Youth Using Behavioral Health Services

Making the Transition from the Child to Adult System

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Contents

I. Introduction

Young adulthood is a time of intense change as youth begin to establish themselves in adult roles through pursuing employment, higher education, independent living, and meaningful relationships. Young adults are at greater risk for developing mental illness and substance use disorders than younger or older age groups, and for those with existing mental health disorders, young adults experience greater risk for developing co-occurring substance use disorders (Pottick, Bilder, Vander Stoep, Warner, & Alvarez, 2008). Nearly half of Americans will meet the criteria for a mental illness during their lifetime. Half of all instances begin by age 14, and 75% start by age 24 (Kessler et al., 2005), indicating that successfully navigating through this "transition" age (often defined as 16-25 years) has substantial connections with mental health outcomes.

Addressing the specific needs of youth across multiple life domains as they transition from the children's behavioral health treatment system to the adult treatment system is critically important. Youth with a mental illness experience greater difficulties when transitioning into adult roles and responsibilities than youth without mental illness. Poor outcomes among youth with mental illness include higher prevalence of dropping out of school, unemployment or underemployment, involvement with the juvenile probation system or adult criminal justice system, homelessness, and unplanned pregnancy (Manteuffel, Stephens, Sondheimer, & Fisher, 2008; National Longitudinal Transition Study, 2004; Vander Stoep, et al. 2000).

While research on effective programs and policies to address the unique needs of transition-age youth is still developing, programs aimed at supporting the transition process – moving beyond symptom management and crisis intervention – show promise in improving mental health and independent living outcomes (Haber et al., 2008). Behavioral health providers can play an important role in helping youth in their services transition more successfully into adulthood. Yet national research suggests that many youth drop out of the treatment system after they turn 18 (Pottick et al., 2008); discussions AHCI has had with Community Care Behavioral health (Medicaid managed care organization) and County behavioral health staff indicate this is also of concern at the local level. Gaining a better understanding of service use at this critical juncture can indicate areas for intervention to improve the continuity of care for youth during this transition period.

To help quantify these issues and contribute to discussions related to system interventions locally, AHCI identified a cohort of youth who turned 17 between January 2007 and December 2009 and used behavioral health services while 17. In this report, we describe their service use characteristics and involvement with other systems during their 17th year compared to their 18th year. Using data mining software, we also developed exploratory clustering models to assess whether we could identify groups, or clusters, of youth based on these data and predict with rule induction (decision tree) algorithms who accessed services during their 18th year.

II. Characteristics of 17-Year Old Youth Using Behavioral Health Services

1. Race, Gender and Primary Diagnosis

We identified 3,716 youth who turned 17 between January 2007 and December 2009 and used a mental health or substance use treatment service while 17. We worked with the Allegheny County Department of Human Services to identify which of these youth were involved with other social services and systems during their 17th year. Table 1 summarizes the characteristics of this cohort of 17 year olds receiving treatment in the behavioral health system.

Table 1

Race, Gender and Diagnosis Characteristics of 17 Year Old Service Users (17th birthday between 1/1/07 – 12/31/09)			
Race & Gender	Black/African-American females	657	18%
	Black/African-American males	871	23%
	White females	849	23%
	White males	976	26%
	Other race females	167	4%
	Other race males	195	5%
	Total	**3716**	**100%**
Primary diagnosis	ADHD	506	14%
	Adjustment	536	14%
	Anxiety	262	7%
	Autism Spectrum	169	5%
	Bipolar	150	4%
	Depression/MDD	880	24%
	Drug/alcohol	498	13%
	Oppositional/Defiant or Conduct Disorder	363	10%
	Other	350	9%
	Total	**3716**	**100%**
Co-occurring mental health and substance use diagnosis		464	12%

Approximately 45% of this cohort is female and 55% male. Each person's primary diagnosis is the most frequently billed diagnostic category from behavioral health service claims (including services paid by HealthChoices, Pennsylvania's managed care Medicaid program, and Allegheny County funds) during their 17th year. Depressive disorders are most common (24%), followed by ADHD (14%), adjustment disorders (14%), and drug and alcohol use disorders (13%). The 12% of youth who used both a mental health and substance use treatment service during their 17th year were categorized as having a co-occurring disorder.

2. Use of Behavioral Health Services when 17

These youth used a variety of behavioral health services. Table 2 summarizes services used by at least 5% of this cohort during their 17th year. This data includes services paid by the HealthChoices program and by Allegheny County for youth not enrolled in HealthChoices. Most youth (87%) were eligible for the HealthChoices program for all or part of their 17th year.

Table 2

Use of Behavioral Health Services by 17 Year Old Youth (17th birthday between 1/1/07 – 12/31/09)

Service group	Service category	Number of youth	Percent of cohort	Patterns of service use frequency
Community based mental health	BHRS	476	13%	59% had 30 or fewer days with a billed contact with a BHRS provider, 28% 31-90 days, and 13% more than 90 days. While 17, the number of days with billed contact with a BHRS provider ranged from 1 to 239 days.
	Family-based	247	7%	34% had 14 or fewer days with a billed contact with a family-based provider, 27% had 15-30 days, and 39% had more than 30 days. While 17, the number of days with family-based services ranged from 1 to 100 days.
	Med check	1112	30%	27% had one med check, 31% 2-3 visits, 31% 4-6 visits, and 11% more than 6 visits. While 17, the number of med checks billed ranged from 1 to 59.
	MH partial hospitalization	183	5%	50% used less than 30 days, and 50% used more than 30 days. While 17, the number of days with partial services ranged from 1 to 188 days.
	MH outpatient	2160	58%	23% had one day, 21% 2-3 days, and 21% 7 or fewer days. 32% had 14-30 days of service, and 4% had 60 or more days. While 17, the number of days with a billed outpatient mental health visit ranged from 1 to 95.
	Service coordination	661	18%	45% had 14 or fewer days, 25% 15-30 days, and 30% more than 30 days. While 17, the number of days with service coordinator billed contact ranged from 1 to 146.
Crisis services	Telephone, mobile, or walk-in crisis services	675	18%	61% had one crisis service day, 18% two days, 21% more than two days. Days of contact with crisis services ranged from 1 to 21 days.
Drug and alcohol	Non-hospital rehab	164	4%	80% used more than 30 days. The number of days ranged from 1 to 355 days.*
	Outpatient, intensive outpatient, and partial hospital	668	18%	32% had one day, 25% had 2-7 days, 33% had 8-30 days, and 10% had 30 or more days. The number of days with these services ranged from 1 to 114.
Residential or inpatient	Residential treatment facility	206	6%	83% used more than 120 days. The number of days ranged from 1 to 1285.*
	Psychiatric hospitalization	265	7%	68% had 14 days or fewer, 19% had 15-30 days, 13% had more than 30 days.* The number of days with these services ranged from 1 to 297.

* The days for admissions beginning while 17 extending into a youth's 18th year are included with 17th year totals. The days for admissions beginning prior to 17 but ending in a youth's 17th year are also included with 17th year totals. This results in a small number of youth with a high number of days for RTF, non-hospital rehab, and psychiatric hospitalization (exceeding 365 days for RTF).

Youth most commonly accessed mental health outpatient services (58%), although two thirds of these youth had seven or fewer days of outpatient services during their 17th year. Thirty percent (30%) of youth had one or more medication checks during their 17th year. Slightly less than 20% of youth used service coordination, outpatient drug and alcohol, and/or crisis services.

Smaller proportions of youth used more intensive community based mental health services – behavioral health rehabilitation services (BHRS, 13%) and family-based mental health (7%) – or residential treatment (6%) and psychiatric hospitalizations (7%). Higher proportions of these youth accessed these services prior to when they were 17 (between the ages of 12 and 16):

- 25% used BHRS and 17% used family-based services between 12 and 16
- 11% used RTF services and 16% had at least one psychiatric hospitalization
- 23% had service coordination services for some period

The median cost for behavioral health treatment for 17 year olds was $986, and the mean cost $6,700. About 20% of youth used services costing $16,000 or more.

3. Involvement with Other Social Services and Systems when 17

Some youth were involved with the Office of Children, Youth and Families (CYF) and/or the Juvenile Probation Office (JPO). See Table 3. While 18% of 17 year olds had a history of CYF placement outside the home between 12 and 16 years, 9% had a placement during their 17th year and 15% were on the active CYF caseload for some portion of their 17th year. About 16% of youth had at least one stay at the Shuman Detention Center, and 13% had other placements within the JPO system.

Table 3

	17 Year Old's Involvement with CYF or JPO (17th birthday between 1/1/07 – 12/31/09)		
CYF	At least one CYF placement 12-16	664	18%
	Open with CYF for all or portion of 17th year	551	15%
	At least one CYF placement 17-18	323	9%
JPO	1 Shuman detention 17-18	335	9%
	2+ Shuman detention 17-18	250	7%
	Other JPO episodes 17-18	488	13%

Incarcerations were rare for 17 year olds (1%), as the great majority of youth with criminal justice system involvement were handled through JPO. Very few youth (approximately 6%) had services through the two public housing authorities, the Housing Authority of the City of Pittsburgh or the Allegheny County Housing Authority.

4. Identifying Clusters of 17 Year Olds based on Service Use and Multi-System Involvement

Data mining software like IBM's SPSS Modeler can help find patterns in data to provide insight into behavioral health service patterns and to predict future events. With SPSS Modeler, we used service use characteristics and involvement with other service systems to identify groups, or clusters, of similar youth, as a potentially helpful tool to summarize this complex, multi-source data.

Clustering methodology aims to maximize differences between clusters (cluster separation) and minimize differences among the members of each cluster (cluster cohesion) on the input variables used. For the results to be useful, the number of clusters needed to summarize the data should be relatively few (depending on the complexity and size of the dataset) and a cluster should include a minimum number of cases. For this analysis, we used the K-Means methodology,[1] and explored solutions with between five and nine clusters, with a minimum of 30 youth in a cluster; the clusters were also evaluated to assure they make conceptual sense. Correlations between inputs were examined prior to including inputs in the modeling.[2] The resulting models presented here are exploratory and should be considered preliminary results useful for discussion.

To develop meaningful clusters with K-Means, we ran many iterations of the model, using different numbers of clusters, different inputs — including behavioral health service use while 17, use of selected services between 12-16, primary diagnosis, eligibility for HealthChoices, and involvement with JPO and CYF — and inputs using different measurement scales (i.e., did the youth use BHRS or not, a yes/no input, vs. how many service days of BHRS did the youth use, a continuous input). The output for each model ranked the importance of each input in identifying the clusters.

SPSS Modeler measures cluster quality on a scale of -1 to 1, with ranges for poor, fair and good based on cluster cohesion and separation measures. The AHCI analyst for this project evaluated these model iterations using two primary criteria: was the cluster quality in the "good" range and did the cluster solution make conceptual sense based on knowledge of the service system.

Table 4 summarizes the best clustering solution found through multiple modeling iterations. CYF involvement, JPO involvement, and RTF stays while 17 were the most important inputs in assigning cluster membership to individual youth. Primary diagnosis was somewhat important,[3] and mean days of individual service categories were relatively less important in assigning cluster membership. For all services except psychiatric hospitalizations, the mean number of days is a frequency of contact measure; it is the mean number of days an individual had a billed contact with a provider in a specific service category during their 17th year. For psychiatric hospitalizations, the mean number of days reflects the total average days hospitalized in the year.

[1] See the Appendix for more information on the clustering methods used.
[2] If two inputs are highly correlated, both should not be used in the same model.
[3] Because of the variation in diagnoses and service use represented by the "Other" diagnostic group, this clustering solution excludes the "Other" diagnostic group (350 youth, or 9% of the cohort). Therefore, 3,364 youth were included in the clustering analysis.

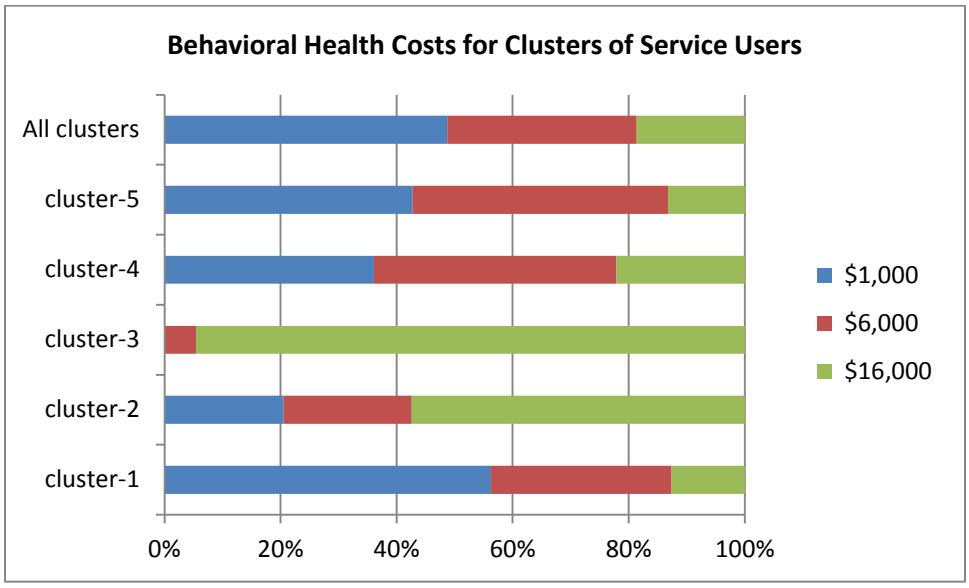
- **Cluster 1:** This cluster includes the majority of youth (68%). None had CYF or JPO involvement or an RTF stay while 17. This cluster has a higher relative proportion of youth with depressive disorders, anxiety disorders, and autism spectrum disorders, and fewer youth with conduct disorders and drug and alcohol disorders. Youth in this cluster used less than the average days of family-based, psychiatric hospital, and outpatient drug and alcohol services, and more BHRS.
- **Cluster 2:** This cluster includes only 6% of youth in the cohort, all of whom had at least one JPO placement or detention while 17; 57% also were CYF-involved and half had an RTF stay while 17. This cluster has a higher relative proportion of youth with a primary diagnosis of ADHD, oppositional/defiant or conduct disorder, or drug and alcohol disorders. They used slightly higher mean days of psychiatric inpatient and higher mean days of substance use treatment services.
- **Cluster 3:** This cluster includes only 3% of youth, all of whom had an RTF stay while 17; one third were also CYF-involved. This cluster has a higher relative proportion of youth with ADHD and bipolar disorder, and slightly higher proportion of youth with depression. They had substantially higher mean days of family-based, psychiatric hospital days, and service coordination, and somewhat higher mean days of BHRS and substance use treatment.
- **Cluster 4:** This cluster represents 12% of the cohort. All had at least one JPO detention or placement; none were involved with CYF or had RTF. This cohort had a higher relative proportion of oppositional/defiant or conduct disorder and drug and alcohol disorders.
- **Cluster 5:** This cluster represents 11% of the cohort; all were CYF-involved and none were JPO involved or had an RTF stay. A higher relative proportion of youth had a primary adjustment disorder or drug and alcohol diagnosis. Youth in this cohort used less mean days of all services except for drug and alcohol treatment compared to the total.

Table 4

Clusters of 17 Year Old Service Users								
Cluster number			**1**	**2**	**3**	**4**	**5**	**Total**
	Cluster size		2296	190	92	407	379	3364
	Proportion of cohort (N=3,364)		68%	6%	3%	12%	11%	100%
most important	Involved with CYF		0%	57%	32%	0%	100%	15%
	JPO detention or placement		0%	100%	0%	100%	0%	18%
	Had RTF while 17		0%	51%	100%	0%	0%	15%
	Primary diagnosis	ADHD	15%	24%	20%	15%	11%	15%
		Adjustment disorder	15%	11%	4%	13%	28%	16%
		Bipolar disorder	4%	3%	18%	3%	5%	4%
		Oppositional Defiant/Conduct	8%	23%	10%	17%	13%	11%
		Drug and alcohol	10%	22%	5%	34%	23%	15%
		Depression/MDD	31%	13%	28%	14%	14%	26%
		Anxiety disorder	9%	5%	4%	3%	5%	8%
		Autism spectrum	7%	1%	10%	0%	1%	5%
		Total	100%	100%	100%	100%	100%	100%
least important	Mean number of days with billed services for each service category	Mean # of days with billed contact with family-based provider	1.5	4.6	17.1	0.6	1.2	2.0
		Mean # days of psychiatric hospital	0.8	1.7	13.4	0.7	0.9	1.2
		Mean # of days with billed contact with service coordinator	4.0	3.0	18.8	2.4	5.0	4.3
		Mean # of days with billed outpatient MH services	5.1	2.9	4.2	3.6	8.1	5.1
		Mean # of days with billed contact with BHRS provider	6.0	2.2	7.8	1.8	2.7	5.0
		Mean # of days with billed services for oupatient/IOP/ partial D&A	1.3	4.7	3.4	3.4	5.7	2.3

These clusters have different costs, as shown in Table 5. Cluster 1 includes the highest proportion of youth with services costing less than $1000 during their 17th year. In Cluster 3, with all youth having RTF stays, almost all youth had services exceeding $16,000 during their 17th year. Below, the value of these clusters in predicting whether youth access behavioral health services while 18 will be examined.

Table 5



III. Behavioral Health Service Use after Youth Turned 18

1. Does Cluster Assignment When 17 Predict Service Use When 18?

Forty-one (41%) of youth who used behavioral health services when 17 did not use any services when 18.[4] The proportional race, gender, and primary diagnosis characteristics of the 2,200 youth from the original cohort of 17 year olds who used services during their 18th year were very similar to Table 1.

Table 6 shows the proportion of each cluster that used behavioral health services between the ages of 18 and 19.

Table 6

Used BH services in 18th year			
	No	Yes	Cluster size
Cluster 1	40%	60%	2296
Cluster 2	37%	63%	190
Cluster 3	14%	86%	92
Cluster 4	43%	57%	407
Cluster 5	45%	55%	379
Total	40%	60%	3364

[4] This includes both County-funded and HealthChoices services where providers bill for each encounter with an individual. Administrative case management is excluded.

A high proportion of youth in cluster 3 – primarily characterized by RTF utilization while 17 – used behavioral health services between 18 and 19. The remaining four clusters, representing 97% of the clustered cohort, did not differ substantially in the proportion of youth remaining connected to services after turning 18.

While potentially helpful in distinguishing different groups of 17-year old service users, these clusters did not predict the groups of youth more or less likely to remain connected to behavioral health services. This suggests that two of the most important characteristics used to assign membership to the clusters – CYF and JPO involvement – are not as influential in predicting the use of mental health or substance use treatment when youth are 18. Also, only a small proportion of youth in the cohort (15% CYF, 16% JPO, see Table 3) was involved with one of these other systems.

2. Service Utilization Patterns for 17 Year Olds between 18 and 19

Table 7 summarizes the service use patterns for those in the 17 year old cohort who received services after turning 18. Individuals may have used more than one type of service between their 18th and 19th birthdays; this table represents the 59% (about 2,200 youth) who used services.

Table 7

17-Year Old Cohort's Use of Behavioral Health Services between 18 and 19 Years

Service group	Service category	# of 18 year old services users	% of original cohort	Frequency of service use
Community based mental health	BHRS	274	7%	55% had 30 or fewer days. While 18, the number of days with billed contact with a BHRS provider ranged from 1 to 203 days.
	Family-based	86	2%	66% had more than 30 service days. While 18, the number of days with family-based services ranged from 1 to 91 days.
	Med check	809	22%	23% had one med check, 37% 2-3 visits, 30% 4-6 visits, 10% more than 6 visits. While 18, the number of med checks billed ranged from 1 to 39.
	MH outpatient	1187	32%	22% had one day, 22% 2-3 days, and 40% 7 to 14 days. 16% had more than 30 days. While 18, the number of days with a billed outpatient mental health visit ranged from 1 to 82.
	MH partial	104	3%	45% used 30 days or fewer. While 18, the number of days with partial services ranged from 1 to 173 days.
	Service coordination	481	13%	42% had 14 or fewer days, 23% 15-30 days, and 35% more than 30 days. While 18, the number of days with service coordinator billed contact ranged from 1 to 126.
Crisis services	Telephone, mobile, or walk-in crisis services	264	7%	55% had one crisis service day, 17% two days, 28% more than two days. Days of contact with crisis services ranged from 1 to 146 days.
Drug and alcohol	Non-hospital rehab	71	2%	42% used more than 30 days. The number of days ranged from 1 to 330 days.*
	Outpatient, intensive outpatient, and partial hospital	292	8%	28% had one day, 29% had 2-7 days, 29% had 8-30 days, and 14% had 30 or more days. The number of days with these services ranged from 1 to 138.
Residential or inpatient	Residential treatment facility	16	0%	The number of days ranged from 1 to 492.*
	Psychiatric hospitalization	147	4%	63% had 14 days or fewer, 20% had 15-30 days, 16% had more than 30 days. The number of days ranged from 1 to 473.*
Total	Used at least one billable service	2200	59%	

* The days for admissions beginning while 18 extending into a youth's 19th year are included with 18th year totals. This results in a small number of youth with a high number of days (sometimes exceeding 365 days) for RTF, non-hospital rehab, and psychiatric hospitalization.

When compared to service use while 17 (Table 2), the proportional use of each service category decreased. The mean cost of behavioral health treatment when 18 (excluding those with zero costs) was $5,953, and the median was $888. This is less than the mean cost ($6,700) and median cost ($986) for the cohort when they were 17.

Involvement with other service systems changed across the two years. The proportion of youth involved with CYF and JPO decreased from 15% to 8% and 16% to 9% respectively. The number of youth with incarcerations at the Allegheny County jail increased from 1% to 7%. Three percent (3%) had services through the two public housing authorities, the Housing Authority of the City of Pittsburgh or the Allegheny County Housing Authority. Three percent (3%) received other housing/homeless assistance services, including emergency shelters.

We did not observe a large drop in HealthChoices eligibility from 17 to 18, and we included both HealthChoices and County-funded services in the dataset. In the cohort of 3,716 youth, 13% were ineligible for HealthChoices while 17, and 16% were ineligible while 18. So, the great majority of youth were HealthChoices-eligible for all or a portion of each year.

3. Predicting Which 17 Year Olds Use Behavioral Health Services When 18

While many youth may not need behavioral health services in consecutive years as they transition to adulthood, investigating the characteristics of service use while 17 that predict service use while 18 may help identify groups of youth we may expect to benefit from continued involvement with behavioral health services (e.g., youth with intensive service use or certain diagnoses).

Using the C5.0 modeling technique in SPSS Modeler,[5] we developed a set of rules that divided the 17-year olds into subgroups based on relationships between the inputs (e.g., use of specific services when 17) and whether they used behavioral health services when 18. As with the clustering analysis, many iterations of the C5.0 rule induction model were tested, varying the inputs and inputs using different measurement scales (as described on page 6).

The AHCI analyst evaluated each model using two criteria:

- the proportion of youth with accurate predictions on whether they used services when 18
- whether the model makes conceptual sense based on system knowledge and data understanding

This technique provides a count of the youth in each subgroup and the percentage of the subgroup whose service use when 18 is accurately predicted by the rule set. Table 8 shows the C5.0 model with the highest percentages of accurate predictions of models tested that also made conceptual sense. Medication checks were the most important predictor, followed by frequency of service coordination. Other service categories shown in Table 8 were predictors, but of little relative importance.

[5] See the Appendix for more information on the rule induction methods used in this analysis.

As summarized in Table 8:

- **Rule 1:** If a youth had one or fewer medication check visits while 17, the model predicts the youth will not access services when 18. This rule is accurate 66% of the time, and applied to 42% of the youth in the data tested. The model did not identify other rules predicting no service use.
- **Rule 2:** If a youth had more than one medication check visit while 17, the model predicts the youth will access services when 18. This rule is accurate 83% of the time and applied to 22% of the youth in the data tested.
- **Rule 3:** If a youth had more than 3 days of mental health outpatient, and less than the split in days of med checks, service cocordination, BHRS, and mental health partial identified by the model, the model predicts the youth will access services when 18. This rule is only accurate 64% of the time, and applied to 18% of the youth in the data tested.
- **Rules 4-8:** These rules identify smaller subgroups of youth (2% - 6%) who had days in one particular service category higher than the split identified by the model (bolded in Table 8). Diagnoses of bipolar disorder and autism spectrum disorders were also predictors. Accuracy of these rules varied from 60% to 92%.

Table 8

Decision Rules for Predicting Service Use When 18

				More important in model ……					less important in model
	Rule #	% of youth	% correct	Med check	Service coord.	BHRS	MH outpatient	Diagnosis	MH partial
NO service use when 18	1	42%	66%	≤ 1 visit					
YES service use when 18	2	22%	83%	**> 1 visit**					
	3	18%	64%	≤ 1 visit	≤ 6 days	≤ 10 days	**> 3 days**		≤ 30 days
	4	6%	77%	≤ 1 visit	**> 6 days**	≤ 10 days			≤ 30 days
	5	5%	86%	≤ 1 visit		**> 10 days**			≤ 30 days
	6	3%	60%	≤ 1 visit	≤ 6 days	≤ 10 days	≤ 3 days	All other diagnoses	≤ 30 days
	7	2%	92%	≤ 1 visit					**> 30 days**
	8	2%	73%	≤ 1 visit	≤ 6 days	≤ 10 days	≤ 3 days	**Bipolar or autism**	≤ 30 days
	Subtotal	58%	75%						

In sum, this model predicts correctly 66% of the time youth who do not access services when 18. It predicts correctly 75% of the time youth who do access services when 18.[6] We can infer that youth prescribed psychiatric medications may be more likely to remain connected to services as they enter the adult system. The other decision rules suggest youth receiving more frequent services while 17 are also more likely to remain connected to services as they enter the adult system. However, these patterns do not form the basis for highly accurate predictions.

IV. Conclusion and Next Steps

This report provides insight into service use for youth as they are making a critical transition to adulthood. By identifying a cohort of youth 17-18 years old who used behavioral health services, we had a sufficiently large group of youth to examine service use patterns during what is typically considered to be the last year in the child service system. We identified some preliminary clusters of 17 year old youth, where CYF involvement, JPO involvement, and RTF use were the most important inputs in defining the clusters.

While these clusters provide some insight into groupings of youth at this particular age, they did not serve as strong predictors of whether youth remained connected to publicly funded behavioral health services after turning 18 (until their 19th birthday at least). The strongest predictors of service use when 18 were whether youth received medication checks (i.e., were taking a psychiatric medication), followed by frequency of a number of different service categories. Even after many iterations, the best model developed for this report only predicted "no service use when 18" with 66% accuracy and "yes service use when 18" with 75% accuracy.

It is important to note that the application of SPSS Modeler for this report should be considered exploratory, and variables that may better predict service use may not be captured through AHCI's data system. While many iterations of models were run, and the AHCI analyst applied consistent criteria to evaluate each model, different modeling techniques and different selection of input variables may result in more accurate and insightful models.

This analysis is helpful in several ways. First, it summarizes complex data from multiple sources by looking for larger patterns. Second, new data mining techniques were applied to build this understanding. This report will be reviewed and discussed with Allegheny County and Community Care Behavioral Health to identify possible applications of this analysis.

[6] This model was tested using a randomly generated 70% of the data; when validated on the remaining 30% of the data, the accuracy of predictions decreased somewhat to predicting no service use when 18 62% of the time and predicting service use when 18 73% of the time. Developing a model using 70% of the data then validating using the remaining 30% of the data is the SPSS-recommended approach to avoid overstating the accuracy of the model. Other inputs tested for inclusion in model iterations included CYF and JPO involvement when 17, RTF use when 17, HealthChoices eligibility, race, gender, and total cost for behavioral health services when 17.

Appendix: Additional Information on Data Mining Techniques Used in this Report

Association and Clustering Analyses

The analysis on pages 5-7 describes the results of a data mining clustering technique. SPSS Modeler provides different methods for association and clustering (SPSS, 2010a). Association rules group data based on field values (e.g. amount of a specific service), while clustering models cluster cases (people). As we were interested in identifying youth who shared characteristics – an analysis at the "case" level – clustering analysis was used. Clustering methods include Kohonen networks, K-Means, and Two-Step clustering. K-Means is the most popular clustering method, and it allows the analyst to select the number of clusters and compare different solutions for their utility.

Rule Induction Analyses

The analysis on pages 12-14 describes the results of applying a data mining rule induction methodology. C5.0 is one of several rule induction (also called decision tree) modeling techniques available in SPSS Modeler. These algorithms analyze a group of predictors through dividing the data into subgroups according to the strength of the relationships between the predictors and the output or target field. For example, in our analysis, the rule induction algorithm C5.0 assessed the relationship between the use of different services when 17 (predictors or inputs) and the target, service use when 18. C5.0 was selected because it allows binary targets, allows splits into more than two subgroups, and provides an option in modeling to maximize generality on other data (vs. accuracy on the training sample used to create the model). There are other differences between C5.0 and the other rule induction methods, and these other techniques could also be used in further analysis for comparative purposes (SPSS, 2010b).

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