

Variation in US Outpatient Antibiotic Prescribing Quality Measures According to Health Plan and Geography

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Antibiotic resistance has become one of the most pressing public health issues of our time. In 2013, the CDC published a report that quantified the dangers of antibiotic resistance in the United States. This report revealed a staggering statistic: at least 2 million illnesses and 23,000 deaths can be attributed each year to serious bacterial infections that are resistant to 1 or more antibiotics.¹ Further, it is well documented that antibiotic use is a main driver of antibiotic resistance.²⁻⁴ Antibiotics are life-saving drugs that are essential for treating bacterial illnesses, but unnecessary use for viral illnesses increases selective pressure that contributes to antibiotic resistance. Although antibiotic prescribing for children has improved since the 1990s, over half of all antibiotic prescriptions in the outpatient setting are still written for mild respiratory infections—many of which are caused by viruses.^{5,6} Antibiotic overprescribing also contributes to avoidable adverse drug events, such as *Clostridium difficile* infections.^{7,8}

Antibiotic prescribing has become increasingly viewed as an issue related to patient safety and quality of care. The Healthcare Effectiveness Data and Information Set (HEDIS) contains many healthcare quality measures. According to the National Committee for Quality Assurance (NCQA), HEDIS measures are used by more than 90% of US health plans to measure performance on important dimensions of care and service, and are also used by public health policy makers, the public, and the health plans themselves to identify high-performing plans and to focus improvement efforts.⁹ HEDIS measures cover a wide variety of healthcare performance issues, such as asthma medication use, breast cancer screening, and childhood and adolescent immunization status. Participating health plans report HEDIS data annually through surveys, medical chart reviews, and insurance claims, and the results are audited by an NCQA-approved auditing firm prior to public reporting.⁹

We analyzed 2 HEDIS measures related to appropriate antibiotic prescribing (upper respiratory infection in children and acute bronchitis in adults) and a measure related to appropriate testing to guide antibiotic prescribing (pharyngitis testing). The primary

ABSTRACT

OBJECTIVES: Antibiotic prescribing has become increasingly viewed as an issue related to patient safety and quality of care. The objective of this study was to better understand the differences between health plan reporting and the geographic variation seen in quality measures related to antibiotic use.

STUDY DESIGN: We focused on 3 measures from the Healthcare Effectiveness Data and Information Set (HEDIS) related to antibiotic prescribing and testing to guide antibiotic prescribing.

METHODS: We analyzed data for 3 relevant measures for the years 2008 to 2012, including only commercial health plans. We analyzed the following 3 HEDIS measures: 1) "Appropriate Testing for Children With Pharyngitis," 2) "Appropriate Treatment for Children With Upper Respiratory Infections," and 3) "Avoidance of Antibiotic Treatment in Adults With Acute Bronchitis."

RESULTS: Out of these 3 measures, health plans consistently performed poorly on the adult bronchitis measure. Performance was better on the 2 measures focused on the pediatric population. We also saw geographic variation between measures when looking at Census divisions across all years.

CONCLUSIONS: There is wide variation between individual health plan performance on the measures related to antibiotic use. Geographic differences were also observed on these measures, with health plans in the South Central Census division performing worse than other parts of the country. Stakeholders, such as public health, advocacy groups, foundations, and professional societies, interested in improving the quality of care that patients receive related to antibiotic use in the outpatient setting should consider how existing measures and working with health plans could be used to improve prescribing.

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TAKE-AWAY POINTS

Antibiotic prescribing has become viewed as a patient safety and quality-of-care issue. With antibiotic-resistant infections on the rise and national support to improve antibiotic use, the time to focus efforts on improving prescribing practices in the outpatient setting is now.

- ▶ Explore opportunities to expand existing quality measures, or create new measures, that focus on appropriate antibiotic use.
- ▶ Share lessons learned from high-performing plans with lower-performing plans.
- ▶ Implement proven interventions to improve antibiotic use, especially with providers who treat adults, as progress has been minimal in decreasing inappropriate antibiotic prescribing in the adult population.

objectives of this study were to assess overall health plan performance on the 3 HEDIS measures for 2008 to 2012 and explore potential variation between health plans. Prior studies in the United States have shown geographic variation in antibiotic prescribing^{10,11}; therefore, we also wanted to explore whether health plan performance on these 3 measures varied geographically.

METHODS

We analyzed the following 3 HEDIS measures: 1) “Appropriate Testing for Children With Pharyngitis” (pharyngitis testing), which is defined as the proper diagnosis of streptococcal pharyngitis for children aged between 2 and 18 years. This requires a diagnosis of pharyngitis, an antibiotic being prescribed, and a group A *Streptococcus* (strep) test administered for the episode in eligible children; 2) “Appropriate Treatment for Children With Upper Respiratory Infections” (URIs), which is defined as the percent of antibiotic prescriptions for eligible children aged between 3 months and 18 years who were diagnosed with a URI (common cold) and not prescribed an antibiotic on or within 3 days of the episode date; and 3) “Avoidance of Antibiotic Treatment in Adults With Acute Bronchitis” (bronchitis), which is defined as the percent of eligible adults diagnosed with acute bronchitis and not prescribed an antibiotic.

For all 3 measures, a higher percent indicates better performance. The technical specifications for the measures, including how eligible populations are determined and reported by participating health plans, have been previously published by NCQA.¹²

We obtained a data set from NCQA containing the 3 measures for the years 2008 to 2012. This data set only included commercial health plans (Medicaid and Medicare were excluded) and all lines of business (health maintenance organization [HMO], preferred provider organization [PPO], and point of service [POS]).¹³ The data included confidence intervals for each measure and for each year, according to health plan. We also received national, US Census division,¹⁴ and state means and medians for each measure. Not every health plan reported data for each relevant measure for each year; therefore, some health plans and states are missing data for 1 or more measures in any given year. No identifying characteristics related to the individual health plans

were included in this analysis, as the intent was to learn more about the overall performance on the measures of interest and not to identify specific health plans by name or to provide a ranking of individual plans based on performance.

We first assessed whether there were extreme observations, or outliers, in the data at the individual health plan level. We computed simple statistics, describing the variation of the individual plan rates using mean and

standard deviation by year. We determined if there was a decreasing or increasing linear trend in the average of each relevant HEDIS measure from 2008 to 2012 and explored variability between, and within, health plans over time. We also performed descriptive statistics based on whether the reporting product was an HMO, a PPO, a POS, or a combination of these, to determine if this had an impact on performance. However, we did not perform descriptive statistics for plans with sample sizes of less than 10, so the reporting products included in these analyses were HMO, HMO/POS combined, and PPO. We also determined whether there were differences in mean rates among these 3 reporting products for each HEDIS measure by year using SAS Proc GLM (SAS Institute, Cary, North Carolina) to account for unequal sample sizes. For multiple comparisons, we also adjusted means using the Tukey method. Additionally, we explored geographic variation in HEDIS measure performance by Census division for all years (2008–2012) using the mean for each measure in each Census division for each year. Data management and all analyses were performed using SAS version 9.3 (SAS Institute, Cary, North Carolina).

RESULTS

During 2008 to 2012, an average of 373 (347–394) individual plans reported on the 3 measures to NCQA (Table). Wide variations were observed at the individual health plan level within measures for the years 2008 to 2012. Across all years and all reporting health plans, the overall mean of children tested for group A *Streptococcus* and prescribed an antibiotic (pharyngitis testing) was 77% (range = 2.23%–96.6%). For URIs, the mean percent of children treated appropriately was 84% (range = 31.1%–99.4%). The avoidance of antibiotic treatment for adults with bronchitis was 24% (range = 7.4%–90.5%).

Testing for pharyngitis improved over time ($P < .01$), with the lowest average of 74.6% in 2008 and the highest of 79.9% in 2012. The proportion of children to whom antibiotics were not prescribed for URIs did not change significantly over the study period ($P = .93$); the highest average was 85% in 2011 and the lowest was 83.4% in 2012. The bronchitis measure did not improve over the time period; in fact, there was a decreasing trend in antibiotic avoidance for bronchitis ($P = .03$), with the highest (best) average

of 26.6% in 2008 and the lowest (worst) of 22.1% in 2011, with no improvement in 2012 (22.7%).

Health plans that performed well on 1 measure often performed well on the other 2 measures. For example, the highest-performing health plan for the adult bronchitis measure (71.7%) was also in the top 5 performing plans for both pharyngitis testing (95.6%) and URIs (98.7%) in 2012.

We further examined the available descriptive statistics of the health plans for the 3 HEDIS measures by the product reported (eg, HMO, PPO, POS) to determine if there were any differences in performance (eAppendix, available at www.ajmc.com). For the adult bronchitis measure, in all years, a majority of the plans reported PPO (45%-48%), followed by HMO/POS combined (37%-40%), and HMO (12%-13%). Analyses on differences of mean rates show that in all years, HMO rates were significantly higher than the rate of HMO/POS combined ($P < .001$). Also, HMO rates were higher than PPO rates in 2010 to 2012 ($P < .001$), but PPO rates were higher than HMO/POS combined rates in 2008 and 2009 ($P < .001$).

For pharyngitis testing, the distribution of health plans show a similar pattern to that of the adult bronchitis measure. Comparisons of mean rates show no statistically significant differences between HMO, PPO, or HMO/POS combined. A similar distribution was also observed for children diagnosed with URIs. Comparisons of mean rates show HMO rates were higher than PPO rates in all years ($P < .01$). HMO rates were also higher than HMO/POS combined rates in 2008 ($P = .04$) and 2009 ($P = .03$).

We also saw geographic variation between measures when looking at US Census divisions across all years (Figure). For pharyngitis testing, the highest-performing division was New England (80.1%) and the lowest-performing division was the Pacific (69.1%), followed by the South Central (71.4%). For children with URIs, the highest-performing division was New England (91.7%) and the worst-performing division was South Central (72.0%). For bronchitis, all divisions performed poorly, ranging from a high of 29.7% in the Pacific division to a low of 21.9% in the New England division.

DISCUSSION

Out of the 3 measures of interest, health plans consistently performed poorly on the adult bronchitis measure. In 2012, health plans reported an average antibiotic avoidance of 20.6% for adults with bronchitis, meaning that adults diagnosed with acute bronchitis were prescribed an antibiotic nearly 80% of the time, despite the fact that antibiotics are

not indicated for this diagnosis. Other studies using other data sets have shown that approximately 70% of visits for acute bronchitis result in antibiotic prescription.^{15,16} Health plans performed better on the 2 measures focused on the pediatric population (URI and pharyngitis testing). One reason for this could be because of programs and organizations promoting appropriate antibiotic use in the community, such as the CDC's "Get Smart: Know When Antibiotics Work" program, and the American Academy of Pediatrics. Both have provided appropriate antibiotic use guidance and education for parents of young children, as well as resources for pediatric healthcare providers. In spite of the seemingly high rates of performance associated with these 2 pediatric measures, there is room for improvement. The common cold (a URI) is always viral in nature, so an antibiotic is never necessary and the goal should be 100% antibiotic avoidance for common cold diagnoses.

We also observed differences in rates by line of business for both the adult bronchitis measure and the URI measure. For both measures, plans reporting HMO lines of business were reporting significantly higher rates than those by PPO or HMO/POS combined in most instances. It is unclear why we see these differences, as antibiotic prescriptions are written by individual providers who may see many patients with varied insurance types and other payment methods over the course of a year. We believe it would be unlikely for a provider to prescribe differently based on the specific type of health insurance product (HMO, PPO, or some variation), although

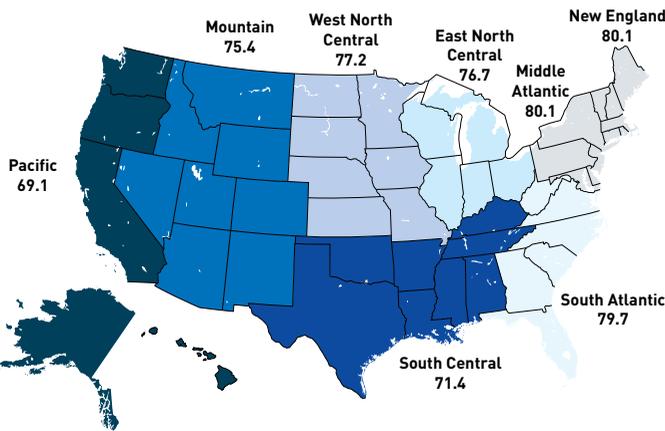
TABLE. Health Plan Performance (%) on Selected HEDIS Measures, 2008-2012

Year	Number of Participating Health Plans	Mean %	Median %	Minimum %	Maximum %
Appropriate Testing for Children With Pharyngitis					
2008	375	74.6	76.1	35.2	96.0
2009	371	75.7	77.2	37.8	95.2
2010	392	76.9	77.8	41.0	96.4
2011	347	78.0	78.7	39.1	96.1
2012	375	79.9	81.1	2.23	96.6
Appropriate Treatment for Children With Upper Respiratory Infection					
2008	374	83.8	84.7	49.9	98.5
2009	372	84.0	85.3	47.0	99.1
2010	393	83.6	85.0	31.1	97.8
2011	350	85.0	86.2	44.5	98.5
2012	376	83.4	84.7	44.7	99.4
Avoidance of Antibiotic Treatment in Adults With Acute Bronchitis					
2008	375	26.6	24.9	14.5	85.6
2009	375	25.4	23.5	9.9	90.5
2010	394	23.2	21.7	12.8	87.7
2011	349	22.1	20.7	8.5	75.0
2012	375	22.7	20.7	7.4	71.6

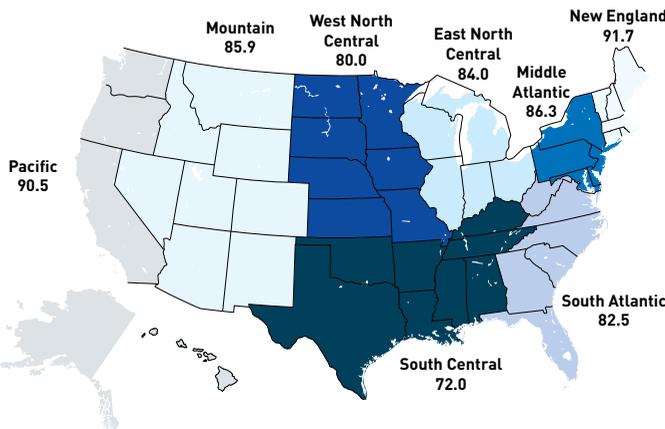
HEDIS indicates Healthcare Effectiveness Data and Information Set.

FIGURE. Geographic Variability in HEDIS Measures Related to Appropriate Antibiotic Use

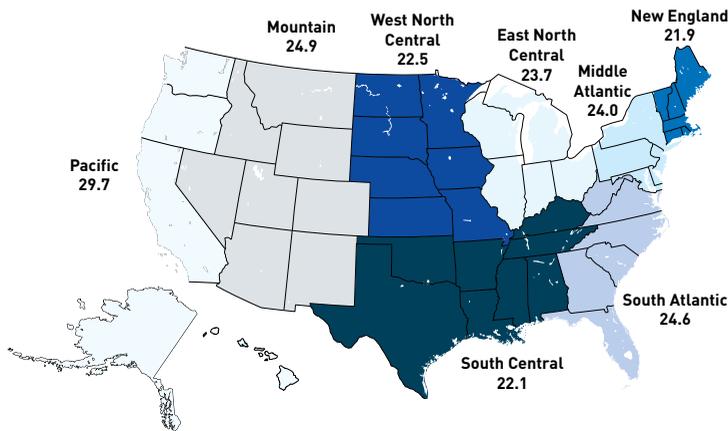
a) Appropriate testing for children with pharyngitis (average), by Census division, 2008-2012



b) Appropriate testing for children with upper respiratory infection (average), by Census division, 2008-2012



c) Avoidance of antibiotic treatment in adults with acute bronchitis (average), by Census division, 2008-2012



HEDIS indicates Healthcare Effectiveness Data and Information Set.

at least 1 study has found that among older adults, antibiotic prescribing increased when insurance coverage improved.¹⁷ As the data for this analysis was commercial only and did not include Medicare or Medicaid patients, it is unclear if differences in insurance coverage are impacting HEDIS rates, and this may be one area where further study is warranted.

We also observed wide geographic variation in health plan performance for the 3 measures. Previous studies have shown that antibiotic prescribing rates are higher in the South than in other parts of the country. Specifically, prescribing rates in some states in the South, and through the Appalachian region of the country, were more than double the state prescribing rates in the Pacific Northwest.^{10,11} However, because these reports do not contain diagnosis or visit-based data, it is difficult to assess whether providers in the South were more likely to prescribe inappropriately. Because the HEDIS quality measures are direct indicators of appropriate treatment and prescribing, our study confirms that inappropriate prescribing is higher in the South. This is important to both the understanding of this complex issue, and to the planning of future antibiotic stewardship activities in the South. Improving antibiotic use is a national priority,¹⁸ and this information is useful for identifying where antibiotic stewardship programs are needed most.^{10,11}

In general, the highest-performing plans tended to do well across all 3 measures and were consistent over time, leading us to conclude that there may be lessons learned that could be shared with the plans that are not performing as well. There may then be opportunities to expand existing measures (eg, measuring URI prescribing for all ages, not only the pediatric population) or creating new measures focused on appropriate antibiotic use (eg, appropriate prescribing for sinusitis). Public health, advocacy groups, foundations, professional societies, and others interested in improving antibiotic use in the outpatient setting should consider how existing quality measures and multi-stakeholder collaborations could be used to impact prescribing. One example of a multi-stakeholder collaboration

is California AWARE, a joint effort between the California Medical Association Foundation, the California Department of Health Services, health plans in the state, and others. The California AWARE program has focused on improving antibiotic prescribing rates in the state for many years using a number of different strategies, including educational tools and resources targeting providers, as well as the general public, and also by working closely with health plans to identify high-prescribing providers to target for interventions.

Finally, interventions to improve antibiotic use should target providers who treat adults, specifically for the diagnosis of acute bronchitis, as progress has been minimal. Healthcare providers cite diagnostic uncertainty, time limitations (eg, not enough time to communicate about appropriate use with patients), and patient demand as reasons for prescribing antibiotics even when they are not clinically indicated.^{19,20} Because guidelines and information on management of bronchitis have been available for many years, it may take more focused and deliberate efforts to engage adult providers. We are hopeful, however, that progress can be made based on the improvements seen in prescribing for children after a concerted effort was made to engage pediatric providers around this issue. Interventions at the clinician level, such as audit and feedback, clinical decision support tools, and active education strategies, such as academic detailing, may be useful for improving prescribing practices.

Limitations

There were limitations associated with this analysis. As shown in the Table, not every health plan reported data for every measure or for every year. Health plans may go out of business, relocate, or choose not to report on these measures. Also, these data only include commercial lines of business within health plans and do not include Medicare or Medicaid lines of business, which may differ due to the unique populations represented. Additionally, the measures associated with antibiotic prescribing rely on data gathered from medical chart reviews, and, specifically, diagnostic codes. Diagnostic coding can be unreliable and is another limitation associated with this study.

CONCLUSIONS

With antibiotic-resistant infections on the rise, and a strong interest and level of support from the White House—given the release of the National Strategy for Combating Antibiotic-Resistant Bacteria,¹⁸ the National Action Plan for Combating Antibiotic-Resistant Bacteria²¹ and a Presidential Executive Order²²—to improve antibiotic stewardship, the time to focus efforts on improving prescribing practices in the outpatient setting is now. Armed with the knowledge of where inappropriate prescribing is most common and support for this topic on a national level, public health professionals, health plans, provider groups, and other stakeholders invested in antibiotic stewardship can begin to deliberately focus interventions where improvement is most needed.

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eAppendix

Table A. Descriptive statistics for Appropriate Testing for Children With Pharyngitis

Year	Participating Health Plans	Participating Health Plans, n (%)	Mean	Median	Minimum	Maximum
2008	HMO	47 (13)	75.8	75.1	44.2	96.0
	HMO/POS combined	143 (38)	75.3	78.2	35.2	89.8
	HMO/POS/PPO combined	3 (1)				
	HMO/PPO combined	0 (0)				
	POS	6 (2)				
	PPO	176 (47)	73.2	74.8	43.1	90.1
	Total	375 (101)				
2009	HMO	47 (13)	77.8	78.5	56.7	95.2
	HMO/POS combined	147 (40)	76.6	79.0	37.8	90.6
	HMO/POS/PPO combined	3 (1)				
	HMO/PPO combined	0 (0)				
	POS	7 (2)				
	PPO	167 (45)	74.0	75.0	39.8	88.7
	Total	371 (101)				
2010	HMO	49 (13)	78.2	77.6	52.5	96.4
	HMO/POS combined	157 (40)	77.7	80.0	44.0	92.0
	HMO/POS/PPO combined	4 (1)				
	HMO/PPO combined	0 (0)				
	POS	7 (2)				
	PPO	175 (45)	75.5	76.4	41.0	92.9
	Total	392 (101)				
2011	HMO	45 (13)	78.6	78.3	51.7	96.1
	HMO/POS combined	133 (38)	78.9	81.7	48.6	95.8
	HMO/POS/PPO combined	5 (1)				
	HMO/PPO combined	1 (0)				

	POS	3 (1)				
	PPO	160 (46)	76.7	77.3	39.1	93.8
	Total	347 (99)				
2012	HMO	48 (13)	78.7	79.2	22.1	95.6
	HMO/POS combined	138 (37)	80.7	82.7	2.2	96.6
	HMO/POS/PPO combined	5 (1)				
	HMO/PPO combined	1 (0)				
	POS	3 (1)				
	PPO	180 (48)	79.3	80.0	46.5	94.1
	Total	375 (100)				

Table B. Descriptive Statistics for Appropriate Treatment for Children With Upper Respiratory Infections

Year	Participating Health Plans	Participating Health Plans, n (%)	Mean	Median	Minimum	Maximum
2008	HMO	46 (12)	86.7	88.0	72.5	96.7
	HMO/POS combined	143 (38)	83.7	84.5	63.5	98.5
	HMO/POS/PPO combined	3 (1)				
	HMO/PPO combined	0 (0)				
	POS	6 (2)				
	PPO	176 (47)	82.9	84.5	49.9	98.5
	Total	374 (100)				
2009	HMO	46 (12)	87.5	89.0	72.3	98.2
	HMO/POS combined	147 (40)	84.2	85.1	58.5	99.1
	HMO/POS/PPO combined	3 (1)				
	HMO/PPO combined	0 (0)				
	POS	7 (2)				
	PPO	169 (45)	82.9	84.7	49.1	98.9
	Total	372 (100)				
2010	HMO	51 (13)	86.6	90.3	31.1	97.8
	HMO/POS combined	157 (40)	83.9	84.7	59.5	96.8
	HMO/POS/PPO combined	4 (1)				
	HMO/PPO combined	0 (0)				
	POS	7 (2)				
	PPO	174 (4)	82.5	84.2	48.9	96.7
	Total	393 (100)				
2011	HMO	47 (13)	87.3	89.7	55.8	98.1
	HMO/POS combined	133 (38)	85.7	86.8	60.3	98.2
	HMO/POS/PPO combined	5 (1)				
	HMO/PPO combined	1 (0)				
	POS	3 (1)				

	PPO	161 (46)	83.7	85.6	44.5	98.5
	Total	350 (99)				
2012	HMO	48 (13)	86.0	89.2	46.3	99.2
	HMO/POS combined	139 (37)	84.0	84.7	55.2	99.0
	HMO/POS/PPO combined	5 (1)				
	HMO/PPO combined	1 (0)				
	POS	3 (1)				
	PPO	180 (48)	82.0	84.1	44.7	95.4
	Total	376 (100)				

Table C. Descriptive Statistics for Avoidance of Antibiotic Treatment in Adults With Acute Bronchitis

Year	Participating health plans	No. participating health plans (%)	Mean	Median	Minimum	Maximum
2008	HMO	46 (12)	29.9	23.8	14.5	85.6
	HMO/POS Combined	144(38)	23.9	23.0	14.5	44.6
	HMO/POS/PPO Combined	3(1)				
	HMO/PPO Combined	0(0)				
	POS	6(2)				
	PPO	176(47)	27.9	26.7	15.8	81.2
	Total	375(100)				
2009	HMO	48(13)	29.8	24.0	9.9	90.5
	HMO/POS Combined	149(40)	23.0	22.1	15.8	34.4
	HMO/POS/PPO Combined	2(1)				
	HMO/PPO Combined	0(0)				
	POS	7(2)				
	PPO	169(45)	26.4	24.7	15.0	77.7
	Totsl	375(101)				
2010	HMO	52(13)	28.2	23.9	12.8	87.7
	HMO/POS Combined	157(40)	22.6	21.5	13.8	79.9
	HMO/POS/PPO Combined	3(1)				
	HMO/PPO Combined	0(0)				
	POS	6(2)				
	PPO	176(45)	22.4	21.5	14.4	41.9
	Total	394(101)				
2011	HMO	47(13)	27.9	22.6	12.3	75.0
	HMO/POS Combined	132(38)	20.9	20.3	8.5	36.8
	HMO/POS/PPO Combined	5(1)				
	HMO/PPO Combined	1(0)				

	POS	3(1)				
	PPO	161(46)	21.4	20.7	11.8	39.2
	Total	349(99)				
2012	HMO	47(13)	30.4	26.0	13.8	71.6
	HMO/POS Combined	139(37)	21.9	20.6	10.3	43.4
	HMO/POS/PPO Combined	5(1)				
	HMO/PPO Combined	1(0)				
	POS	3(1)				
	PPO	180(48)	21.4	20.5	7.4	39.2
	Total	375(100)				