

# Chester Smiles: A Collaborative Public Health Initiative to Improve Dental Care in an Underserved Community

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## Abstract

This community-based, one-year follow-up study analyzes Chester Smiles, a health plan-supported dental initiative aiming to improve access and quality of dental care in an underserved community. The program leverages relationships with regional public health stakeholders and supports mobile dental care delivery in Chester, Pennsylvania, USA. Utilization and expenditures are compared among three Chester-based cohorts and one Reading comparator cohort (provided standard dental outreach), using two-sample and multivariate repeated-measure analysis to compare pre- and post-index data. Post-index dental access, preventive treatment and associated expenditures significantly increased in Chester, but decreased or remained unchanged in Reading. A 12-percent baseline gap in annual dental visits between Chester and the Southeastern Pennsylvania service area was dramatically reduced. While baseline utilization and expenditures in Reading were significantly higher than in Chester, parity in post-index utilization and expenditures was achieved without weakening existing traditional dental provider networks. Chester Smiles demonstrates how payer-provider-community collaboration in public dental health—coupled with alternate vehicles in care delivery, personalized dental care management, and educational programming—promote personalized dentistry at the member level and address environmental, socioeconomic, and psychobehavioral barriers to dental care in an underserved population.

**Keywords:** Public Health Dentistry, Dental Health Services, Mobile Dental Vans, Preventive Utilization, Restorative Utilization, Health Disparities

## INTRODUCTION

Addressing access- and utilization-based disparities in dental care is a priority in underserved communities throughout the United States. Poor oral care is prevalent, preventable, and exacerbates other physical health conditions, but only one in five Medicaid-eligible children from low-income households makes a single dental visit [1]. Medicaid is a government-funded insurance program providing health care coverage to 69 million primarily low-income Americans, including children, pregnant women, parents, and individuals with disabilities [2].

Pennsylvania has 159 dental health professional shortage areas (DHSAs), including the city of Chester, Pennsylvania [3]. Chester has a large underserved population, with nearly one-third of residents living below the federal poverty level (\$12,060 annual income for individuals; \$24,600 for a four-

person family) [4]. Unlike the comparably low-income city of Reading, Chester residents have limited access to dental care; in 2011, only four dental providers practiced in Chester. Consequently, over 50% of Chester-residing Medicaid members had not visited a dentist during the prior two years (based on Keystone First dental claims).

Keystone First is Pennsylvania's largest Medicaid managed care health plan serving more than 400,000 members across Southeastern Pennsylvania. Keystone First implemented Chester Smiles, a dental initiative designed to promote awareness, education, and access to dental care for Chester residents by coordinating care with dental providers, hosting community events, and providing public access to mobile dental clinics. Mobile dental units have been used for decades to provide access to dental services for remote [9] and/or underserved populations [5-8]. A Medline review of UK-based dental studies targeting underserved populations

concluded that providing mobile clinics in schools was one of the most effective approaches to increasing dental utilization [9]. A California-based study reported that mobile dental clinic participants were all low-income individuals, and primarily elementary and preschool children, non-English speakers, and Medicaid-eligibles [10]. About half of the clinics provided services in designated DHSAs.

Chester Smiles combines mobile clinic services with telephonic dental care management and educational programming to deliver precision dentistry at the member level and address barriers to dental care in underserved populations. In this manner, the program functions by targeting dental treatment to a patient's individualized needs on the basis of environmental, socioeconomic, and psychobehavioral determinants of health impacting the delivery of dental care to improve oral health outcomes [11]. Our hypothesis was that offering mobile dental clinic services to a low-income population in an underserved community would increase preventive dental care delivery and bring population-level dental utilization into line with more advantaged communities.

## **PATIENTS AND METHODS PENNSYLVANIA MEDICAID ELIGIBILITY**

Participation in Pennsylvania Medicaid is generally limited to 1) U.S. nationals, citizens, legal aliens, or permanent residents; and 2) Pennsylvania residents with low incomes (\$15,800 annual income for individuals; \$32,319 for a four-person household) [12].

## **DESCRIPTION OF MOBILE DENTAL CLINIC**

Dentex Dental Mobile, a Philadelphia-based dental service provider, was contracted to operate the mobile dental clinics outfitted with a comprehensive range of state-of-the-art dental equipment to perform preventative and diagnostic procedures, including: at least two operatories with high-speed and low-speed dental drills; a handheld digital X-ray imaging device; two sterilization systems (one cold sterilization and one autoclave unit); central dry suction; central air compressor; three roof-mounted air conditioners; two propane heaters; two diesel generators; restroom; self-contained fresh water system; propane water heater; automatic leveling system; two onboard computers for patient insurance information and medical imaging; sphygmomanometers to test for hypertension; and a waiting area for patients.

In each van, patients are treated by a licensed dentist and dental auxiliary staff (dental hygienists and assistants). Although mobile dental clinics served as de facto primary

care dental locations to increase access to dental care, traditional dental practices continued to receive member referrals from Keystone First. The mobile clinics operated on a 9:00 a.m. to 5:00 p.m. schedule, Monday through Friday, at fixed locations throughout the city, providing full-service dental and follow-up care. Uninsured individuals were also welcome to use the mobile facilities at no cost to the patient.

## **COMMUNITY PARTNERSHIPS AND EDUCATION EVENTS**

In 2011, President Obama launched the Strong Cities, Strong Communities (SC2) initiative, selecting Chester as one of seven participating cities "eligible to compete for comprehensive economic planning assistance through a grant competition [13]." Under this program, city administrators received training and support from the U.S. Department of Health and Human Services (DHHS), who assisted Chester's Bureau of Health in developing a strategic plan to address local health disparities.

In 2012, Keystone First contacted stakeholders and community partners in Chester-including the mayor's office, community advocacy groups, Widener University, and area hospitals-forming the Chester Smiles Initiative to develop community partnerships and vet locations for mobile dental clinics. Now called the Healthy Chester Coalition, its role under the regional director of the DHHS has evolved to promote SC2 objectives through collaborations "to leverage resources to deliver health care services to the citizens of Chester efficiently and effectively" and build a healthier community [14].

Weekly advertisements with mobile clinic schedules and locations were published in local newspapers and covered by regional media, thereby increasing the program's visibility to Chester residents. In addition to operating mobile dental clinics, Chester Smiles also sponsored and participated in dental education programs and community events, offering free teeth cleanings to attendees.

## **IDENTIFICATION, APPOINTMENT SCHEDULING AND FOLLOW UP OF MEMBERS**

Chester members lacking dental services over the past two years were contacted by care managers from Keystone First's Rapid Response and Outreach Team to be introduced to the program and reconnected with dental services. Care managers also assisted with scheduling appointments by calling at the mobile clinic or with traditional provider offices, and monitored mobile dental follow-up visits via the Dentex Dental informatics scheduling and reporting system.

## STUDY DESIGN AND POPULATION

This prospective, interventional study combined a pre/post comparison with a quasi-two-arm (intervention versus comparator) experimental design.

Of Chester's 34,000+ residents, nearly one-third (>11,000) are Keystone First members. Four study cohorts were analyzed. The Chester mobile cohort included members (N=830) who received dental services from mobile clinics in Chester (ZIP code 19013) and met all of the inclusion criteria below. To evaluate the population-level impact of the mobile clinic intervention, three additional study cohorts who met all requisite inclusion criteria were analyzed. The first population cohort was a mobile-included Chester population cohort inclusive of all Chester-residing members (N=9,634), including Chester mobile participants. The second population cohort was a mobile-excluded Chester population cohort consisting of members who did not visit or were otherwise excluded from the mobile cohort-i.e., the Chester population cohort minus the Chester mobile cohort (N=8,729). The third population cohort, functioning as a nonequivalent comparator cohort, included Reading-residing (ZIP codes 19601-19612) members of an affiliated health plan serving the Lehigh/Capital-New West Pennsylvania (LCNWPA) service area (N=21,769) who were provided traditional dental outreach.

Inclusion criteria for the aforementioned cohorts included plan enrollment for at least 6 months pre- and post-index date during pre/post 12-month windows. The index date is defined as the date of the member's first visit to the mobile dental clinic for the Chester mobile cohort or April 01, 2012 for the population cohorts.

## DENTAL UTILIZATION AND EXPENDITURES

All dental service-related claims were extracted from Keystone First's dental or medical claims database using dental procedure codes and/or primary dental diagnosis codes. Medical claims for dental services delivered in office settings and dental claims were classified as "office-based claims." The remaining medical claims were classified as "facility-based claims" (i.e., ambulatory surgical center, emergency room, inpatient and outpatient dental services). Dental claims were further subcategorized into preventive dental services (including prophylaxis, X-rays, oral examination, and topical fluoride and sealant administration) and restorative dental services (including composite resin administration, dental implants, and oral surgery) [15]. In the absence of a dental code, a claim was categorized as "restorative."

Time frames for utilization and cost analyses were

delineated relative to the service date-one year before (baseline or pre-index period) and one year after (post-index period). Utilization and cost of dental care was calculated and normalized to per thousand members per year (PKPY) and per member per month (PMPM) data, respectively.

## ANNUAL DENTAL VISITS

The Healthcare Effectiveness Data and Information Set (HEDIS<sup>®</sup>) measure of annual dental visits (ADV) is the percentage of members ages 2 to 21 who had at least one dental visit during the measurement year (May 2012 to December 2013) in Chester versus the entire Southeastern Pennsylvania (SEPA) service area.

Measurement specifications included parameters for continuous enrollment; i.e., no more than one gap in member enrollment of up to 45 days during the measurement year and no more than a 30-day gap in coverage. The anchor date was December 31st of the measurement year. Members were recorded as having annual dental visits if the encounter contained either a dental claim or a dental-related medical claim. Monthly HEDIS percentages, run monthly on a year-to-date basis, were calculated as rolling 12-month averages starting from the prior year.

## STATISTICAL ANALYSIS

Signed rank tests were performed to compare pre- and post-index utilization and cost by claim source and category for each cohort. Wilcoxon-Mann-Whitney two-sample tests were performed to compare pre- and post-index utilization and cost, as well as changes in pre- to post-index utilization between the intervention and comparator cohorts by claim source and category. Bootstrap methods were used to compute 95% confidence intervals (CI) of utilization and cost changes from pre- and post-index periods, as well as the differences between intervention and comparator cohorts.

To account for demographic differences between Chester and Reading cohorts, repeated measure analyses were performed (after controlling for covariates) comparing whether changes from pre- to post-index utilization and cost differed between intervention and comparator cohorts. All analyses were performed using SAS version 9.2 and SAS EG 6.1 (SAS Institute, Cary, NC, USA). *P*-values <0.05 were considered statistically significant.

## RESULTS SUBJECT CHARACTERISTICS

Of the 1,695 participants visiting the mobile dental clinics,

1,665 were Keystone First members, 1,050 of whom were Chester residents. Seventy-nine percent of participating Chester-residing members met eligibility criteria for inclusion into the mobile cohort (n=830).

The demographic characteristics of the four cohorts are as follows (**Table 1**): 1) two-thirds of the Chester mobile cohort was female and one-third was male, while 57% to 58% of the remaining cohorts were female; 2) the majority in all four cohorts (56% to 60%) was under the age of 17, whereas only 9% to 15% was age ≥46; 3) English was the primary language for the vast majority of the population in the Chester cohorts (95% to 97%), but only 80% for the Reading cohort; 4) the racial majority in the Chester cohorts was black (85% to 90%) compared to only 10% in the Reading cohort, while the ethnic majority in the Reading cohort was Hispanic (66%) compared to <10% in the Chester cohorts.

Based on patient intake information, 28% of mobile dental participants had visited a dentist within the past year and 60% in the past three years. Conversely, 12% had not visited a dentist in the past five years and 9% had never visited a dentist. Thirty-two percent of mobile clinic survey participants scheduled a follow-up appointment (Dentex reporting database; unpublished observations).

## PROCEDURES PERFORMED IN MOBILE AND FACILITY-BASED DENTAL CLINICS

Diagnosis and preventive treatment accounted for 65% of the procedures performed in the mobile dental clinics, while restorative/tertiary treatment accounted for the remaining 35% (**Table 2**). Administration of dental composite resins and sealants as preventive treatments, followed by oral examinations, together accounted for >75% of all procedures performed. By contrast, oral surgery and emergency care together accounted for <1% of the dental care administered.

Among all Chester members, only 3.8% sought facility-based dental care, out of which only 4.3% sought preventive dental services, a different utilization profile from the mobile dental clinics. Facility-based preventive dental care is often provided in the form of specialty dental care to individuals with special needs [16]. However, for the vast majority of the Chester population, preventive dental care was delivered in an office setting.

## MOBILE DENTAL CLINICS INCREASED UTILIZATION AND ASSOCIATED SERVICE EXPENDITURES

The availability of mobile dental clinics in Chester was

**Table 1. Demographic Summary of Chester and Reading Study Cohorts.**

Demographic	N	%	N	%	N	%	N	%		
<b>Gender</b>										
Female	545	65.7%	5,624	58.4%	5,026	57.6%	12,376	56.9%		
Male	285	34.3%	4,010	41.6%	3,703	42.4%	9,393	43.1%	.01	.25
<b>Race</b>										
Black	746	89.9%	8,240	85.5%	7,426	85.1%	2,221	10.2%		
Caucasian	28	3.4%	678	7.0%	647	7.4%	5,516	25.3%	<.01	<.01
Other	56	6.7%	716	7.4%	656	7.5%	14,032	64.5%		
<b>Language</b>										
English	803	96.7%	9,148	95.0%	8,276	94.8%	17,348	79.7%		
Spanish	10	1.2%	122	1.3%	111	1.3%	3,270	15.0%	<.01	<.01
Unknown	17	2.0%	364	3.8%	342	3.9%	1,151	5.3%		
<b>Age group</b>										
<18 years	464	55.9%	5,731	59.5%	5,243	60.1%	12,803	58.8%		
18-30 years	201	24.2%	1,654	17.2%	1,419	16.3%	3,503	16.1%		
31-45 years	90	10.8%	888	9.2%	788	9.0%	2,378	10.9%	<.01	<.01
>45 years	75	9.0%	1,361	14.1%	1,279	14.7%	3,085	14.2%		
<b>Ethnicity</b>										
Hispanic	71	8.6%	860	8.9%	787	9.0%	14,295	65.7%		
Non-Hispanic	759	91.4%	8,774	91.1%	7,942	91.0%	7,474	34.3%	<.01	<.01

Source: Southeastern Pennsylvania and Lehigh/Capital-New West Pennsylvania claim data Chester mobile cohort, CMC; mobile-included Chester Population cohort, CMI; mobile-excluded Chester Population cohort, CME; Reading Comparator cohort, RCC. \* Chi-square tests were used to test the homogeneity of demographic factors between CMI and CME on one hand, and RCC on the other.

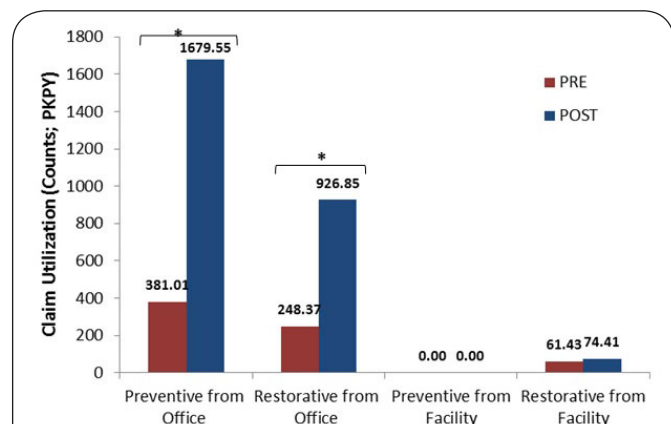


**Table 2. Utilization Profile of Procedures Performed at Mobile Clinics.**

Dental service provided	Proportion of total (%)
Oral examination	12.6
X-rays	7.8
Prophylactic care	11.5
Topical fluoride	4.6
Sealants	28.8
Restorative care	33.9
Oral surgery	0.5
Emergency care	0.3

expected to increase dental utilization and expenditures, especially in preventive care. Indeed, office-based utilization for the mobile cohort significantly increased between pre- to post-index periods from 381.01 to 1,679.55 PKPY (+1,298.54 PKPY; CI, 1,208.22 to 1,388.86; +341%;  $P < .01$ ) for preventive treatment, and from 248.37 to 926.85 PKPY (+678.48 PKPY; CI, 596.35 to 760.60; +273%;  $P < .01$ ) for restorative treatment (Figure 1, Table 3). Consistent with utilization results, the total service cost in the Chester mobile cohort significantly increased between pre- to post-index periods by \$28.83 PMPM (CI, 25.02 to 32.66; +406%;  $P < .01$ ). Service expenditures of office-based services significantly increased between pre- to post-index periods by \$13.75 PMPM (CI, 12.73 to 14.76; +565%;  $P < .01$ ) for preventive treatment and by \$13.17 PMPM (CI, 11.22 to 15.12; +397%;  $P < .01$ ) for restorative treatment.

Conversely, no facility-based preventive utilization and service expenditure was reported. The increases observed in facility-based restorative utilization and service expenditures were not statistically significant.

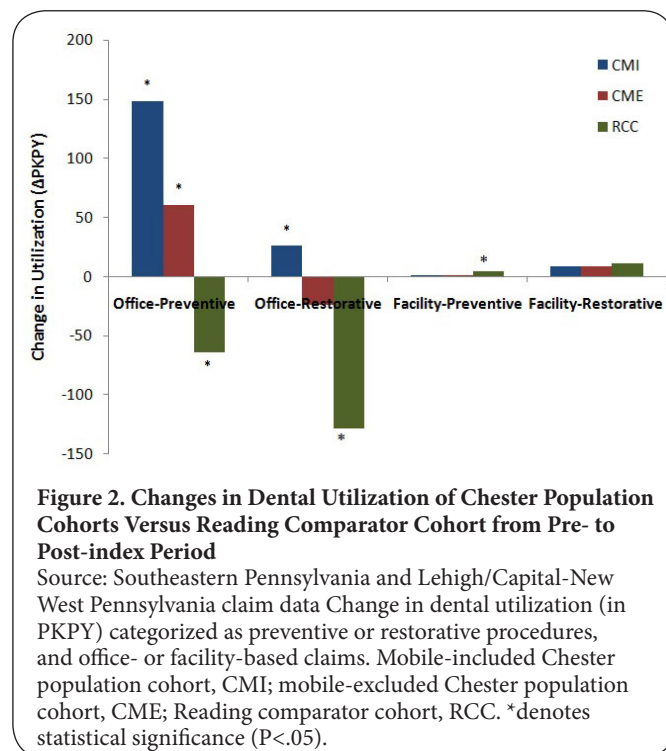


**Figure 1. Dental Utilization of Chester Mobile Participants in Pre- and Post-index Periods.**

Source: Southeastern Pennsylvania claim data Dental utilization (in PKPY) categorized as preventive or restorative procedures, and office- or facility-based claims based on dental claim codes. \*denote statistical significance ( $P < .05$ ).

## CHESTER SMILES INCREASED UTILIZATION IN CHESTER POPULATION

Increased dental utilization and expenditures afforded by the mobile clinic was expected to be reflected in the broader Chester member population. Indeed, office-based preventive utilization for the mobile-included Chester population cohort significantly increased between pre- to post-index periods from 729.20 to 877.30 PKPY (+148.09 PKPY; CI, 118.85 to 177.34; +20%;  $P < .01$ ; Figure 2, Table 4).



**Figure 2. Changes in Dental Utilization of Chester Population Cohorts Versus Reading Comparator Cohort from Pre- to Post-index Period**

Source: Southeastern Pennsylvania and Lehigh/Capital-New West Pennsylvania claim data Change in dental utilization (in PKPY) categorized as preventive or restorative procedures, and office- or facility-based claims. Mobile-included Chester population cohort, CMI; mobile-excluded Chester population cohort, CME; Reading comparator cohort, RCC. \*denotes statistical significance ( $P < .05$ ).

Other utilization changes were not statistically significant.

However, office-based utilization for the Reading cohort significantly decreased between pre- to post-index periods from 959.40 to 894.76 PKPY (-64.64 PKPY; CI, -84.87 to -44.41; -7%;  $P < .01$ ) for preventive treatment, and from 587.17 to 458.3 PKPY (-128.87 PKPY; CI, -150.72 to -107.02; -22%;  $P < .01$ ) for restorative treatment. Conversely, facility-based utilization significantly increased between pre- to post-index periods from 4.59 to 8.74 PKPY (+4.15 PKPY; CI, 2.44 to 5.87; +91%;  $P < .01$ ) for preventive treatment, and from 69.94 to 81.06 PKPY (+11.11 PKPY; CI, 1.83 to 20.39; +16%;  $P = 0.02$ ) for restorative treatment.

## CHESTER AND READING POPULATIONS ACHIEVED PARITY IN UTILIZATION

The increases in utilization and expenditures were com-

**Table 3. Utilization and Associated Cost of Dental Care in Chester and Reading Cohorts.**

Cohort	Type of Service	Category	Utilization (PKPY)					Cost Change (ΔPMPM)		
			Pre	Post	Post-Pre	% Change	P value *	Post-Pre	% Change	P value *
CMC	Office services	Preventive	381.01	1679.55	1298.54	340.8%	<.01	13.75	564.6%	<.01
		Restorative	248.37	926.85	678.48	273.2%	<.01	13.17	397.0%	<.01
	Facility services	Preventive	0.00	0.00	0.00	N/A	N/A	0.00	N/A	N/A
		Restorative	61.43	74.41	12.98	21.1%	.60	1.92	142.8%	.06
<b>All</b>		<b>All cost</b>						<b>28.83</b>	<b>406.1%</b>	<b>&lt;.01</b>
CMI	Office services	Preventive	729.20	877.30	148.09	20.3%	<.01	1.42	27.1%	<.01
		Restorative	468.73	494.16	25.44	5.4%	<.01	0.56	8.2%	<.01
	Facility services	Preventive	1.15	1.82	0.66	57.8%	.20	0.02	154.9%	.63
		Restorative	73.80	82.06	8.27	11.2%	.20	1.70	80.5%	.16
<b>All</b>		<b>All cost</b>						<b>3.70</b>	<b>26.2%</b>	<b>&lt;.01</b>
CME	Office services	Preventive	751.89	812.33	60.44	8.0%	<.01	0.41	7.5%	<.01
		Restorative	485.03	460.48	-24.54	-5.1%	.79	-0.36	-5.1%	.92
	Facility services	Preventive	1.27	2.00	0.73	57.8%	.20	0.03	154.9%	.63
		Restorative	75.53	83.77	8.25	10.9%	.26	1.79	81.3%	.38
<b>All</b>		<b>All cost</b>						<b>1.86</b>	<b>12.7%</b>	<b>&lt;.01</b>
RCC	Office services	Preventive	959.40	894.76	-64.64	-6.7%	<.01	-0.26	-2.9%	.07
		Restorative	587.17	458.30	-128.87	-21.9%	<.01	-2.77	-25.7%	<.01
	Facility services	Preventive	4.59	8.74	4.15	90.6%	<.01	0.09	130.7%	<.01
		Restorative	69.94	81.06	11.11	15.9%	.09	0.30	15.3%	.09
<b>All</b>		<b>All cost</b>						<b>-2.64</b>	<b>-12.2%</b>	<b>&lt;.01</b>

Sources: Southeastern Pennsylvania and Lehigh/Capital-New West Pennsylvania claim data  
 Chester mobile cohort, CMC; mobile-included Chester population cohort, CMI; mobile-excluded Chester population cohort, CME; Per member per month (PMPM); Per thousand members per year (PKPY); Reading comparator cohort, RCC.  
 \*denotes P value to test utilization and cost differences in each cohort between pre- and post-index periods using Signed rank tests. P values <.05 are considered statistically significant.

**Table 4. Utilization and Cost of Dental Care of Chester Population Cohorts Versus Reading Comparator Cohort.**

Type of Service	Category	Utilization (PKPY) P values*				Utilization Change (ΔPKPY)				
		CMI Pre	CMI Post	CME Pre	CME Post	CMI	CME	RCC	P values **	P values ***
Office services	Preventive	<.01	.60 <sup>‡</sup>	<.01	<.01	148.09	60.44	-64.64	<.01	<.01
	Restorative	<.01	<.01	<.01	.41	25.44	-24.54	-128.87	<.01	<.01
Facility services	Preventive	<.01	<.01	<.01	<.01	0.66	0.73	4.15	<.01	.05; .06 <sup>§</sup>
	Restorative	.35	.22	.48	.29	8.27	8.25	11.11	.66; .68	.31; .39
Type of Service	Category	Cost (PMPM) P values*				Overall Cost Change (ΔPMPM)				
		CMI Pre	CMI Post	CME Pre	CME Post	CMI	CME	RCC	P values **	P values ***
Office services	Preventive	<.01	<.01 <sup>‡</sup>	<.01	<.01	1.42	0.41	-0.26	<.01	<.01
	Restorative	<.01	<.01	<.01	.15	0.56	-0.36	-2.77	<.01	<.01
	<b>Subtotal</b>	<.01	<.01	<.01	<.01	1.98	0.05	-3.03	<.01	<.01
Facility services	Preventive	.02	<.01	.03	<.01	0.02	0.03	0.09	.06; .09	.02; .03 <sup>§</sup>
	Restorative	.20	.24	.32	.27	1.70	1.79	0.30	.84; .96	.54; .50
	<b>Subtotal</b>	.13	.07	.23	.09	1.72	1.81	0.39	.86; .76	.36; .32
<b>All</b>	<b>All</b>	<.01	<.01	<.01	<.01	3.70	1.86	-2.64	<.01	<.01

Sources: Southeastern Pennsylvania claim data  
 Utilization values (PKPY) used to generate P values seen on the left side of the table are displayed in Table 3. Mobile-included Chester population cohort, CMI; Mobile-excluded Chester population cohort, CME; Reading comparator cohort, RCC.  
 \* P value to test utilization or cost difference at pre- or post-index periods between CMI and RCC and between CME and RCC using Wilcoxon-Mann-Whitney two-sample tests. \*\* P value to test difference of utilization change or cost change from pre- to post-index periods between CMI and RCC and between CME and RCC using Wilcoxon-Mann-Whitney two-sample tests. \*\*\* P value to test the interaction effect from pre- to post-index periods by cohort (CMI vs. RCC and CME vs. RCC) after adjusting for demographic covariates. \*\*, \*\*\* P <.01 for both CMI-RCC and CME-RCC comparisons. Differing P values from CMI-RCC and CME-RCC comparisons were separated by a semicolon (CMI; CME). ‡, § Notable differences between utilization and cost (see manuscript text).

pared between the two city cohorts to determine whether underserved Chester achieved greater parity in dental care with higher-utilizing Reading. During the pre-index period, the Reading cohort had significantly greater utilization

than the mobile-included Chester population cohort for office-based preventive and restorative services, and facility-based preventive services (+230.19 PKPY [CI, 200.70 to 259.60], +118.44 PKPY [CI, 84.77 to 152.10], and +3.44

PKPY [CI, 2.15 to 4.73], respectively; **Figure 2, Table 4**). During the post-index period, parity was achieved in office-based preventive utilization between Chester population and Reading cohorts (877 versus 895 PKPY, +17.46; CI, -10.33 to 45.25). Interestingly, office-based restorative utilization in the Chester population cohort increased significantly beyond that observed in the Reading cohort (494 versus 458 PKPY, +35.87; CI, -66.03 to -5.70). These outcomes were the result of dramatically divergent pre- to post-index utilization changes between mobile-included Chester population and Reading comparator cohorts (+148% versus -65% in preventive services, and +25% versus -129% in restorative services, respectively). Conversely, the Reading cohort continued to have significantly greater facility-based preventive utilization than the mobile-included Chester population cohort (8.74 versus 1.82 PKPY, +6.93; CI, 5.27 to 8.58).

## CHESTER SMILES IMPACT BEYOND THE MOBILE CLINIC

To determine the impact of Chester Smiles beyond the direct provision of mobile dental services (e.g., advertising and referrals to traditional dental practices), a secondary utilization and cost analysis was performed on a mobile-excluded Chester population cohort. Office-based preventive utilization for the mobile-excluded Chester population cohort increased between pre- to post-index periods from 751.89 to 812.33 PKPY (+60.44 PKPY; CI, 30.25 to 90.63; +8%; **Figure 2, Table 4**). Other utilization changes were not significant.

Upon evaluating the Chester versus Reading populations, pre-index utilization differences between the mobile-excluded and -included Chester population cohorts were comparable to the Reading cohort. However, post-index office- and facility-based preventive utilization remained significantly greater in the Reading cohort than in the mobile-excluded Chester population cohort (+82.43 PKPY [CI, 53.71 to 111.10] and +6.74 PKPY [CI, 5.03 to 8.44], respectively). Post-index office- and facility-based restorative utilization remained comparable between the two cohorts.

A comparison of mobile-included and -excluded Chester population data demonstrates that mobile clinics had a significant impact toward driving greater office-based preventive and restorative utilization. During the pre-index period, office-based preventive and restorative utilization were significantly lower in both Chester cohorts than the Reading cohort. During the post-index period, office-based preventive utilization in the mobile-included Chester population cohort was comparable, while office-based restorative utilization significantly surpassed the Reading cohort. Conversely, office-based restorative utilization in

the mobile-excluded Chester population cohort was comparable, while office-based preventive utilization remained significantly below the Reading cohort.

## SERVICE EXPENDITURES EFFECTIVELY MIRRORRED UTILIZATION

Cost changes largely mirrored utilization during pre- and post-index periods for both Chester population cohorts versus the Reading cohort. Overall service expenditures provided to the Chester population cohorts increased between pre- to post-index periods by \$3.71 PMPM (CI, 1.12 to 6.28; +26%;  $P < .01$ ) for the mobile-included cohort, and by \$1.86 PMPM (CI, -0.96 to 4.69; +13%;  $P = .2$ ) for the mobile-excluded cohort. By comparison, overall service expenditures to the Reading cohort decreased by -\$2.64 PMPM (CI, -3.49 to -1.78; -12%;  $P < .01$ ; **Table 4**). The first driver of these cost differentials was the significant increases in utilization for office-based preventive treatments (for both Chester cohorts) and restorative treatments (for mobile-included Chester population cohort) in Chester. The second driver was the significant decreases in utilization for office-based preventive and restorative treatments in Reading.

Two notable differences were observed between post-index cost and utilization outcomes in Chester versus Reading. First, office-based preventive service costs were significantly lower in the mobile-included Chester population cohort than in the Reading cohort, while utilization was not significantly different (\* superscript in **Table 4**). Second, after adjusting for confounding effects from demographic covariates, facility-based preventive service costs were significantly lower in the mobile-included and -excluded Chester cohorts than in the Reading cohort, while utilization differences were of marginal significance (§ superscript in **Table 4**).

## CHESTER SMILES INCREASED HEDIS RATES

HEDIS\* ADV rates were measured for both Chester and SEPA (May 2012 to December 2013). Despite an almost 12% differential in Chester compared to the entire SEPA service area in May 2012, the gap was virtually eliminated by March to May 2013 (0.14% to 0.4%), before modestly increasing again in September 2013 (**Figure 3** or **Table 5**). Modest erosions in gains from peak utilization were observed from June to August 2013 and continued into December 2013. By contrast, little change in utilization was observed in Reading population or the entire LCNWPA service area.

## DISCUSSION

While Pennsylvania ranked fourth in 2012 among states

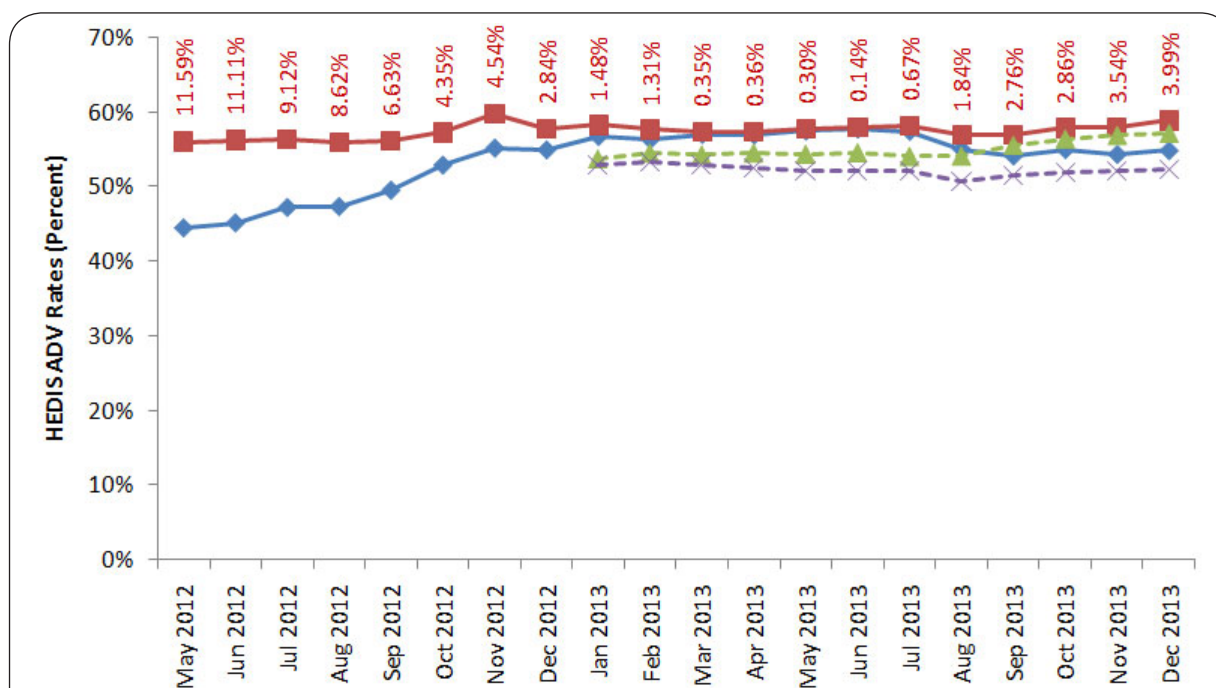


**Table 5. Comparison of Monthly HEDIS ADV Rates Between Chester and Southeastern Pennsylvania Service Area (2012 to 2013) and Between Reading and Lehigh/Capital-New West Pennsylvania Service Area (2013)**

Month Year	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	Oct 2012	Nov 2012	Dec 2012
<b>Chester</b>	44.44%	45.11%	47.19%	47.32%	49.52%	52.89%	55.18%	54.94%
<b>SEPA</b>	56.03%	56.22%	56.31%	55.94%	56.15%	57.24%	59.73%	57.79%
<b>Diff.</b>	-11.59%	-11.11%	-9.12%	-8.62%	-6.63%	-4.35%	-4.54%	-2.84%

Month Year	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013
<b>Chester</b>	56.76%	56.32%	57.03%	56.94%	57.50%	57.77%	57.45%	55.04%	54.12%	54.98%	54.34%	54.85%
<b>SEPA</b>	58.24%	57.63%	57.37%	57.31%	57.80%	57.91%	58.12%	56.88%	56.88%	57.84%	57.88%	58.84%
<b>Diff.</b>	-1.48%	-1.31%	-0.35%	-0.36%	-0.30%	-0.14%	-0.67%	-1.84%	-2.76%	-2.86%	-3.54%	-3.99%
<b>Reading</b>	53.70%	54.48%	54.24%	54.51%	54.35%	54.55%	54.04%	54.08%	55.56%	56.43%	56.90%	57.17%
<b>LCNWPA</b>	52.93%	53.35%	52.97%	52.62%	52.10%	52.17%	52.07%	50.74%	51.58%	51.92%	52.08%	52.39%
<b>Diff.</b>	-0.77%	-1.13%	-1.27%	-1.89%	-2.25%	-2.38%	-1.97%	-3.34%	-3.98%	-4.51%	-4.82%	-4.78%

Source: Southeastern Pennsylvania claims/HEDIS data  
 Chester and SEPA service area from May 1, 2012 through December 31, 2013. Reading and the entire LCNWPA service area from January 1, 2013 through December 31, 2013. Monthly HEDIS rates are 12-month rolling averages starting from the prior year.



**Figure 3. Comparison of Monthly HEDIS ADV Rates Between Chester and Southeastern Pennsylvania Service Area (2012 to 2013) and Between Reading and Lehigh/Capital-New West Pennsylvania Service Area (2013).**

Source: Southeastern Pennsylvania claims/HEDIS data  
 Chester (solid blue) and SEPA service area (solid red) from May 1, 2012 through December 31, 2013. Reading (dashed green) and the entire LCNWPA service area (dashed purple) from January 1, 2013 through December 31, 2013. Monthly HEDIS rates are 12-month rolling averages starting from the prior year.



in Medicaid expenditures [17], utilization of dental care services remains inadequate. In 2010, the percentage of children receiving preventive dental care was 36.9% (below the national average of 40.8%) [18].

As the primary dental payer in Chester, Keystone First is uniquely positioned to monitor the impact of Chester Smiles from a public health perspective on a major percentage of the city's population. The Chester Smiles program demonstrated how a health plan: 1) identified an underserved community; 2) applied clinical and financial resources to improve dental access; 3) collaborated with regional public health stakeholders to address the dental needs of the community; 4) improved utilization of dental care by engaging traditional and mobile dental provider services; and 5) increased member awareness of the importance of regular dental care.

The analysis described here primarily addresses mobile dental clinic utilization and service costs. Carr and colleagues reported that the most prevalent services provided (30% to 95%) by the mobile dental programs evaluated were oral examination, dental cleaning, restorative treatment, education, X-rays, screening, topical fluoride, sealants, emergency care, oral surgery, and fluoride varnish. Programs rarely provided specialty services ( $\leq 10\%$ ), like endodontic care [10]. This utilization profile is consistent with the Chester Smiles program.

Chester was selected because one-third of the city's population was Keystone First members, providing an opportunity to measure the program's effects at the population level. Provider partnerships were established among the city's key public health stakeholders, including the local dental provider network.

Chester Smiles demonstrated a measurable impact in dental utilization and associated expenditures both at cohort and population levels. Specifically, office-based preventive and restorative utilization and cost in the Chester cohorts increased from pre- to post-index periods (statistically significant in all but two instances), while office-based preventive and restorative utilization in the Reading cohort significantly decreased. Office-based preventive care provided by a dental team is an effective and cost-efficient approach for delivering routine dental care and avoiding dental-related emergency room visits [19]. Facility-based utilization and cost changes between pre- and post-index periods were statistically insignificant in the Chester cohorts, whereas facility-based utilization and cost changes in the Reading cohort significantly increased.

All Chester cohorts began the pre-index period with lower office- and facility-based utilization compared to the

Reading cohort, consistent with the former's designation as a dentally underserved community. During the post-index period, office-based restorative utilization in the mobile-included Chester population cohort was statistically greater than the Reading cohort, whereas preventive utilization was comparable. Despite its comparably low-income population, the greater number of dental access points in Reading was reflected in substantially higher dental utilization and lack of DHSA designation. Predictably, increased dental utilization occurred alongside higher service expenditures; early increases in preventive and restorative utilization are expected when addressing unmet clinical demand. Over time, demand for dental services is expected to reflect a predominance of preventive dental services with a concomitant reduction in restorative procedures. Likewise, potentially preventable dental-related medical expenses (e.g., emergency room claims) are expected to decrease over time as the population's oral health improves.

A secondary analysis of the mobile-excluded Chester population cohort demonstrated the substantial impact of Chester Smiles beyond the direct provision of mobile dental services (e.g., educational programming, word-of-mouth referrals to traditional dental practices). Specifically, Chester Smiles appears to have encouraged a measurable increase in office-based preventive utilization among Chester-based members who utilized existing, traditional dental practices instead of the mobile clinic services. In one example, the number of monthly member visits at a single Chester-based dental provider increased by 160% during the first seven months of the program (Keystone First dental claims; unpublished observations). However, the significant increase in office-based restorative utilization appears to be solely associated with mobile clinic utilization.

Monthly comparisons of HEDIS ADV measures between Chester and the wider region demonstrated success in closing the 12% Chester-SEPA gap in annual dental visits within a one-year period, although a modest erosion of gains was observed toward the end of the year as the program matured and clinic attendance plateaued. Several limitations are apparent in this study. Regional differences in service expenditures and other confounding variables precluded a fully controlled comparison of the Chester cohort. To minimize the impact of this limitation—including regression to the mean—a repeated measure statistical model was used to compare the Chester cohorts to the nonequivalent Reading comparator cohort. Moreover, the number of facility-based claims in all cohorts may be too small to draw any statistically reliable conclusions. Finally, improvements in HEDIS ADV rates in Chester should be examined within the context of annual increases throughout Keystone First's entire SEPA region since 2009 (Keystone First HEDIS data for SEPA; unpublished observations).

That said, the improvements observed in Chester were markedly greater than those observed region-wide during the same time period.

In summary, Chester Smiles demonstrated a measurable impact in dental utilization in dentally underserved Chester—including increased utilization of both preventive and restorative services and increases in annual dental visits. Despite increased spending in Chester, total cost remained significantly lower than in Reading.

## LIST OF ABBREVIATIONS

Annual dental visits (ADV); Confidence interval (CI); Dental health professional shortage areas (DHSAs); Department of Health and Human Services (DHHS); Healthcare Effectiveness Data and Information Set (HEDIS®); Lehigh/Capital-New West Pennsylvania (LCNWPA); Per member

per month (PMPM); Per member per year (PMPY); Per thousand members per year (PKPY); Place of service (POS); Southeastern Pennsylvania (SEPA); Strong Cities, Strong Communities (SC2)

## COMPETING INTEREST

The authors of this study have no conflicts of interest to declare.

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