic profiles were similar between SEPA (N = 2 796) and LCNWPA cohorts (N = 793) regarding age (primarily 5–17 years), gender (>55% female), languages spoken (>70% English), and aid category (approximately 50% receiving Supplemental Security Income). The primary demographic differences were that the SEPA cohort had a higher percentage of black members (66.6% vs. 11.0%), whereas the LCNWPA cohort had a higher percentage of Caucasians (47.1% vs. 13.5%), self-identified “other” race category (41.9% vs. 19.9%), and Spanish speakers (10.5% vs. 2.3%). Of the 3589 program participants, 767 subjects of the PI subcohort received personalized services (571 SEPA and

196 LCNWPA) and 2822 subjects of the GI subcohort received only general services (2 225 SEPA and 597 LCNWPA; Table 2). The nearly four-fold greater number of GI versus PI subjects coincides with the greater number of Medicaid members with less severe asthma symptomatology and lower exacerbation rates (as evidenced by lower acute hospitalization claims).

Effect of interventions on medication adherence

The relationship between intervention type (GI or PI) and medication adherence was examined for subjects in both MCOs. Both SEPA and LCNWPA cohorts experienced statistically significant improvements in the mean PDC rate from 2012 to 2013 (+4.9% and +7.2; *p* = 0.01 and *p* = 0.03, respectively; Table 3). These improvements

Table 3. Relationship between intervention methods and adherence in 2013 versus 2012.

Intervention cohorts by MCO	PDC 2012	PDC 2013	PDC post-pre	%PDC change	<i>p</i> for change from 2012 to 2013 ^a	<i>p</i> for interaction between intervention group and pre/post period ^{a,b}
SEPA						
GI	42.8	44.2	1.3	+3.0%	0.51	<0.01
PI	43.4	48.7	5.3	+12.2%	<0.01	
All-study cohort	43.0	45.1	2.1	+4.9%	0.01	
LCNWPA						
GI	41.6	43.9	2.3	+5.5%	0.25	0.04
PI	42.8	50.4	7.6	+17.8%	<0.01	
All-study cohort	41.7	44.7	3.0	+7.2%	0.03	

Note. Data from subjects with one or more identified comorbidities were removed from the analysis.

^a*p* values < 0.05 were considered statistically significant.

^bAdjusted by age, gender, race, language, aid category, and risk scores.

GI, General intervention; LCNWPA, Lehigh/Capital-New West Pennsylvania (service area); MCO, Managed care organization; PDC, Proportion of days covered; PI, Personalized intervention; SEPA, southeastern Pennsylvania (service area).

Table 4. Relationship between intervention method and ED visits in 2013 versus 2012.

ED visits by MCO	ED 2012	ED 2013	ED post-pre	%ED Change	<i>p</i> for change from 2012 to 2013 ^a	<i>p</i> for interaction between intervention group and pre/post period ^{a,b}
All-cause visits (PKPY)						
<u>SEPA</u>						
GI	1719.7	1437.4	−156.9	−9.1%	<0.01	0.75
PI	1731.4	1470.8	−144.4	−8.3%	<0.01	
All study cohort	1722.0	1444.2	−154.7	−9.0%	<0.01	
<u>LCNWPA</u>						
GI	2046.8	1741.3	−362.5	−17.7%	<0.01	0.02
PI	3671.3	4177.0	+51.7	+1.4%	0.12	
All study cohort	2255.6	2072.0	−242.2	−10.7%	0.02	
Asthma-related visits (PKPY)						
<u>SEPA</u>						
GI	795.6	598.3	−197.3	−24.8%	<0.01	0.38
PI	700.5	596.1	−104.4	−14.9%	0.03	
All study cohort	776.9	597.9	−179.0	−23.0%	<0.01	
<u>LCNWPA</u>						
GI	905.6	672.2	−233.4	−25.8%	<0.01	0.03
PI	1531.9	1714.0	+182.1	+11.9%	0.35	
All study cohort	986.1	813.6	−172.5	−17.5%	<0.01	

Note. Data from subjects with one or more identified comorbidities were removed from the analysis.

^a*p* values < 0.05 were considered statistically significant.

^bAdjusted by age, gender, race, language, aid category, and risk scores.

ED, Emergency department visits; GI, General intervention; LCNWPA, Lehigh/Capital-New West Pennsylvania; MCO, Managed care organization; PI, Personalized intervention; PKPY, Per thousand per year; SEPA, southeastern Pennsylvania.

were statistically significant in the PI subcohort (12.2% for SEPA and 17.8% for LCNWPA; $p < 0.01$), but not in the GI subcohort (3.0% for SEPA and 5.5% for LCNWPA; $p > 0.2$). Furthermore, improvements in the mean PDC were significantly greater in PI subcohorts than the GI subcohorts for both SEPA ($p < 0.01$) and LCNWPA ($p = 0.04$).

Effect of interventions on acute hospitalization

The relationship between intervention type and all-cause, as well as asthma-related acute hospitalization, was examined for subjects in both MCOs. The numerical trends were similar for all-cause and asthma-related acute hospitalizations.

For ED visit rates, statistically significant decreases were observed for both SEPA (all-cause: −154.7 PKPY; −9.0%; asthma-related: −179.0 PKPY; −23.0% for SEPA; $p < 0.01$ for both) and LCNWPA cohorts (all-cause: −242.2 PKPY; −10.7%; asthma-related: −172.5 PKPY; −17.5%; $p = 0.02$ and $p = 0.01$, respectively; Table 4). The GI subcohort experienced significant decreases in ED visit rates for SEPA (all-cause: −156.9 PKPY; −9.1%; asthma-related: −197.3 PKPY; −24.8%; $p < 0.01$ for both) and for LCNWPA (all-cause: −362.5 PKPY; −17.7%; asthma-related: −233.4 PKPY; −25.8%; $p < 0.01$ for both). The PI subcohort experienced significant decreases in ED visit rates for SEPA (all-cause: −144.4 PKPY; −8.3%; asthma-related: −104.4 PKPY;

−14.9%; $p < 0.01$ and $p = 0.03$, respectively), while the PI subcohort in LCNWPA experienced a non-significant increase in ED visit rates (all-cause: +51.7 PKPY; +1.4%; asthma-related: +182.1 PKPY; +11.9%; $p > 0.1$ for both). The differences in percent change of all-cause and asthma-related ED visit rates (favoring the GI subcohort) were significant in LCNWPA ($p = 0.02$ and $p = 0.03$, respectively), but not significant in SEPA ($p > 0.1$ for both).

For IP admission rates, statistically significant decreases were observed for both SEPA (all-cause: −99.9 PKPY; −27.8%; asthma-related: −81.6 PKPY; −37.1%; $p < 0.01$ for both) and LCNWPA cohorts (all-cause: −62.5 PKPY; −32.9%; asthma-related: −44.8 PKPY; −40.0%; $p < 0.01$ for both; Table 5). The GI subcohort experienced significant decreases in IP admission rates for SEPA (all-cause: −107.5 PKPY; −29.4%; asthma-related: −85.1 PKPY; −39.1%; $p < 0.01$ for both) and for LCNWPA (all-cause: −111.5 PKPY; −63.6%; asthma-related: −73.2 PKPY; −68.3%; $p < 0.01$ for both). The PI subcohort in SEPA also experienced decreases in asthma-related IP admission rates (all-cause: −69.4 PKPY; −20.9%; asthma-related: −68.1 PKPY; −29.7%), although only the latter was statistically significant ($p = 0.03$). Conversely, the PI subcohort in LCNWPA experienced significant increases in IP admission rates (all-cause: +242.7 PKPY; +83.5%; asthma-related: +134.1 PKPY; +92.3%; $p < 0.01$ for both). The differences in percent change of all-cause and asthma-related IP admission rates (favoring the GI

Table 5. Relationship between intervention method and IP admissions in 2013 versus 2012.

Inpatient admissions by MCO	IP 2012	IP 2013	IP post-pre	%IP Change	<i>p</i> for change from 2012 to 2013 ^a	<i>p</i> for interaction between intervention group and pre/post period ^{a,b}
All-cause visits (PKPY)						
<u>SEPA</u>						
GI	365.8	258.4	−107.5	−29.4%	<0.01	0.50
PI	332.6	263.3	−69.4	−20.9%	0.11	
All study cohort	359.3	259.4	−99.9	−27.8%	<0.01	
<u>LCNWPA</u>						
GI	175.3	63.8	−111.5	−63.6%	<0.01	<0.01
PI	290.5	533.2	+242.7	+83.5%	<0.01	
All study cohort	190.1	127.6	−62.5	−32.9%	<0.01	
Asthma-related visits (PKPY)						
<u>SEPA</u>						
GI	217.9	132.8	−85.1	−39.1%	<0.01	0.50
PI	229.1	161.0	−68.1	−29.7%	0.03	
All study cohort	220.1	138.5	−81.6	−37.1%	<0.01	
<u>LCNWPA</u>						
GI	107.1	33.9	−73.2	−68.3%	<0.01	<0.01
PI	145.3	279.3	+134.1	+92.3%	<0.01	
All study cohort	112.0	67.2	−44.8	−40.0%	<0.01	

Note. Data from subjects with one or more identified comorbidities were removed from the analysis.

^a*p* values < 0.05 were considered statistically significant.

^bAdjusted by age, gender, race, language, aid category, and risk scores.

GI, General intervention; IP, Inpatient admissions; LCNWPA, Lehigh/Capital-New West Pennsylvania (service area); MCO, Managed care organization; PI, Personalized intervention; PKPY, Per thousand per year; SEPA, southeastern Pennsylvania (service area).

subcohort) were significant in LCNWPA ($p < 0.01$ for both), but not significant in SEPA ($p = 0.50$ for both).

Discussion

Multifaceted MCO-initiated interventions targeting members with asthma, MCO staff, and their network providers in two demographically diverse Pennsylvania-based Medicaid MCOs were successful in improving medication adherence rates for asthma controller medications and decreasing all-cause and asthma-related acute hospitalization rates. When MCO cohorts were subdivided by intervention type, PI cohorts (consisting of higher-risk members with asthma subject to PIs) showed greater improvements in PDC rates and mostly comparable acute hospitalization rates to GI cohorts, despite the former's greater asthma burden.

While simple interventions can be highly successful in improving short-term adherence, maintaining improvements in long-term adherence and acute hospitalization rates remains a challenge. A systematic review of 70 randomized controlled trials reported that 36 out of 83 interventions were associated with improvements in adherence, but only 25 were effective in improving at least one treatment outcome (30). Nearly all of these interventions were complex, yet individually displayed only modest benefits. A systematic review of 62 studies prepared for the Agency for Healthcare Research and

Quality found the strongest evidentiary support for short-term improvements in adherence and symptom relief in three unrelated care management programs, including medication self-management programs in patients taking asthma medications (31). AmeriHealth Caritas' multifaceted, population-based managed care strategy helped "move the needle" favorably in improved adherence to controller medications and decreased acute hospitalizations resulting from unmanaged asthma-related sequelae.

We should note that low- versus high-risk designations in this study partially, but not completely, overlap with the clinical designations of moderate versus severe asthma, respectively. The low-risk asthma population included members with a primary diagnosis of asthma. The high-risk asthma population analyzed included those who 1) were diagnosed with persistent asthma; 2) had one or more acute hospitalizations in 12 months; 3) have an unstable medical and behavioral health or support situation; 4) have pregnant status with an asthma-related inpatient admission; 5) have no available pharmacy data for controller medications; and/or 6) had four or more rescue medication fills within a four-month period. Members with low-risk asthma in the GI subcohort received GIs (like asthma-related educational material and automated message reminders), while members with high-risk asthma in the PI subcohort received individualized interventions (like telephonic care management). Improvements in medication adherence to asthma controllers

were significantly greater in higher-risk members in the PI subcohort than lower-risk members in the GI subcohort ($p < 0.01$), although these differences did not consistently translate into statistically significant improvements in all-cause or asthma-related acute hospitalization rates. Members in the PI subcohort shared a greater degree of engagement in asthma self-management, but also a higher asthma burden at baseline compared to members in the GI subcohort, so the statistical comparability in acute hospitalization rates between the two SEPA subcohorts was, in itself, a positive accomplishment. This selection bias of high-risk members' greater prevalence in a PI subcohort is consistent with our prior study identifying enrollment in care management as a risk factor for acute hospitalization in Medicaid members prescribed hypoglycemics, statins, and/or antihypertensives (32). In addition to greater medication adherence monitoring, subjects in the PI subcohort required more personalized, coordinated care. This trend remained consistent when members with asthma taking antihypertensives, hypoglycemics, and statins were included in the analysis.

Beyond member-targeted initiatives, network providers were also offered multiple MCO-supported tools to improve member engagement in medication adherence: provider mailings; free continuing medical education-certified medication adherence and cultural competency training; provider portal access to member clinical summaries and care gap alerts (triggered by overdue medication refills); provider shared savings programs with medication adherence measures; and point-of-care dispensation followed by on-site education of asthma medication and supplies from secured medication cabinets in the provider's office (*Breathe Easy. Start Today* [BEST] program). Provider-led member referrals to MCO-led telephonic care management were also enhanced to promote medication adherence and instructions on using member care gap information (*Let Us Know* program).

The multifaceted approach to AmeriHealth's comprehensive asthma management strategy limits our ability to identify the contribution of each initiative to adherence-related outcomes, but some inferences can be made concerning the extent of impact of several initiatives listed in Table 1 (see Supplemental Table 2 for engagement rates). First, the specific process measures implemented (e.g., adherence-related enhancements to the medical management platform) were unlikely, in isolation, to drive population-level improvements. Additionally, other initiatives had relatively few participants with asthma (e.g., pill station program, where no statistically significant differences in medication adherence or medical cost were observed between pre- and post-periods), were newly implemented, or were community outreach programs

providing adherence-related education to members with a variety of chronic conditions, including asthma (e.g., *Health Empowerment Tour* and *4 Your Kids Care* programs). Conversely, MCO-led telephonic care management was found to be especially impactful for high-risk adult members with asthma. More than 1800 mostly adult members in the SEPA region alone were open to care management at some point during the year (Supplemental Table 2). Post-discharge engagement of Medicaid members with asthma following an inpatient readmission — criteria that would have resulted in subject inclusion into this study — drove a 20% decrease in 30-day hospital readmissions (33). Post-discharge engagement of members with chronic conditions (including asthma) was primarily supported by MCO-led telephonic care management, whereby increasing member engagement frequency was inversely proportional to lower likelihood of 30-day hospital readmissions (i.e., three or more post-discharge calls were more effective than either two or one). Even casual telephonic engagement fosters member awareness of their health-related needs. Care managers are trained to spontaneously identify potentially serious issues and assist in addressing them before they require emergency care. The positive effect is greatly amplified when managing high-risk members, especially those with other comorbid conditions who display higher rates of medication adherence and care management engagement (32), and when care managers complete validated medication adherence assessments and care gap surveys on behalf of targeted members, thereby uncovering additional assessment-focused concerns. Pediatric members with asthma were primarily impacted by another combination of initiatives, including the BEST asthma and drug therapy management programs, where 86% and 40% of participants were 12 years or under, respectively.

Some initiatives were successfully operationalized in later years, while other initiatives were not. For example, automated refill messaging consisted of outbound call prior to the refill due date and after a refill date has been missed, was discontinued due to 1) low authentication rates (designed to ensure that messages went to the targeted individual) and 2) a low rate of members taking action following outreach calls. By contrast, the BEST asthma program has grown to serving more than 10,000 members in Pennsylvania and the District of Columbia, with maintenance medication refills accounting for more than 60% of prescriptions. Additionally, MCO-employed asthma health navigators were later embedded into high-volume pediatric hospitals to support care management for high-risk asthma pediatric members, serving as an extension of the practice and MCO care management by providing face-to-face care coordination, environmental home assessments, and asthma-related education for

pediatric members and their families, while addressing the social determinants impacting member health. Lessons learned during this study greatly enhanced our comprehensive asthma management strategy enterprise-wide, resulting in the selection of AmeriHealth Caritas as the 2016 health plan winner for the Environmental Protection Agency's National Environmental Leadership Award (34).

Our analyses are subject to a number of limitations. First, selection bias affected the relatively higher acute hospitalization rates of the PI versus the GI subcohorts and the adherent versus non-adherent cohorts. Most of the higher utilization rates observed in the PI and adherent cohorts during the study period, however, were not statistically significant. Depending on their level of asthma severity, all affected members receive a basic level of asthma outreach, whether written correspondence, telephonic contact, or via community-based programming, so a non-intervention control cohort was unavailable. Second, inherent limitations exist in using pharmacy refill data to calculate medication adherence, including medication tracking by fill date as a proxy for utilization and lack of capacity to validate proper medication administration. Third, although statistically significant, changes in medication adherence between 2012 and 2013 overall and in the PI cohort were rather modest in absolute numerical terms and well below full adherence levels (PDC > 80%). Therefore, MCOs should regularly evaluate new adherence-improvement programs and re-evaluate the effectiveness of its existing programs in their aim to help members achieve full medication adherence.

Conclusion

This unique study reports on the results of employing a multifaceted array of interventions—with GIs for low-to-medium-risk subjects and PIs for higher-risk care-managed subjects—as an effective approach in asthma management for member populations belonging to two sociodemographically diverse Medicaid MCOs. Medication adherence rates significantly improved and acute hospitalization rates (both all-cause and asthma-related) were significantly reduced during the study period in both MCO cohorts. Additionally, PIs targeted to the level of member need were successful in significantly improving adherence compared to GIs, and—despite including high-risk members with a greater asthma burden—showing statistically comparable reductions in acute hospitalization rates in the more populous of the two MCOs.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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References

1. 2014 National Health Interview Survey (NHIS) Data. Centers for Disease Control and Prevention [Internet]. 2016 Jan [cited 2017 Mar 8]. Available from: <http://www.cdc.gov/asthma/nhis/2014/data.htm>.
2. 2014 Asthma Data: Behavioral Risk Factor Surveillance System (BRFSS) Prevalence Tables and Maps. Centers for Disease Control and Prevention [Internet]. 2016 [cited 2017 Jun 2]. Available from: <https://www.cdc.gov/asthma/brfss/2014/default.htm>.
3. Malomo M. Pennsylvania Asthma Focus Report: Inpatient Hospitalizations with Asthma as the Primary Discharge Diagnosis. Pennsylvania Department of Health. Harrisburg (PA); 2015.
4. Bryant-Stephens T. Asthma disparities in urban environments. *J Allergy Clin Immunol*. 2009;123(6):1199–1206. doi:10.1016/j.jaci.2009.04.030. PMID:19501229.
5. Barnes PJ, Jonsson B, Klim JB. The costs of asthma. *Eur Respir J*. 1996;9(4):636–642. doi:10.1183/09031936.96.09040636. PMID:8726924.
6. Butz A, Morpew T, Lewis-Land C, Kub J, Bellin M, Ogborn J, Mudd SS, Bollinger ME, Tsoukleris M. Factors associated with poor controller medication use in children with high asthma emergency department use. *Ann Allergy Asthma Immunol*. 2017;118(4):419–426. doi:10.1016/j.anai.2017.01.007. PMID:28254203.
7. Capo-Ramos DE, Duran C, Simon AE, Akinbami LJ, Schoendorf KC. Preventive asthma medication discontinuation among children enrolled in fee-for-service Medicaid. *J Asthma*. 2014;51(6):618–626. doi:10.3109/02770903.2014.895010. PMID:24580372.
8. Piecoro LT, Potoski M, Talbert JC, Doherty DE. Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state Medicaid population. *Health Serv Res*. 2001;36(2):357–371. PMID:11409817.
9. Sullivan SD, Rasouliyan L, Russo PA, Kamath T, Chipps BE. Extent, patterns and burden of uncontrolled disease in severe or difficult-to-treat asthma. *Allergy*. 2007;62(2):126–133. doi:10.1111/j.1398-9995.2006.01254.x. PMID:17298420.
10. Priest JL, Cantrell CR, Fincham J, Cook CL, Burch SP. Quality of care associated with common chronic diseases in a 9-state Medicaid population utilizing claims data: an evaluation of medication and health care use and costs. *Popul Health Manag*. 2011;14(1):43–54. doi:10.1089/pop.2010.0019. PMID:21142926.
11. Nestor A, Calhoun AC, Dickson M, Kalik CA. Cross-sectional analysis of the relationship between national

- guideline recommended asthma drug therapy and emergency/hospital use within a managed care population. *Ann Allergy Asthma Immunol.* **1998**;81(4):327–330. doi:10.1016/S1081-1206(10)63124-9. PMID:9809496.
12. Auger KA, Kahn RS, Davis MM, Simmons JM. Pediatric asthma readmission: asthma knowledge is not enough? *J Pediatr.* **2015**;166(1):101–108. doi:10.1016/j.jpeds.2014.07.046. PMID:25241184.
 13. Rust G, Zhang S, Reynolds J. Inhaled corticosteroid adherence and emergency department utilization among Medicaid-enrolled children with asthma. *J Asthma.* **2013**;50(7):769–775. doi:10.3109/02770903.2013.799687. PMID:23734973.
 14. Rust G, Zhang S, McRoy L, Pisu M. Potential savings from increasing adherence to inhaled corticosteroid therapy in Medicaid-enrolled children. *Am J Manag Care.* **2015**;21(3):173–180. PMID:25880622.
 15. Rust G, Zhang S, Holloway K, Tyler-Hill Y. Timing of emergency department visits for childhood asthma after initial inhaled corticosteroid use. *Popul Health Manag.* **2015**;18(1):54–60. doi:10.1089/pop.2013.0126. PMID:25046059.
 16. Andrews AL, Teufel RJ 2nd, Basco WT Jr. Low rates of controller medication initiation and outpatient follow-up after emergency department visits for asthma. *J Pediatr.* **2012**;160(2):325–330. doi:10.1016/j.jpeds.2011.07.037. PMID:21885062.
 17. Camargo CA Jr, Ramachandran S, Ryskina KL, Lewis BE, Legorreta AP. Association between common asthma therapies and recurrent asthma exacerbations in children enrolled in a state Medicaid plan. *Am J Health Syst Pharm.* **2007**;64(10):1054–1061. doi:10.2146/ajhp060256. PMID:17494905.
 18. Shireman TI, Heaton PC, Gay WE, Cluxton RJ, Moomaw CJ. Relationship between asthma drug therapy patterns and healthcare utilization. *Ann Pharmacother.* **2002**;36(4):557–564. doi:10.1345/aph.1A067. PMID:11918499.
 19. Celano MP, Linzer JF Sr, Demi A, Bakeman R, Oyeshiku Smith C, Croft S, Kobrynski LJ. Treatment adherence among low-income, African American children with persistent asthma. *J Asthma.* **2010**;47(3):317–22. doi:10.3109/02770900903580850. PMID:20394517.
 20. Kenyon CC, Rubin DM, Zorc JJ, Mohamad Z, Faerber JA, Feudtner C. Childhood asthma hospital discharge medication fills and risk of subsequent readmission. *J Pediatr.* **2015**;166(5):1121–1127. doi:10.1016/j.jpeds.2014.12.019. PMID:25641244.
 21. Chang J, Freed GL, Prosser LA, Patel I, Erickson SR, Bagozzi RP, Balkrishnan R. Comparisons of health care utilization outcomes in children with asthma enrolled in private insurance plans versus Medicaid. *J Pediatr Health Care.* **2014**;28(1):71–79. Erratum in: *J Pediatr Health Care* **2014**;28(2):185. doi:10.1016/j.pedhc.2012.11.001. PMID:23312366.
 22. Herndon JB, Mattke S, Evans Cuellar A, Hong SY, Shenkman EA. Anti-inflammatory medication adherence, healthcare utilization and expenditures among Medicaid and children's health insurance program enrollees with asthma. *Pharmacoeconomics.* **2012**;30(5):397–412. doi:10.2165/11586660-000000000-00000. PMID:22268444.
 23. Bloomberg GR, Banister C, Sterkel R, Epstein J, Bruns J, Swerczek L, Wells S, Yan Y, Garbutt JM. Socioeconomic, family, and pediatric practice factors that affect level of asthma control. *Pediatrics.* **2009**;123(3):829–835. doi:10.1542/peds.2008-0504. PMID:19255010.
 24. Auger KA, Kahn RS, Davis MM, Beck AF, Simmons JM. Medical home quality and readmission risk for children hospitalized with asthma exacerbations. *Pediatrics.* **2013**;131(1):64–70. doi:10.1542/peds.2012-1055. PMID:23230073.
 25. Vaidya V, Gupte R, Balkrishnan R. Failure to refill essential prescription medications for asthma among pediatric Medicaid beneficiaries with persistent asthma. *Patient Prefer Adherence.* **2013**;7:21–26. doi:10.2147/PPA.S37811. PMID:23341734.
 26. Bauers S. Addressing Phila. asthma crisis. *The Philadelphia Inquirer.* **2015** April 18 [accessed 2017 Feb 10] (subscription required). http://articles.philly.com/2015-04-18/news/61257715_1_asthma-crisis-asthma-symptoms-high-pollen-counts.
 27. Asthma Capitals™ **2015**. Asthma and Allergy Foundation of America [Internet]. 2015 [cited 2017 Mar 8]. Available from: <http://www.aafa.org/page/asthma-capitals.aspx>.
 28. Children's Asthma in Philadelphia. *PediatricAsthma.org* [Internet]. **2005** [cited 2017 Mar 8]. Available from: http://www.pediatricasthma.org/community_coalitions/philadelphia.
 29. Barner JC. Assessing Medication Adherence and Persistence. International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Student Forum Presentation, **2010** Feb [cited 2017 Mar 8]. Available from: <https://www.ispor.org/student/teleconferences/ISPORStudentForumPresentation022410.pdf>.
 30. Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev.* **2008**;2:CD000011. PMID:18425859.
 31. Viswanathan M, Golin CE, Jones CD, et al. Medication adherence interventions: Comparative effectiveness. Closing the quality gap: Revisiting the state of the science. Evidence Report No. 208. AHRQ Publication No. 12-E010-EF. Rockville (MD): Agency for Healthcare Research and Quality; **2012**.
 32. Gelzer AD, Gao W, Keleti D, Donia T, Downey T, Michael KE. Risk factors for medication nonadherence and acute hospital utilization in Medicaid recipients prescribed hypoglycemics, statins, and antihypertensives. *J Manag Care Med.* **2016**;19(1):52–67.
 33. Gao W, Keleti D, Donia TP, Jones J, Michael KE, Gelzer AD. Post-discharge engagement decreased hospital readmissions in Medicaid populations. *Am J Manag Care.* **2018**; In Press.
 34. U.S. Environmental Protection Agency. National Environmental Leadership Award in Asthma Management: **2016** Award Winners. [Internet]. 2017 [cited 2017 Mar 8]. Available from: <https://www.epa.gov/asthma/national-environmental-leadership-award-asthma-management>.

Supplementary Material

Supplemental Table 1: Baseline PDC by sociodemographic variables by managed care organization

		LCNWPA			SEPA		
		PDC Mean	PDC STD	<i>p</i> value	PDC Mean	PDC STD	<i>p</i> value
Age	5–17	41.2	12.7	0.06	42.5	13.1	<0.01
	18–39	40.4	13.4		43.1	12.8	
	40–64	43.2	13.0		45.5	12.9	
Gender	Female	42.3	13.1	0.20	43.7	12.9	0.07
	Male	41.1	12.6		42.8	13.1	
Language	English	42.4	13.0	0.10	43.2	13.1	0.32
	Spanish	40.3	12.4		44.8	12.2	
	Other	40.3	13.0		43.9	13.0	
Race	Black	44.0	12.7	0.03	43.1	12.9	0.20
	Caucasian	42.5	13.2		44.2	13.3	
	Other	40.5	12.6		43.6	13.3	
Aid category	SSI	41.9	13.1	0.83	44.4	13.0	< 0.01
	Non-SSI	41.7	12.8		42.5	13.0	

LCNWPA, Lehigh-Capital/New West Pennsylvania (service area); PDC, Proportion of days covered; SEPA, southeastern Pennsylvania (service area); SSI, Supplemental Security Income; STD, Standard deviation.

Supplemental Table 2: Engagement in select initiatives as part of comprehensive asthma strategy

Initiative	Brief description	Engagement data (2013–2014)
<i>Breathe Easy. Start Today.</i> ® (B.E.S.T.) asthma program	Point-of-service provider-led dispensation of asthma medication and supplies, as well as education on their appropriate use.	Almost 1,500 participating members, with 649 corticosteroids prescribed from 2013 to mid-2014, with 86% of them children, ages 12 or under.
Asthma care management	Telephonic person -centered approach to coordinate member healthcare and support services for driving better outcomes.	Almost 1,800 members in the SEPA region alone had care management sometime during the 2014 year, with 75% of them adults, ages 18 years and older.
<i>Health Empowerment Tour: 40-Day Journey to Better Health</i> program	Community outreach program for members to learn about health with cooking demonstrations and other activities, as well as receiving health screenings.	General health education of 278 adult members, with relatively few diagnosed with asthma.
<i>4 Your Kids Care</i> program	Community outreach program for parents or caregivers of members on what to do when one’s child gets sick.	Education of the parents or caregivers of 515 pediatric members, 35%–40% on average diagnosed with asthma.
Drug therapy management program	Pharmacist-based interventions from the PBM and care management from the MCO combine to reduce the incidence of medication-related problems and improve the delivery of member care.	Participation of 174 members in SEPA and LCNWPA regions, with 40% of them children, ages 12 or under.
Pill station program	Members taking multiple medications are supplied with a pill station to assist them in becoming more adherent in taking their prescribed medications.	Participation of only 32 members in SEPA and LCNWPA regions.

LCNWPA, Lehigh-Capital/New West Pennsylvania (service area); MCO, Managed care organization; PBM, Pharmacy benefit manager; SEPA, Southeastern Pennsylvania (service area).