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A Rural vs. Urban Analysis of Procedures Provided to Medicaid Recipients by Pediatric, General, and Public Health Dentists in the Commonwealth of Virginia: Fiscal Years 1994-1995

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A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

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ABSTRACT

A RURAL VS. URBAN ANALYSIS OF PROCEDURES PROVIDED TO MEDICAID RECIPIENTS BY PEDIATRIC, GENERAL, AND PUBLIC HEALTH DENTISTS IN THE COMMONWEALTH OF VIRGINIA: FISCAL YEARS 1994-1995

By Frank C. Pettinato II, D.M.D.

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

Virginia Commonwealth University, 2003

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Purpose: The purpose of this study was to report the distribution of procedures provided to Virginia Medicaid children by three types of dental providers in rural and urban areas.

Methods: Medicaid claims filed for dental patients younger than 21 were obtained and analyzed for fiscal years 1994 and 1995. Dental providers were categorized according to their practice type: general practice (GP), pediatric (PD) and public health (PH) dentists. Each type of practice was categorized as practicing in a Metropolitan, Urban, Rural or Completely Rural location and evaluated for percentages of preventive, diagnostic, and corrective services provided.

Results: The number of procedures was shown to differ depending upon: year, practice type, location, significant provider status, and the type of procedure.

Conclusion: General, pediatric and public health dentists in Metropolitan and Urban areas perform slightly more diagnostic services and much less corrective services than practitioners in more rural areas.

Introduction

Studies have shown that the overall caries incidence in children is dropping in the United States. This is due to the use of sealants, public water fluoridation programs and systemic and topical fluorides. This data is not representative of the entire population, numerous studies have shown that 80% of the decay is present in 25% of the population which is comprised mostly of the lower socioeconomic groups (1, 2). Dental decay is the single most common chronic childhood disease – five times more common than asthma and seven times more common than hay fever. Poor children suffer twice as much dental caries as their more affluent peers and more than 51 million school hours are lost each year to dental-related illness (2).

It has been shown in a previous study done in Virginia that general practitioners (GP) performed a significantly greater percentage of diagnostic procedures to their Medicaid patients than did pediatric and public health dentists. The percentage of preventive procedures performed by PD and GP dentists was not significantly different but was significantly lower than those performed by PH dentists (3). Those numbers do not hold true when it comes to the percentage of corrective procedures done. In this area, pediatric dentists provide significantly more procedures than GP or PH dentists (3). The question arises “in areas where there are no pediatric dentists, such as, the rural areas of

the state, do GPs perform more corrective procedures than elsewhere in the state?" The purpose of this study was to report the distributions of procedures to Virginia Medicaid children provided by pediatric, general, and public health dentists in Metropolitan, Urban, Rural or Completely Rural locations.

Methods

A database was compiled of all Medicaid dental claims paid for the years 1994-1995 from the Virginia Division of Medical Assistance Services (DMAS), which oversees the program. Fiscal years 1994 and 1995 were chosen because they were the last two years DMAS administered the entire Medicaid program for dentistry. In 1996, HMO vendors were added in certain portions of the state. In the database, the number of procedures in each zip-code area of Virginia were classified as to: Year (1994 or 1995), provider (pediatric-PD, general-GP, or public health-PH), whether the provider was a "significant provider" and location of practice. Each provider in each year was classified as a "significant provider" if the total number of procedures performed was greater than or equal to 700. The number 700 was chosen because it had been used in previous research studies as defining significant providers (4). Location was originally coded into the ten categories established by the Economic Research Service of the US Department of Agriculture (5), as seen in Table 1. The number of providers was small in some categories especially in the more rural areas. The ten categories were collapsed into four after it was found that there were no statistically significant differences between the two subgroups of Metropolitan (Metro), three subgroups of Urban, and four subgroups of Rural on the basis of the consistency of their practice patterns across the state. Completely Rural had no subgroups and as such was left alone. Figure 1 shows the geographic relationship of providers by location. Medicaid patients for this study are

patients 21 years of age or younger. More than a million procedures completed by 747 dental providers were studied.

Procedures were classified into diagnostic services, preventive services, corrective services, and other. Diagnostic procedures included radiographic and/or oral exams. Preventive procedures included scaling, prophylaxis, fluoride treatments and sealants. Corrective procedures included all operative, endodontic, prosthodontic, and surgical procedures. The Other procedures included any procedures that were billed to Medicaid by the providers but did not directly fit into the other four categories. Preventive procedures were subdivided into sealants and other preventive procedures. Corrective procedures were subdivided into extractions and other corrective procedures. These categories were subdivided to look for differences in the use of sealants and extractions by the different providers. For the purpose of analysis, five main procedure groups (Table 2) were used: diagnostic services (DX SERV), preventive (PREV), sealants (SEAL), corrective (CORRECT), and extractions (EXT). The "other" (OTHER) category is ignored in analyses.

The relationship between procedures, practice type, location, significant provider and year were analyzed using a repeated-measures log-linear model in SAS (version 8.1). Providers were identified as the independent subject in the generalized estimating equation (GEE) analysis. The frequency counts were assumed to be Poisson distributed and score chi-square tests of effects were determined to be significant at the alpha = 0.05 level.

Results

Significant providers were those who performed more than 700 procedures in a year. In 1994 there were 568 providers, of whom 151 (26.6%) were significant providers. In 1995 there were 747 providers, of whom 212 (28.3%) were significant providers (Table 3). These two percentages are not significantly different (Fisher's exact p-value = 0.4937).

Of all the providers in both years (n = 1315), there were 1136 who were GP (86.4%). In GP practice 259 (22.8%) are significant providers. Of 67 PH, 31 (46.3%) were significant providers. Of 112 PD, 73 (65.2%) are significant providers (Table 4). These percentages are significantly different (chi-square = 92.6, df = 2, $p < .0001$). The differences in the relative ordering of PD having the highest percentage of significant providers, PH the middle percentage, and GP the smallest percentage, depend upon location (Table 3).

Of all the providers in both years, there were 563 in Metropolitan practice of whom 138 (24.5%) were significant providers. This was similar to the 448 Urban providers of whom 135 (30.1%) were significant providers, and similar to the 194 Rural providers of whom 55 (28.4%) were significant providers. The 49 Completely Rural providers had 21 (42.9%), a significantly larger (chi-square = 9.99, df = 3, p = 0.0187) percentage, as significant providers (Table 3).

There are differences in practice composition between significant and non-significant providers. Significant providers have a practice mix consisting of less diagnostic (30.4% vs. 34.8%) and more corrective procedures (22.8% vs. 19.3%) than non-significant providers (Table 5).

There are approximately two and a half times as many non-significant providers as there are significant providers (Table 3). However, there is nearly a four-fold increase in the number of procedures done by significant providers compared to non-significant providers (approximately 200,000 vs. 800,000) over the two years (Table 5).

Table 7 shows all of the factors that significantly predicted the number of procedures. The number of procedures differed by year ($p = 0.0054$), and significant provider status ($p < .0001$). The number of procedures did not directly relate to practice type ($p = 0.5411$) or location ($p = 0.6839$) but there was a significant interaction between year and significant provider ($p = 0.0164$). The main questions of interest related to the mixture of services (the Procedure effect in the model) and how the mixture of services varied with other characteristics (the interaction effects in the model). The number of diagnostic, preventive, and corrective procedures were not the same ($p = 0.0011$). There were significant differences in the mixture of services due to practice type ($p = 0.0002$), location ($p = .0044$), and significant provider ($p < .0001$). There were no significant three- or four-way interactions ($p > 0.05$). So, the mixture of services can be illustrated by showing differences due to practice type and location.

The GP performed a significantly greater percentage of diagnostic procedures to their Medicaid patients than did PD and PH dentists (chi-square = 1672, $p < 0.0001$). The

percentage of preventive procedures performed by PD and GP was not significantly different, but was significantly lower than those performed by PH dentists (chi-square = 914, $p < 0.0001$). Finally, pediatric dentists performed significantly greater (chi-square = 3060, $p < 0.0001$) percentage of corrective procedures than both GP and PH dentists (Table 8).

The relationship between procedure mix and location is subtler. As the providers move from Metro to Completely Rural there is a gradual transformation in the practice composition. For the GP, diagnostic procedures decrease (33.5% to 30.9%), preventive procedures decrease (38.6% to 29.6%) and corrective procedures increase (19.2% to 29.7%) (Table 9). For PD, diagnostic procedures decreases (30.7% to 27.2%), preventive services decrease (38.7% to 20.9%) and corrective procedures increase (19.9% to 24.4%) (Table 10) as practice location changes from Metro to Completely Rural. PH exhibits much less change than GP or PD. Diagnostic procedures slightly decrease (28.8% to 26.7%), however, there is almost no difference between the preventive (43.2% to 43.0%) and corrective (6.2% to 6.2%) procedures (Table 11) as they move from Metro to Completely Rural.

Discussion

The purpose of this study was to report the distributions of procedures to Virginia Medicaid children provided by pediatric, general, and public health dentists in Metropolitan, Urban, Rural or Completely Rural locations. The main question of interest was: "in areas where there are no pediatric dentists, such as, the rural areas of the state, do the GPs perform more corrective procedures than elsewhere in the state?" The relationship between procedures, practice type, location, significant provider and year were analyzed.

Among all significant providers, the largest proportion were pediatric dentists regardless of the geographic area. Of general practitioners who were significant providers, 38.9% were in Completely Rural areas versus 20% in Metropolitan areas (Table 3). Of all the providers in both years, the Completely Rural areas had a larger percentage of significant providers (Table 3). When comparing significant to non-significant providers it can be observed that significant providers perform a higher percentage of corrective procedures (22.8% vs. 19.3%) and a lower percentage of diagnostic procedures (30.4% vs. 34.9%) (Table 5). There are approximately two and a half times as many non-significant providers as significant providers (Table 3). However there is nearly a four-fold increase in the number of procedures done by significant providers compared to non-significant providers (approximately 200,000 versus 800,000)

over the two years (Table 5). Without these vastly outnumbered significant providers, there would be very little care provided to the Virginia children who are on Medicaid.

Overall, general practitioners performed significantly more diagnostic, more preventive but significantly fewer corrective procedures than pediatric dentists. The average GPs practice in a Metropolitan area does 72.1% diagnostic and preventive procedures on children and only 19.2% corrective procedures (Table 9). This does not fit with the knowledge that Medicaid children have the highest caries incidence, since 80% of the decay is in the poorest 25 % of the population (1, 2). These children also have a three times greater unmet need for dental care than children in higher income families (11). It is also known that by the age of 17, dental decay affects 78% of children (2). Lack of access to needed dental care is one of the reasons caries remains untreated in certain populations. Whether the problem is financial, geographic, or lack of education about the importance of good oral health, the fact is that many children who desperately need dental care are not receiving it (1). It has long been observed that many GPs will see a child patient, do a new patient exam, take x-rays, perform a prophlyaxis and fluoride treatment and then refer the child to a pediatric dentist for any corrective procedures that may be needed. This does not appear to be the case in most rural areas where there may not be a pediatric dentist for a hundred miles. The average GPs practice in a Metropolitan area does 19.2% corrective procedures compared to 29.7% in a Completely Rural area (Table 9). In rural areas, the GPs are doing more corrective procedures than GPs in the more populated areas.

When comparing Metropolitan to Completely Rural, there is a decrease in the percentage of preventive for PD (38.7% to 20.9%) and GP (38.6% to 29.6%). At the same time, there is an increase in the percentage of corrective procedures for PD (19.9% to 24.4%) and GP (19.2% to 29.7%) (Tables 9 and 10). This transition makes sense since rural residents of all ages tend to have greater prevalence of untreated caries than their non-rural counterparts (6). This is different for PH dentists whose practice composition does not differ noticeably in Metro vs. Completely Rural communities (Table 11). The increase in percentage of corrective procedures in rural areas could be at least partly due to the lower than adequate amount of fluoride in the water of several non-fluoridated areas in the state of Virginia (less than 1ppm). Lack of fluoride leads to a higher caries rate than in fluoridated areas.

An attempt was made to determine if there were differences in the procedure mix of the different practice types depending on whether or not they were significant or non-significant providers. Table 7 showed that there were no significant differences ($p>0.05$) for such three way interactions. Thus, the procedure mix for significant providers does not differ significantly by the type of practice.

Due to the use of fluoride, there has been a dramatic decrease in the incidence of caries in the last 30 years (7). Nevertheless, dental caries remains the single most common disease of childhood (2). The trends of dental caries today show a decrease in the percentage of interproximal lesions and an increase in the percentage of occlusal lesions (8). Today occlusal sealants are the most effective and important preventive measure available for the prevention of occlusal caries in children and adolescents. The

goal of Healthy People 2000 was that 50% of eight to fourteen year old children have pit and fissure sealants on one or more permanent molars (9). There is clearly a gap between the 1994 and 1995 use of sealants and the 2000 objective, in fact only 5.1% of all the procedures performed by the GP and 4.6% by PD were sealants compared to only 16.0% for PH (Table 8). Overall, dental providers have fallen well below the year 2000 objective and this is the group of children that would benefit the most from sealants (2). Thus lower income children suffer twice as much dental decay as their more affluent peers (2).

In conclusion, the mixture of services varied significantly depending on: practice type, location, and significant provider status. The GP performed a significantly greater percentage of diagnostic procedures to their Medicaid patients than did PD and PH dentists. The percentage of preventive procedures performed by PD and GP was not significantly different, but was significantly lower than those performed by PH dentists. Pediatric dentists performed significantly greater percentage of corrective procedures than both GP and PH dentists. When comparing Metropolitan to Completely Rural, there is a decrease in the percentage of diagnostic and preventive for PD and GP At the same time, there is an increase in the percentage of corrective procedures for PD and GP. This is different for PH dentists whose practice composition does not differ noticeably in Metro vs. Completely Rural communities. The Completely Rural areas had the largest percentage of significant providers. The relative ordering of PD having the highest percentage of significant providers, PH the middle percentage, and GP the smallest percentage, depends upon location. There are differences in practice composition

between significant and non-significant providers. Significant providers have a practice mix consisting of less diagnostic and more corrective procedures than non-significant providers. Non-significant providers outnumber significant providers more than two to one but the significant providers provide nearly four times the number of procedures.

Table 1. Categories of Location

	Number of Procedures		Percentage	
Rurality grouping	1994	1995	1994	1995
Metropolitan			39.4	37.2
a) Central counties of metro areas of 1 mil. or more	157,412	212,148		
b) Fringe counties of metro areas of 1 mil. or more	5,131	8,420		
Urban			41.7	40.0
a) Counties in metro areas of 250,000 to 1 mil.	112,796	147,262		
b) Counties in metro areas of fewer than 250,000	45,958	59,680		
c) Adjacent to a metro area, 20,000 or more	13,334	30,266		
Rural			10.9	13.4
a) Not adjacent to a metro area, 20,000 or more	5,186	11,851		
b) Adjacent to a metro area, 2,500 to 19,999	19,418	26,747		
c) Not adjacent to a metro area, 2,500 to 19,999	15,419	26,501		
d) Adjacent to metro area, less than 2,500	4,984	14,243		
Completely rural			4.1	5.8
a) Not adjacent to metro area, less than 2,500	16,801	34,609		
unknown zip code	15,853	21,759	3.8	3.7
	412,292	593,486		

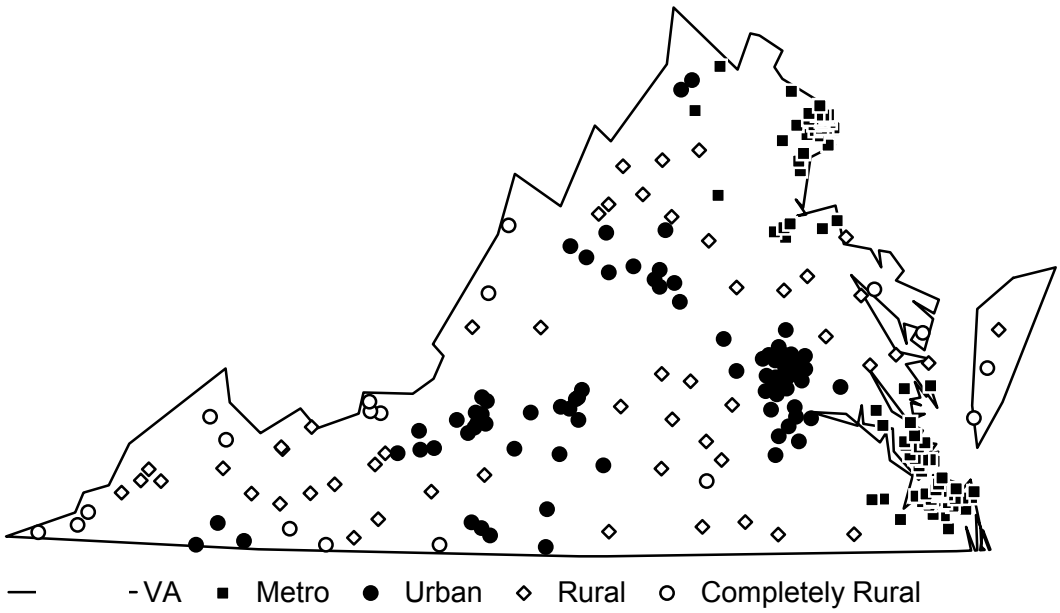

Figure 1. Geographic Distribution of Providers by LocationThe geographic relationship to location is shown above. The black squares are the Metropolitan locations. The black circles are the Urban areas and the white diamonds are the Rural areas. The Completely Rural areas are shown with a white circle.

Table 2. Classification of Procedures by Year

	Number of Procedures		Percentage	
Procedures	1994	1995	1994	1995
DX SERV	129,977	185,283	31.5	31.2
PREV	149,257	213,974	36.2	36.0
SEAL	22,130	35,561	5.4	6.0
CORRECT	92,672	129,115	22.5	21.8
EXT	17,322	25,192	4.2	4.2
OTHER	934	4,361	0.2	0.7
Total	412,292	593,486		

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 3. Significant Providers by Year, Location and Practice Type

		Significant Provider							
	Practice	in 1994		in 1995		all years			
Location	Type	no	yes	no	yes	no	yes	% yes	Total
Metropolitan									
	GP	173	44	218	54	391	98	20.0	489
	PD	10	14	17	21	27	35	56.5	62
	PH	2	3	5	2	7	5	41.7	12
Urban									
	GP	138	39	161	50	299	89	22.9	388
	PD	2	14	2	18	4	32	88.9	36
	PH	5	4	5	10	10	14	58.3	24
Rural									
	GP	53	19	75	29	128	48	27.3	176
	PD	0	1	0	1	0	2	100.0	2
	PH	3	1	8	4	11	5	31.3	16
Completely rural									
	GP	9	5	13	9	22	14	38.9	36
	PD	0	0	1	2	1	2	66.7	3
	PH	2	1	3	4	5	5	50.0	10
Unknown zip code									
	GP	15	5	22	5	37	10	21.3	47
	PD	4	0	3	2	7	2	22.2	9
	PH	1	1	2	1	3	2	40.0	5
Total		417	151	535	212	952	363	27.6	1315

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 4. Number and Percentage of Significant Providers

	Significant Providers		Total Number of Providers
Practice Type	Number	Percentage	
GP	259	22.8	1136
PH	31	46.3	67
PD	73	65.2	112
Total	363		1315

Table 5. Number and Percentage of Procedures for Significant and Non-significant Providers

	Number of Procedures			Percentage		
	Significant Provider			Significant Provider		
Procedures	No	Yes	all	No	Yes	all
DX SERV	72,096	243,164	315,260	34.8	30.4	31.3
PREV	74,147	289,084	363,231	35.8	36.2	36.1
SEAL	11,757	45,934	57,691	5.7	5.7	5.7
CORRECT	39,989	181,798	221,787	19.3	22.8	22.1
EXT	8,701	33,813	42,514	4.2	4.2	4.2
OTHER	207	5,088	5,295	0.1	0.6	0.5
Total	206,897	798,881	1,005,778	100.0	100.0	100.0
Percentage	20.6%	79.4%				

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 6. Percentage of Procedures for Each Location

	Percentage				
	Location				
Procedures	Metro.	Urban	Rural	Completely Rural	all
DX SERV	32.5	30.3	31.2	29.5	31.3
PREV	38.8	34.9	33.1	31.7	36.0
SEAL	5.6	5.2	6.2	8.5	5.7
CORRECT	18.9	24.4	24.5	24.7	22.2
EXT	4.0	4.3	4.9	4.0	4.2
OTHER	0.2	0.9	0.1	1.6	0.5
Total	100.0	100.0	100.0	100.0	100.0

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 7. Repeated-Measures Log-Linear Model Results

Source	df	chi-square	p-value
Year	1	7.73	0.0054
PracType	2	1.23	0.5411
Location	3	1.49	0.6839
Significant provider	1	60.63	<.0001
Year*Sig.	1	5.76	0.0164
PracType*Location	6	7.59	0.2694
Procedure	2	13.57	0.0011
Procedure*PracType	4	22.24	0.0002
Procedure*Location	6	18.86	0.0044
Procedure*Sig.	2	42.34	<.0001

Note: The log-linear model describes the number of procedures performed and what predictors affect this number of procedures. An interaction (*) indicates that the effect of one predictor depends upon another.

Table 8. Number and Percentage of Procedures for Each Practice Type

	Number of Procedures				Percentage			
	Practice Type				Practice Type			
Procedures	GP	PD	PH	all	GP	PD	PH	all
DX SERV	208,036	87,598	19,550	315,184	32.8	28.9	28.6	31.3
PREV	229,772	104,966	28,396	363,134	36.2	34.7	41.5	36.1
SEAL	32,667	14,041	10,967	57,675	5.1	4.6	16.0	5.7
CORRECT	136,675	77,293	7,782	221,750	21.5	25.5	11.4	22.1
EXT	26,269	14,462	1,775	42,506	4.1	4.8	2.6	4.2
OTHER	1,000	4,294	1	5,295	0.2	1.4	0.0	0.5
Total	634,419	302,654	68,471	1,005,544	100.0	100.0	100.0	100.0
	63.1%	30.1%	6.8%					

Note: The GP performed a significantly greater percentage of diagnostic procedures to their Medicaid patients than did PD and PH dentists (chi-square = 1672, $p < 0.0001$). The percentage of preventive procedures performed by PD and GP was not significantly different, but was significantly lower than those performed by PH dentists (chi-square = 914, $p < 0.0001$). Finally, pediatric dentists performed significantly greater (chi-square = 3060, $p < 0.0001$) percentage of corrective procedures than both GP and PH dentists.
Note: The percentages do not add up to exactly 100%, this is due to rounding error.
Note: There were n = 234 procedures unidentified by practice type.

Table 9. For General Practitioners, the Percentage of Procedures for Each Location

	Percentage				
	Location				
Procedures	Metro.	Urban	Rural	Completely Rural	all
DX SERV	33.5	33.0	30.6	30.9	32.6
PREV	38.6	36.0	32.6	29.6	36.1
SEAL	4.8	5.2	5.7	5.0	5.1
CORRECT	19.2	21.6	25.9	29.7	21.8
EXT	4.0	3.8	5.1	4.6	4.2
OTHER	0.0	0.4	0.1	0.0	0.2

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 10. For Pediatric Dentists, the Percentage of Procedures for Each Location

	Percentage				
	Location				
Procedures	Metro.	Urban	Rural	Completely Rural	all
DX SERV	30.7	27.9	32.9	27.2	28.9
PREV	38.7	32.7	35.1	20.9	34.6
SEAL	5.1	3.9	5.3	7.1	4.4
CORRECT	19.9	28.9	23.5	24.4	25.8
EXT	4.9	5.0	3.1	2.5	4.9
OTHER	0.6	1.6	0.0	17.8	1.5

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

Table 11. For Public Health Dentists, the Percentage of Procedures for Each Location

	Percentage				
	Location				
Procedures	Metro.	Urban	Rural	Completely Rural	all
DX SERV	28.8	25.1	32.9	26.7	27.5
PREV	43.2	40.6	39.3	43.0	41.5
SEAL	20.8	14.8	12.8	21.3	17.1
CORRECT	6.2	16.4	12.1	6.2	11.4
EXT	1.0	3.1	2.8	2.7	2.4
OTHER	0.0	0.0	0.0	0.0	0.0

Note: The percentages do not add up to exactly 100%, this is due to rounding error.

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Vita

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