Pediatric Mental Health–Related Emergency Department Visit Trends: Assessing the Impact of the Transition from ICD–9–CM to ICD–10–CM Diagnosis Codes

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The International Classification of Diseases (ICD) provides standardized data on population morbidity and mortality. ICD codes from administrative hospital discharge records are an important source of data to monitor service utilization. However, changes in the ICD coding schema present challenges for monitoring trends over time. This Epi Research Report describes a methodology for monitoring trends in mental health-related pediatric emergency department (ED) visits, taking into account the 2015 transition from ICD-9-CM to ICD-10-CM codes. The report also provides recommendations for interpreting trends and validating findings.

Key Points:

- The transition from ICD-9-CM to ICD-10-CM raises concerns about how trend analyses specific to pediatric mental health may be impacted by changes in ICD codes.

- We examined pediatric mental health-related emergency department (ED) visit trends across disorder groups categorized by transition complexity.

- We observed a decreasing trend in service utilization right before the time of code transition for the schizophrenia and psychosis group, which underwent a complex code transition, lending support for further monitoring and analyses.

- Recommendations:

  1. Continue monitoring trends.

  2. Conduct analyses on the same dataset by different subgroups.

  3. Validate trends by comparing across other data sources.

Background

On October 1, 2015, the United States transitioned from International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) to International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). The World Health Organization (WHO) created this official system of assigning codes to diagnoses, and the tenth revision is the most recent implemented in the United States. Clinicians use ICD codes for billing in clinical settings and researchers use these codes to monitor service utilization patterns. The ICD-9-CM code set has about 14,000 primarily numeric diagnostic codes, and the ICD-10-CM code set has approximately 68,000 alphanumeric codes[1] – a 400% increase in codes from ICD-9-CM. It is unclear how the transition from ICD-9-CM to ICD-10-CM codes may affect the interpretability of data trends that include years before and after the 2015 transition.

Some investigators found an impact of the coding transition on a variety of diagnoses and services.

For example:

- Stewart et al.[2] examined monthly trends of self-inflicted and undetermined intent of injury or poisoning to demonstrate the effect of the coding transition on monitoring suicidal behavior. The authors found an abrupt increase in diagnoses at the time of coding transition and concluded that the increase "almost certainly represents artifacts of coding changes."

1 Making a smooth transition: avoiding the top 5 risks of the ICD-10 conversion. Watertown, MA: Athena Health;. athenahealth.com/whitepapers/icd-10; 2014; accessed October 1, 2017.

2 Stewart C, Crawford PM, Simon GE. Changes in coding of suicide attempts or self-harm with transition from ICD-9 to ICD-10. *Psychiatr Serv.* 2017;68(3):215.

- Grief et al.[3] examined family medicine diagnosis codes to identify areas of the transition that could be challenging to physicians and medical coders. They categorized relationships between ICD-9-CM and ICD-10-CM diagnosis codes as "simple," "convoluted," or "no mapping" to determine how many codes did not have straightforward transitions. Study authors found that 27% of family medicine codes were convoluted, in which additional analyses were required to ensure a successful transition.

- Heslin et al.[4] examined quarterly trends in opioid-related inpatient stays before and after the transition. The authors found shifts in the number of inpatient stays at the time of transition across multiple categorizations of opioid-use diagnoses codes. They concluded that these shifts in stays were attributable to changes in coding.

Case Study

In the United States, mental health-related ED visits among children and youth have been increasing over the past several years.[5] The New York City Health Department monitors pediatric mental health-related ED visits to understand service use patterns and inform decision-making around policies and program planning. We aggregate diagnostic codes into clinically meaningful disorder groups to measure child mental health service utilization trends. However, any observed changes in service use patterns based on ICD codes cannot be taken at face value if those changes bridge the transition from ICD-9-CM to ICD-10-CM, since observed trends may reflect coding changes rather than actual shifts in service use. To assess the ICD-9-CM to ICD-10-CM transition on NYC pediatric mental health-related ED visit patterns, we devised a method to describe the type of transition from each old to new code.

Methods

Adapting the General Equivalence Mappings tool for pediatric mental health

The Centers for Medicare and Medicaid Services (CMS) created a General Equivalence Mappings (GEMs) to facilitate the ICD transition. GEMs is a tool for directional mapping from ICD-9-CM diagnosis codes to ICD-10-CM diagnosis codes, and vice versa.[6] CMS GEMs allows users to find corresponding diagnosis codes between the two code sets. Based on guidance from WHO,[7] we defined pediatric mental health diagnosis codes as 290.0-314.9 for ICD-9-CM and F01-F99 for ICD-10-CM. These code sets encompass our standardized definitions of pediatric mental health. There were 456 ICD-9-CM pediatric mental health codes that transitioned to 706 ICD-10-CM codes.

We adapted the CMS GEMs mapping algorithm to create transition categories for each pediatric mental health code (Figure 1). We cre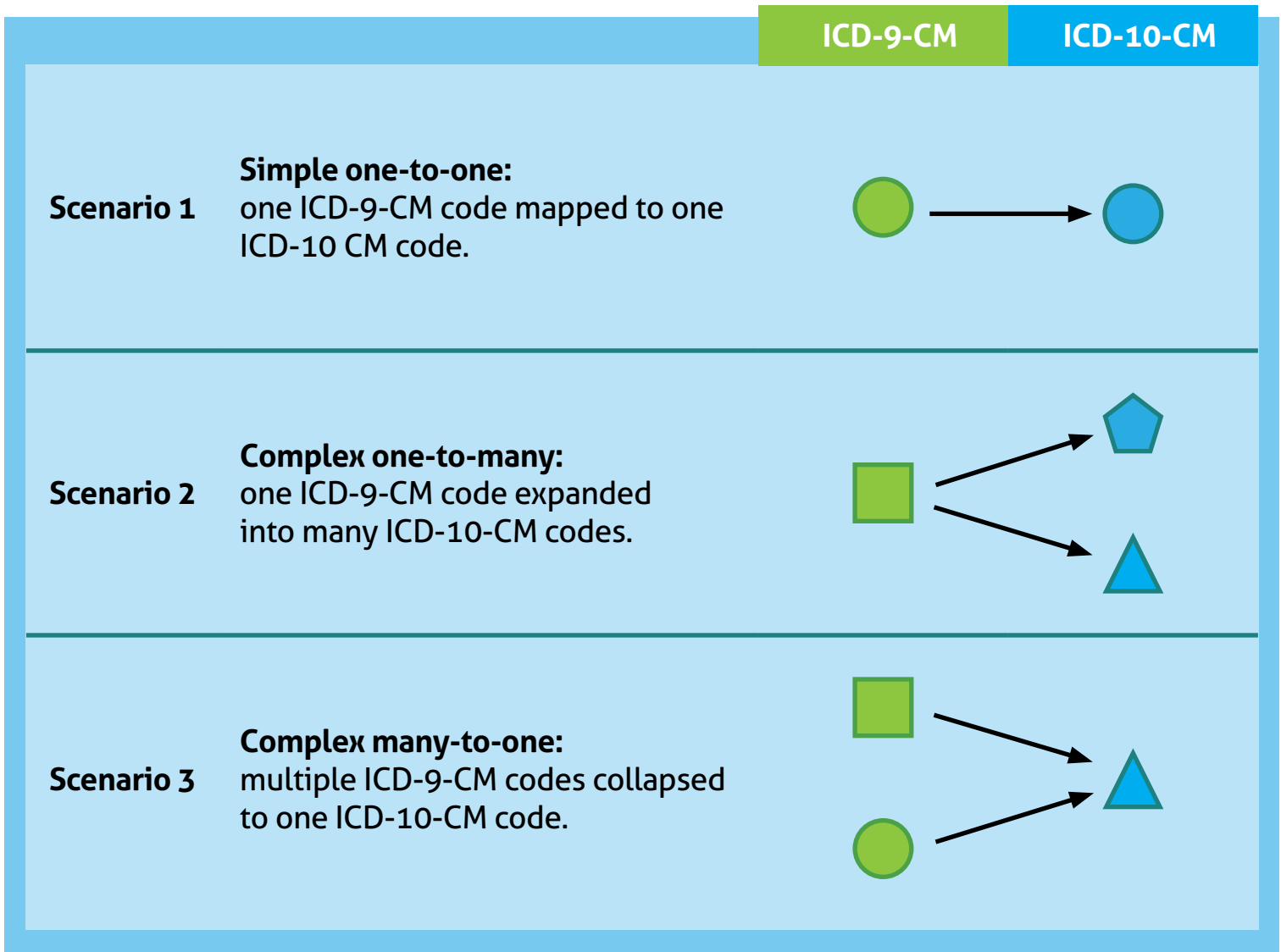ated three code transition categories, one simple and two complex. Some codes matched one-to-one, indicating a simple transition that was an exact or approximate match between one ICD-9-CM code and one ICD-10-CM code. Other codes were more complex one-to-many matches: one ICD-9-CM code was mapped to multiple ICD-10-CM codes. Many-to-one matches were also complex, as multiple ICD-9-CM codes were collapsed to one ICD-10-CM code.

All ICD-9-CM mental health codes were mapped to an ICD-10-CM code, so no codes were identified as having "no mapping."

> ### Our methodology entails the following steps
>
> 1. Adapting the ICD-9-CM to ICD-10-CM GEMs from CMS to categorize pediatric mental health codes based on the complexity of transition.
>
> 2. Defining aggregate mental health disorder subgroups and assigning one disorder group to describe and categorize each of the three types of transition.
>
> 3. Examining any changes in trends of pediatric mental health-related ED visits by transition category.

3 Grief SN, Patel J, Kochendorfer KM, et al. Simulation of ICD-9 to ICD-10-CM transition for family medicine: simple or convoluted? *J Am Board Fam Med.* 2016;29(1):29-36. doi:10.3122/jabfm.2016.01.150146.

4 Heslin KC, Owens PL, Karaca Z, Barrett ML, Moore, BJ, Elixhauser A. Trends in opioid-related inpatient stays shifted after the US transitioned to ICD-10-CM diagnosis coding in 2015. *Med Care.* 2017;55(11):918-923. doi:10.1097/mlr.0000000000000805.

5 Kalb LG, Stapp EK, Ballard ED, Holingue C, Keefer A, Riley A. Trends in Psychiatric Emergency Department Visits Among Youth and Young Adults in the US. *Pediatrics.* 2019;143(4). doi:10.1542/peds.2018-2192

6 2017 ICD-10-CM and GEMs. Baltimore, MD: U.S. Centers for Medicare and Medicaid Services. https://www.cms.gov/Medicare/Coding/ICD10/2017-ICD-10-CM-and-GEMs.html; 2017; accessed October 1, 2017.

7 The ICD-10 classification of mental and behavioural disorders: clinical descriptions and diagnostic guidelines. Geneva, Switzerland: World Health Organization; 1992.

Figure 1: Categorization of transition complexity of ICD–9–CM codes to ICD–10–CM codes

Scenario 1
Simple one-to-one: one ICD-9-CM code mapped to one ICD-10 CM code.

Scenario 2
Complex one-to-many: one ICD-9-CM code expanded into many ICD-10-CM codes.

Scenario 3
Complex many-to-one: multiple ICD-9-CM codes collapsed to one ICD-10-CM code.

This study focused solely on unidirectional mapping of ICD-9-CM to ICD-10-CM to monitor observed changes in pediatric mental health-related ED visits that may have been due to the transition, which began in the fourth quarter of 2015.

It is important to note that the transition categories we created were not mutually exclusive. In the example below (Figure 2), one ICD-9-CM code can be identified as "one-to-many" because it maps to two ICD-10-CM

codes, but can also be "many-to-one" because it maps to the same ICD-10-CM code as another ICD-9-CM code. Therefore, in some instances, codes were counted in more than one transition category.

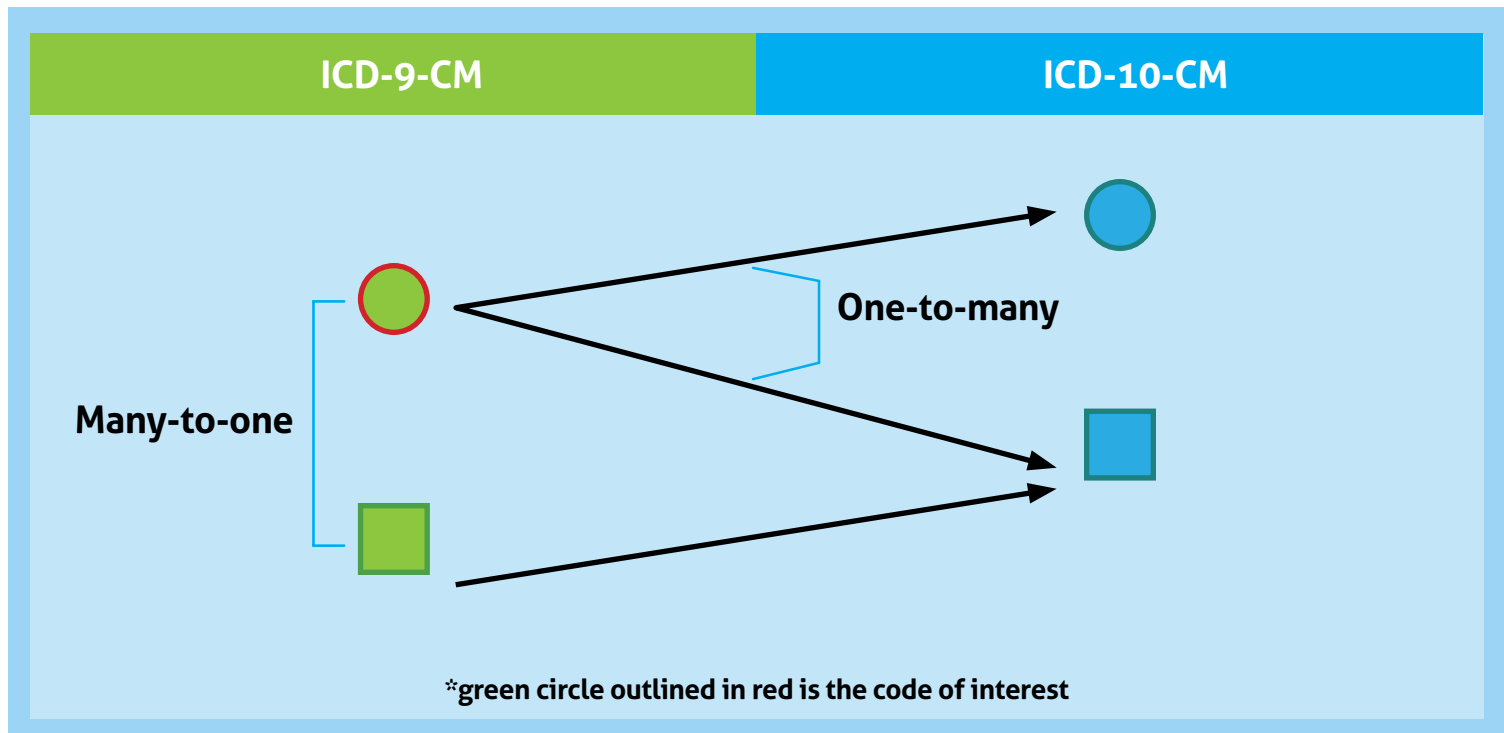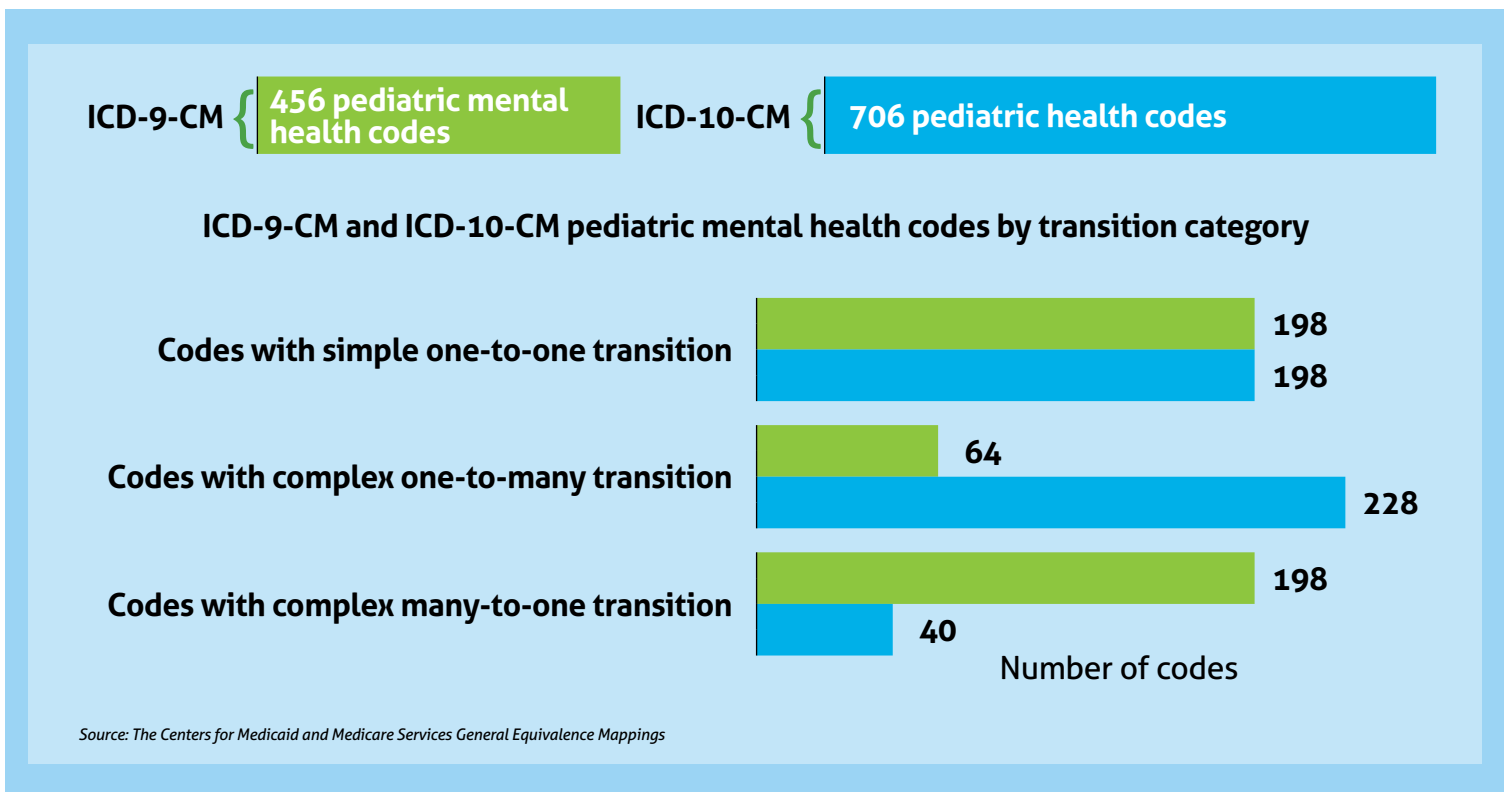## FIGURE 2: Complex, entangled mappings between ICD–9–CM and ICD–10–CM codes

ICD-9-CM	ICD-10-CM

Many-to-one

One-to-many

*green circle outlined in red is the code of interest

FIGURE 3: ICD–9–CM and ICD–10–CM pediatric mental health codes and categorization of transition complexity

ICD-9-CM { **456 pediatric mental health codes**   ICD-10-CM { **706 pediatric health codes**

ICD-9-CM and ICD-10-CM pediatric mental health codes by transition category

Codes with simple one-to-one transition
198
198

Codes with complex one-to-many transition
64
228

Codes with complex many-to-one transition
198
40

Number of codes

Source: The Centers for Medicaid and Medicare Services General Equivalence Mappings

Assigning mental health disorder subgroups to transition categories

To assess if changes in pediatric mental health-related ED visit trends differed by the type of transition it underwent, we chose a pediatric mental health disorder subgroup to represent each of the three transition categories for illustrative purposes. We assigned each mental health diagnostic code to one of eight mental health disorder subgroups, such as mood disorders or anxiety disorders (see Appendix 1). We referred to the DSM-5[8] categorical definitions to ensure aggregated subgroups were clinically meaningful, along with consultations with a child psychiatrist.

We then examined each disorder subgroup and assigned each to a transition category. We based these assignments on the predominate type of transition identified for diagnostic codes included in the subgroup and their relevance to pediatric mental health. For example, the mood disorder subgroup was made up of mostly of one-to-one code transitions, even though a few codes underwent complex transitions. The schizophrenia and psychosis subgroup had majority many-to-one codes and was classified into this transition category. The anxiety disorder subgroup was made up of mostly one-to-many codes, despite also having one-to-one and many-to-one codes, and was classified as the one-to-many transition category. We selected these three subgroups to illustrate the trends of each of the three respective transition categories.

FIGURE 4: Pediatric mental health disorders by transition category

Transition category	Mental health disorder subgroup	Total ICD-9-CM codes	Total ICD-10-CM codes	ICD matches within disorder subgroup
One-to-one	Mood disorders	61	64	**58 one-to-one** 2 many-to-one 3 one-to-many
Many-to-one	Schizophrenia and psychosis	76	21	8 one-to-one **68 many-to-one** 1 one-to-many
One-to-many	Anxiety disorders	12	33	7 one-to-one 0 many-to-one **5 one-to-many**

Examining trends of pediatric mental health-related emergency department visits

Utilizing data from the New York Statewide Planning and Research Cooperative System (SPARCS), we used ICD-9-CM and ICD-10-CM diagnosis codes to examine trends of all ED visits from 2006 to 2016 for children ages 0 to 20 years with a primary diagnosis that was related to mental health. For each quarter from 2006 through 2016, we counted the number of pediatric ED visits and calculated the proportion of visits that were mental health-related (Figure 5). Given the importance of mental health-related ED visits to the increase in overall ED visits among children and youth, we used the proportion as the unit of measurement for this analysis. Non-urgent mental health visits to EDs represent the largest contributors to this increase.[9]

We used Joinpoint Regression Program, version 4.6.0.0, to calculate trends by proportion of ED visits that were mental health-related to examine any fluctuations in the proportion of mental health-related ED visits during the time of transition (Figure 6). We carried out Monte Carlo Permutation tests to measure significance of regression slopes.

8 American Psychiatric Association. *Diagnostic and statistical manual of mental disorders.* 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.

9 Frosch E, dosReis S, Maloney K. Connections to Outpatient Mental Health Care of Youths With Repeat Emergency Department Visits for Psychiatric Crises. *Psychiatr Serv.* 2011;62(6):646-649. doi:10.1176/appi.ps.62.6.646

Results

We examined trends on a quarterly basis, beginning in the first quarter of 2006 through the fourth quarter of 2016 (Figure 6a). Overall, there were three joinpoints (points where the trend changed) in this time period and the proportion of overall pediatric mental health-related ED visits showed a non-significant decrease by 1.12% quarterly from 2014 quarter 1 through the end of 2016.

One-to-One Transition

The trend in proportion of visits specific to mood disorders had two joinpoints in the 10 year time frame and decreased significantly by 2.43% quarterly from 2014

quarter 1 through the end of 2016 (Figure 6b). Because mood disorders make up the largest proportion of pediatric mental health ED visits across all quarters, it was not surprising that the trend for this subgroup mirrored the overall trend in proportion of visits with mental health diagnoses.

Many-to-One Transition

The proportion of ED visits specific to schizophrenia and psychosis showed three joinpoints in the 10 year timeframe and decreased significantly by 3.50% quarterly beginning in 2014 quarter 4 through the end of 2016 (Figure 6c).

One-to-Many Transition

The proportion of ED visits specific to anxiety disorders increased significantly by 1.22% quarterly from 2006 quarter 1 through the end of to 2016 (Figure 6d). A steady increase in visits over the 10 year period was observed and there were no joinpoints.

FIGURE 5: Proportion of pediatric mental health–related emergency department visits, 2006–2016
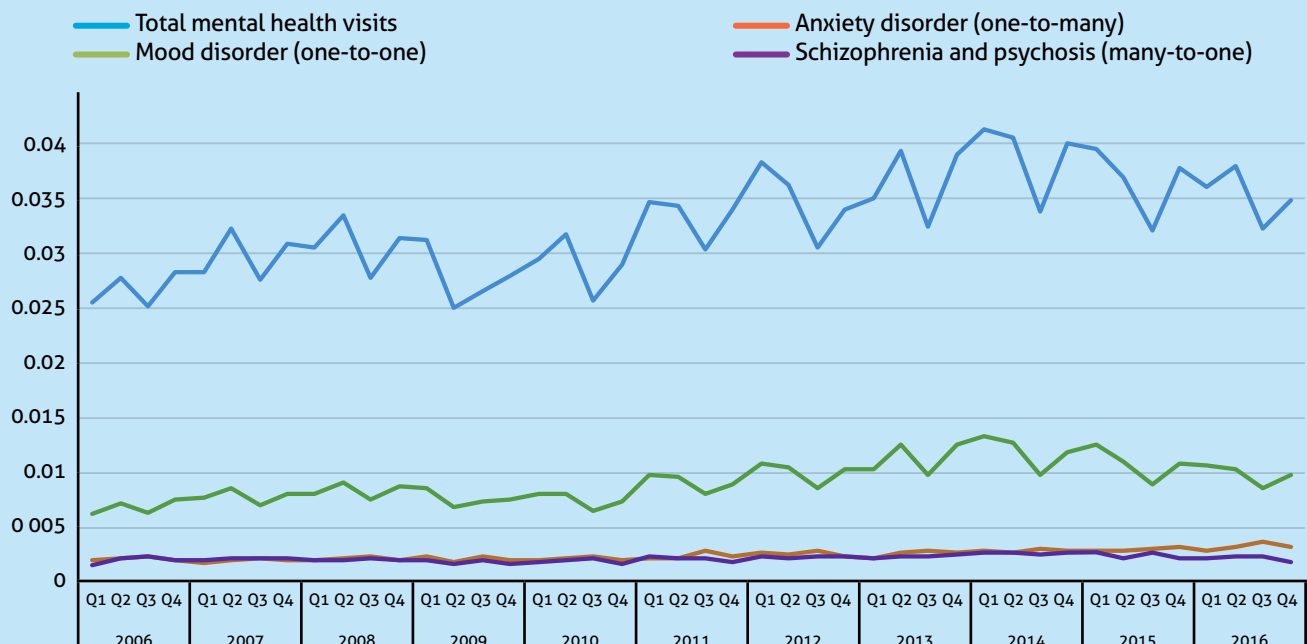
Source: Statewide Planning and Research Collaborative System (SPARCS), 2006-2016.

FIGURE 6: Trends of mental health disorders within each transition category

Figure 6a: Proportion of all mental health–related emergency department visits. Final selected model: three joinpoints
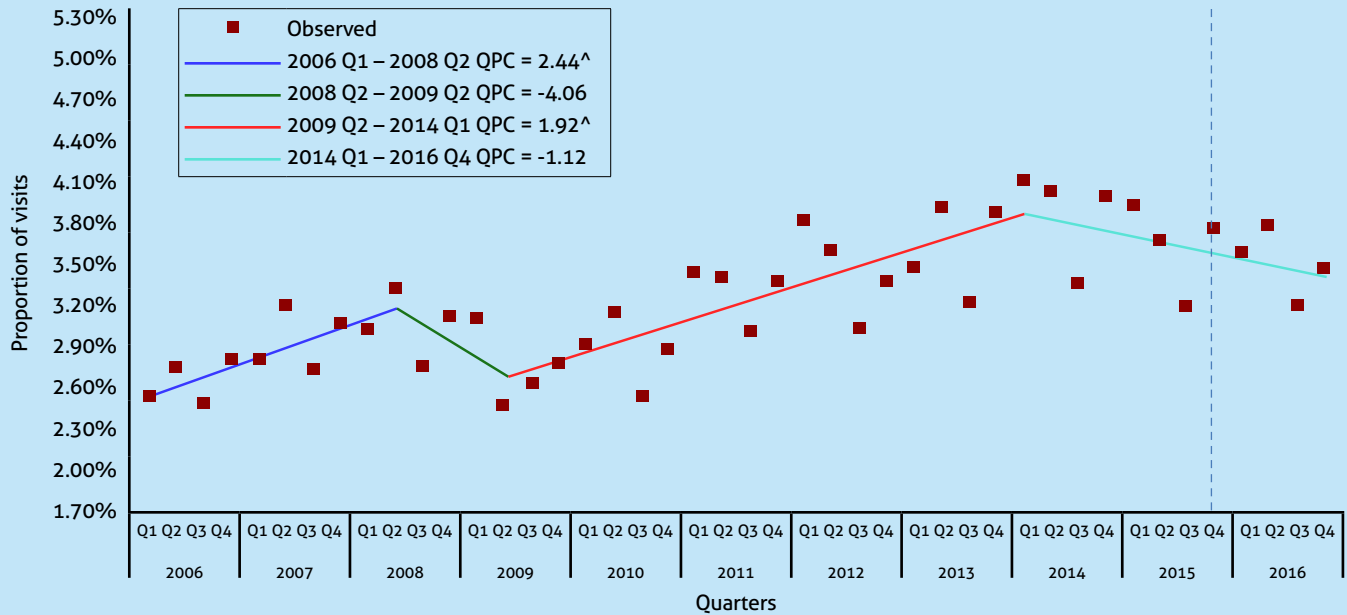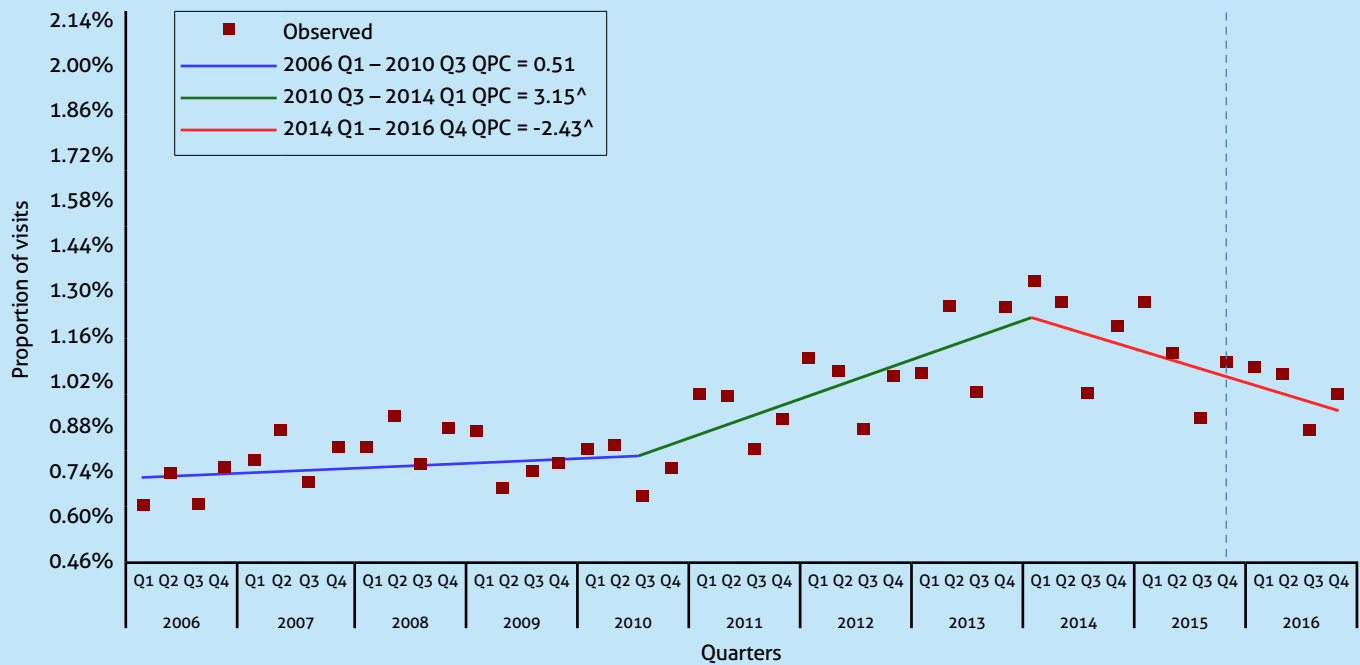

Legend:
- Observed
- 2006 Q1 – 2008 Q2 QPC = 2.44^
- 2008 Q2 – 2009 Q2 QPC = -4.06
- 2009 Q2 – 2014 Q1 QPC = 1.92^
- 2014 Q1 – 2016 Q4 QPC = -1.12

Y-axis: Proportion of visits
X-axis: Quarters

Figure 6b: One-to-one transition: mood disorders. Final selected model: two joinpoints

Legend:
- Observed
- 2006 Q1 – 2010 Q3 QPC = 0.51
- 2010 Q3 – 2014 Q1 QPC = 3.15^
- 2014 Q1 – 2016 Q4 QPC = -2.43^

Y-axis: Proportion of visits
X-axis: Quarters

^ Indicates that the Quarterly Percent Change is significantly different from zero at the alpha = 0.05 level.
The dashed vertical blue line indicates the inflection point of the time of transition.

Source: Statewide Planning and Research Collaborative System (SPARCS), 2006-2016.

FIGURE 6 (cont'd): Trends of mental health disorders within each transition category

Figure 6c: Many-to-one transition: schizophrenia and psychosis. Final selected model: one joinpoint
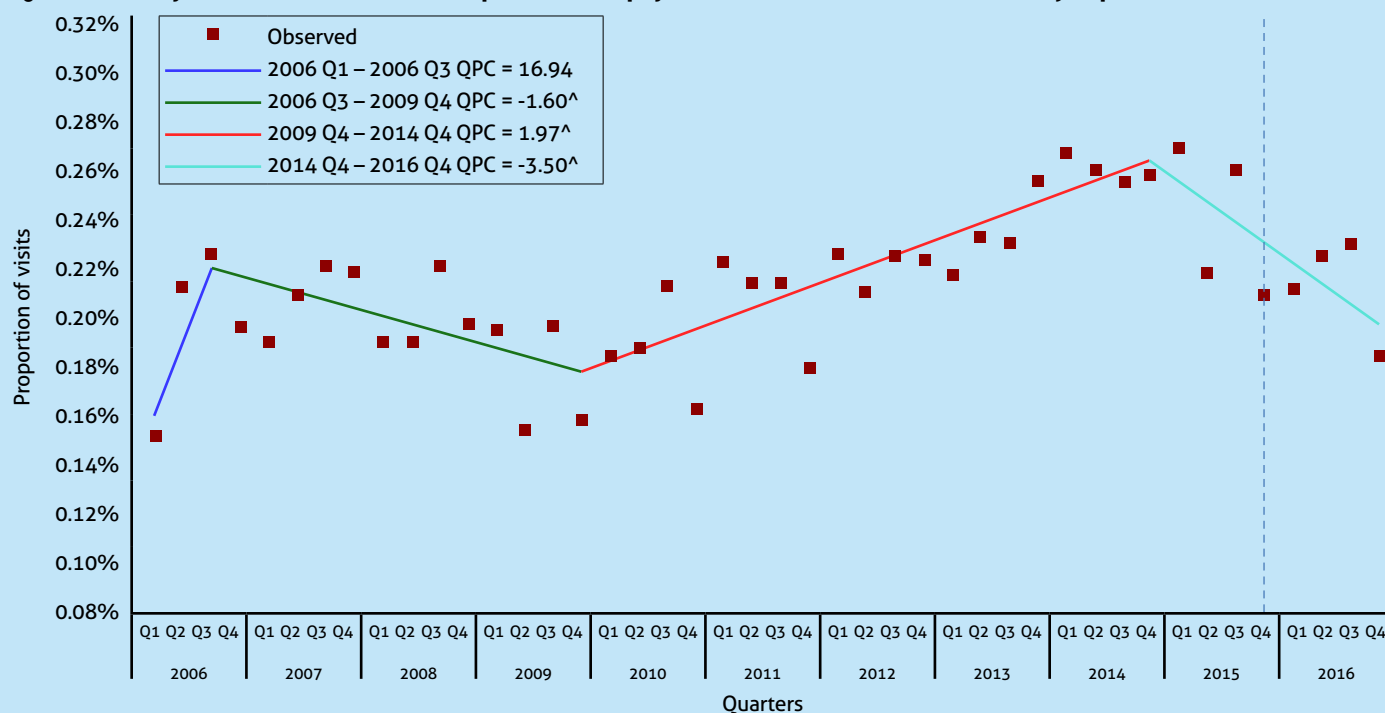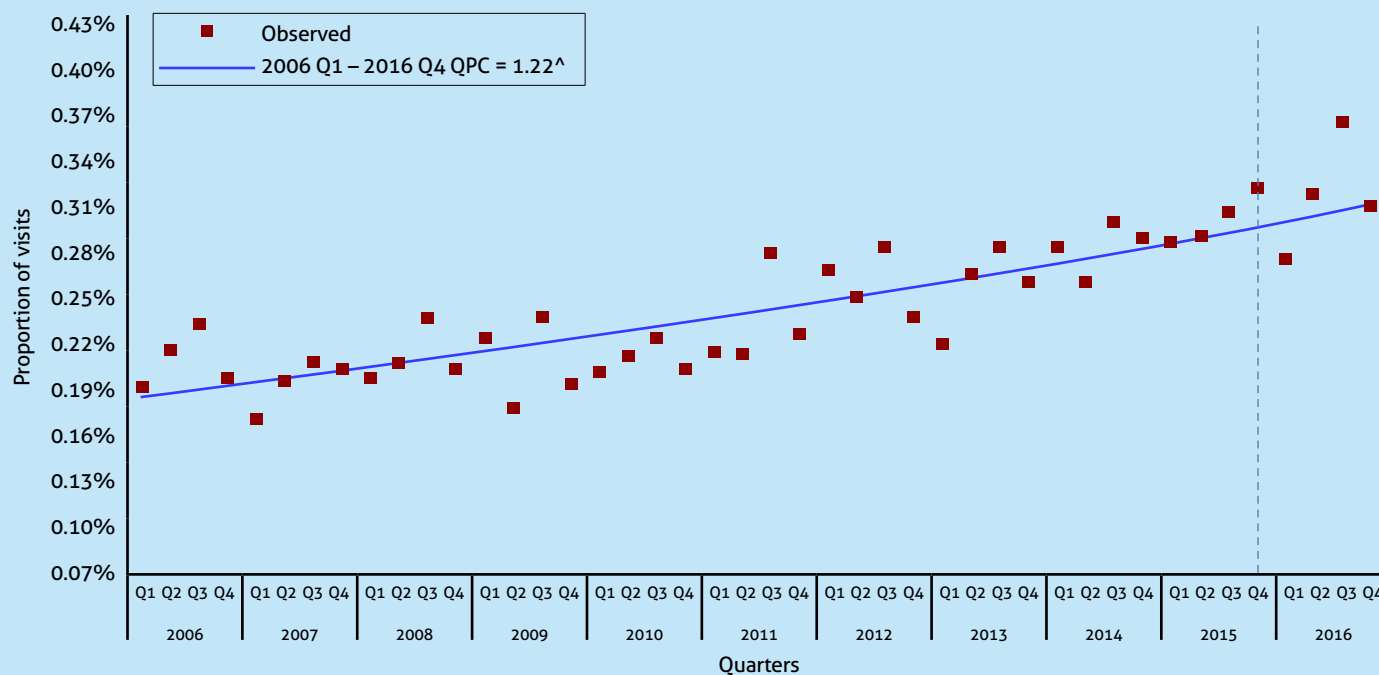

Legend:
- Observed
- 2006 Q1 – 2006 Q3 QPC = 16.94
- 2006 Q3 – 2009 Q4 QPC = -1.60^
- 2009 Q4 – 2014 Q4 QPC = 1.97^
- 2014 Q4 – 2016 Q4 QPC = -3.50^

Figure 6d: One-to-many transition: anxiety disorders. Final selected model: zero joinpoints

Legend:
- Observed
- 2006 Q1 – 2016 Q4 QPC = 1.22^

^ Indicates that the Quarterly Percent Change (QPC) is significantly different from zero at the alpha = 0.05 level.
The dashed vertical blue line indicates the inflection point of the time of transition.

Source: Statewide Planning and Research Collaborative System (SPARCS), 2006-2016

Discussion and Recommendations

The proportion of pediatric ED visits for overall mental health trends and mood disorders (one-to-one) significantly decreased beginning in 2014 quarter 1 through the end of 2016. Closer to the time of transition, schizophrenia and psychosis (many-to-one) showed a significant 3.50% decrease beginning in 2014 quarter 4. A major limitation in conducting this analysis is the lack of a gold standard in the form of prevalence estimates that can be compared with the trends seen in service utilization. Thus we are unable to predict whether changes seen were due to coding differences or were true changes in service utilization, and implicitly, true changes in illness prevalence. Therefore, continued monitoring and further analyses are required to fully assess the impact of the transition on pediatric mental health service utilization trends.

Recommendation 1
Continue monitoring trends

We saw a decrease in ED visits for schizophrenia and psychosis right before the time of transition. Continued monitoring of schizophrenia and psychosis codes separately will aid in assessing how the ICD transition may be impacting the trends and which codes are contributing to the decrease in ED visits.

New ICD-10-CM codes are introduced every year and will need to be added to their respective transition category and disorder subgroup. It is important to monitor changes well beyond the October 2015 inflection point, as the effects of this transition may continue to persist. A Swiss study found that it took up to five years before ICD-10-CM coding for comorbidities in hospitals became as accurate as ICD-9-CM9.[10] Changes in trends seen before the transition date may have also occurred as some health care organizations began implementing changes in diagnosis codes prior to October 2015; thus, it is important to be knowledgeable about health care organizations' billing practices.

Recommendation 2
Conduct analyses on same dataset by different subgroups

Due to the lack of consensus in the literature on how best to address the effect of the ICD transition on trends, along with the lack of a gold standard to compare against, analysts should employ multiple methodologies as a way of validating observed trends. For example, we propose disaggregating groups of codes. Our next steps include analyzing schizophrenia and psychosis codes separately, as well as breaking out mood disorder, depression and bipolar disorder. We can also compare pediatric mental health-related ED visit trends segmented by public and private hospitals to determine if trends across these providers are similar.

The SPARCS data set can be further analyzed by calculating the number of unduplicated patients as the unit of analysis instead of proportion of visits. This would also allow for a longitudinal analysis of frequent ED users and how their diagnosis codes may have changed through the transition. We encourage analysts to use their subject matter expertise to decide how to further stratify their analyses. For pediatric mental health, we know that school days influence ED visits and analyses by school days and school hours would provide more insight into trends.

Recommendation 3
Validate trends by comparing across other data sources

Context-level data analyses are essential for making informed decisions regarding program implementation and/or policy changes related to pediatric mental health. It is challenging to capture actual prevalence of mental health disorders for a number of reasons, including lack of a biological test. While mental health service utilization data are often used as a proxy for estimating prevalence, these data may be incomplete because many services are only billable if a child is given a diagnosis, and diagnoses can be specific to developmental stages. Furthermore, not all children and youth who have a disorder will present for services. Therefore, additional data sources—such as self-reported symptoms through population-based surveys, results from screening instruments, syndromic surveillance-type data that precede diagnoses, or mental health-related visits to the school nurse or counselor—can help to validate service utilization data.

Conclusion

This methodology critically examines trends by disaggregation of ICD codes, categorizing them by their transition complexity and categorizing them into clinically meaningful disorder subgroups. Continued monitoring, further analyses and validation are essential to fully assess whether the ICD transition has affected trends in diagnoses that underwent complex coding changes. There are serious implications for program and policy if the transition has affected trends, and this methodology is a first step in assessing this possibility.

10 Januel JM, Luthi JC, Quan H, et al. Improved accuracy of co-morbidity coding over time after the introduction of ICD-10 administrative data. *BMC Health Serv Res* 2011;11:194.. 2011;11. doi:10.1186/1472-6963-11-14.,

This study has the following strengths and limitations:

- This methodology can be applied to any datasets that utilize ICD-9-CM and ICD-10-CM codes for both billing and monitoring of service utilization, including data from electronic health records, hospitals, clinics and Medicaid and Medicare claims.

- The SPARCS dataset is comprehensive and robust in that it includes all ED visits that were treat-and-release and inpatient admissions over a span of 10 years.

- Because of the nature of ED settings, mental health diagnosis codes may be assigned with limited time, context and resources. Pediatric psychiatrists may not be staffed at the time of a mental health-related ED visit and staff may lack expertise to make an accurate diagnosis in a limited setting.

- ICD-9-CM and ICD-10-CM codes in SPARCS are primarily used for billing purposes, and may not reflect actual mental health diagnoses or may not accurately capture the experiences of young children.

- We were unable to measure the sensitivity of ICD-9-CM and ICD-10-CM coding. Reviewing patient charts and comparing them to the billed codes before and after the transition would lend additional support for trends seen in this analysis.

- Joinpoint regression is more effective with an increasing number of time periods available both before and after the inflection point of interest. SPARCS data are currently limited to 2016, but continued monitoring is necessary as more data become available.

Appendix 1: Disorder subgroups and matrices of code transitions for select subgroups

Pediatric mental health disorder subgroups

- Disruptive behavioral disorders
- Schizophrenia and psychosis
- Mood disorders
- Trauma and stressor disorders
- Anxiety disorders
- Suicidal ideation
- Substance use
- Other (all other mental health diagnoses)

MOOD DISORDERS CODE TRANSITIONS

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
296.00	Bipolar I disorder, single manic episode, unspecified	F3010	Manic episode without psychotic symptoms, unspecified
296.01	Bipolar I disorder, single manic episode, mild	F3011	Manic episode without psychotic symptoms, mild
296.02	Bipolar I disorder, single manic episode, moderate	F3012	Manic episode without psychotic symptoms, moderate
296.03	Bipolar I disorder, single manic episode, severe, without mention of psychotic behavior	F3013	Manic episode, severe, without psychotic symptoms
296.04	Bipolar I disorder, single manic episode, severe, specified as with psychotic behavior	F302	Manic episode, severe with psychotic symptoms
296.05	Bipolar I disorder, single manic episode, in partial or unspecified remission	F303	Manic episode in partial remission
296.06	Bipolar I disorder, single manic episode, in full remission	F304	Manic episode in full remission
296.10	Manic affective disorder, recurrent episode, unspecified	F3010	Manic episode without psychotic symptoms, unspecified
296.11	Manic affective disorder, recurrent episode, mild	F3011	Manic episode without psychotic symptoms, mild
296.12	Manic affective disorder, recurrent episode, moderate	F3012	Manic episode without psychotic symptoms, moderate
296.13	Manic affective disorder, recurrent episode, severe, without mention of psychotic behavior	F3013	Manic episode, severe, without psychotic symptoms
296.14	Manic affective disorder, recurrent episode, severe, specified as with psychotic behavior	F302	Manic episode, severe with psychotic symptoms
29615	Manic affective disorder, recurrent episode, in partial or unspecified remission	F303	Manic episode in partial remission
296.16	Manic affective disorder, recurrent episode, in full remission	F304	Manic episode in full remission
296.20	Major depressive affective disorder, single episode, unspecified	F329	Major depressive disorder, single episode, unspecified
296.21	Major depressive affective disorder, single episode, mild	F320	Major depressive disorder, single episode, mild
296.22	Major depressive affective disorder, single episode, moderate	F321	Major depressive disorder, single episode, moderate
296.23	Major depressive affective disorder, single episode, severe, without mention of psychotic behavior	F322	Major depressive disorder, single episode, severe without psychotic features
296.24	Major depressive affective disorder, single episode, severe, specified as with psychotic behavior	F323	Major depressive disorder, single episode, severe with psychotic features
296.25	Major depressive affective disorder, single episode, in partial or unspecified remission	F324	Major depressive disorder, single episode, in partial remission
296.26	Major depressive affective disorder, single episode, in full remission	F325	Major depressive disorder, single episode, in full remission
296.30	Major depressive affective disorder, recurrent episode, unspecified	F339	Major depressive disorder, recurrent, unspecified
296.31	Major depressive affective disorder, recurrent episode, mild	F330	Major depressive disorder, recurrent, mild
296.32	Major depressive affective disorder, recurrent episode, moderate	F331	Major depressive disorder, recurrent, moderate
296.33	Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior	F332	Major depressive disorder, recurrent severe without psychotic features
296.34	Major depressive affective disorder, recurrent episode, severe, specified as with psychotic behavior	F333	Major depressive disorder, recurrent, severe with psychotic symptoms
296.35	Major depressive affective disorder, recurrent episode, in partial or unspecified remission	F3341	Major depressive disorder, recurrent, in partial remission
296.36	Major depressive affective disorder, recurrent episode, in full remission	F3342	Major depressive disorder, recurrent, in full remission
296.40	Bipolar I disorder, most recent episode (or current) manic, unspecified	F3110	Bipolar disorder, current episode manic without psychotic features, unspecified
296.41	Bipolar I disorder, most recent episode (or current) manic, mild	F3111	Bipolar disorder, current episode manic without psychotic features, mild

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
296.42	Bipolar I disorder, most recent episode (or current) manic, moderate	F3112	Bipolar disorder, current episode manic without psychotic features, moderate
296.43	Bipolar I disorder, most recent episode (or current) manic, severe, without mention of psychotic behavior	F3113	Bipolar disorder, current episode manic without psychotic features, severe
296.44	Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior	F312	Bipolar disorder, current episode manic severe with psychotic features
296.45	Bipolar I disorder, most recent episode (or current) manic, in partial or unspecified remission	F3173	Bipolar disorder, in partial remission, most recent episode manic
296.46	Bipolar I disorder, most recent episode (or current) manic, in full remission	F3174	Bipolar disorder, in full remission, most recent episode manic
296.50	Bipolar I disorder, most recent episode (or current) depressed, unspecified	F3130	Bipolar disorder, current episode depressed, mild or moderate severity, unspecified
296.51	Bipolar I disorder, most recent episode (or current) depressed, mild	F3131	Bipolar disorder, current episode depressed, mild
296.52	Bipolar I disorder, most recent episode (or current) depressed, moderate	F3132	Bipolar disorder, current episode depressed, moderate
296.53	Bipolar I disorder, most recent episode (or current) depressed, severe, without mention of psychotic behavior	F314	Bipolar disorder, current episode depressed, severe, without psychotic features
296.54	Bipolar I disorder, most recent episode (or current) depressed, severe, specified as with psychotic behavior	F315	Bipolar disorder, current episode depressed, severe, with psychotic features
296.55	Bipolar I disorder, most recent episode (or current) depressed, in partial or unspecified remission	F3175	Bipolar disorder, in partial remission, most recent episode depressed
296.56	Bipolar I disorder, most recent episode (or current) depressed, in full remission	F3176	Bipolar disorder, in full remission, most recent episode depressed
296.60	Bipolar I disorder, most recent episode (or current) mixed, unspecified	F3160	Bipolar disorder, current episode mixed, unspecified
296.61	Bipolar I disorder, most recent episode (or current) mixed, mild	F3161	Bipolar disorder, current episode mixed, mild
296.62	Bipolar I disorder, most recent episode (or current) mixed, moderate	F3162	Bipolar disorder, current episode mixed, moderate
296.63	Bipolar I disorder, most recent episode (or current) mixed, severe, without mention of psychotic behavior	F3163	Bipolar disorder, current episode mixed, severe, without psychotic features
296.64	Bipolar I disorder, most recent episode (or current) mixed, severe, specified as with psychotic behavior	F3164	Bipolar disorder, current episode mixed, severe, with psychotic features
296.65	Bipolar I disorder, most recent episode (or current) mixed, in partial or unspecified remission	F3177	Bipolar disorder, in partial remission, most recent episode mixed
296.66	Bipolar I disorder, most recent episode (or current) mixed, in full remission	F3178	Bipolar disorder, in full remission, most recent episode mixed
296.80	Bipolar disorder, unspecified	F319	Bipolar disorder, unspecified
296.81	Atypical manic disorder	F308	Other manic episodes
296.82	Atypical depressive disorder	F328	Other depressive episodes
296.89	Other bipolar disorders	F3181	Bipolar li disorder
296.90	Unspecified episodic mood disorder	F39	Unspecified mood affective disorder
296.99	Other specified episodic mood disorder	F348	Other persistent mood affective disorders

ANXIETY DISORDERS CODE TRANSITIONS

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
293.84	Anxiety disorder in conditions classified elsewhere	F064	Anxiety disorder due to known physiological condition
300.00	Anxiety state, unspecified	F419	Anxiety disorder, unspecified
300.01	Panic disorder without agoraphobia	F410	Panic disorder episodic paroxysmal anxiety without agoraphobia
300.02	Generalized anxiety disorder	F411	Generalized anxiety disorder
300.09	Other anxiety states	F418	Other specified anxiety disorders
300.20	Phobia, unspecified	F409	Phobic anxiety disorder, unspecified
300.21	Agoraphobia with panic disorder	F4001	Agoraphobia with panic disorder
300.22	Agoraphobia without mention of panic attacks	F4002	Agoraphobia without panic disorder
300.23	Social phobia	F4010	Social phobia, unspecified
309.21	Separation anxiety disorder	F930	Separation anxiety disorder of childhood

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
300.29	Other isolated or specific phobias	F40218	Other animal type phobia
300.29	Other isolated or specific phobias	F40240	Claustrophobia
300.29	Other isolated or specific phobias	F40241	Acrophobia
300.29	Other isolated or specific phobias	F408	Other phobic anxiety disorders
300.7	Hypochondriasis	F4521	Hypochondriasis
300.7	Hypochondriasis	F4522	Body dysmorphic disorder

SCHIZOPHRENIA AND PSYCHOSIS CODE TRANSITIONS

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
293.0	Delirium due to conditions classified elsewhere	F05	Delirium due to known physiological condition
293.1	Subacute delirium	F05	Delirium due to known physiological condition
293.81	Psychotic disorder with delusions in conditions classified elsewhere	F062	Psychotic disorder with delusions due to known physiological condition
293.82	Psychotic disorder with hallucinations in conditions classified elsewhere	F060	Psychotic disorder with hallucinations due to known physiological condition
295.00	Simple type schizophrenia, unspecified	F2089	Other schizophrenia
295.01	Simple type schizophrenia, subchronic	F2089	Other schizophrenia
295.02	Simple type schizophrenia, chronic	F2089	Other schizophrenia
295.03	Simple type schizophrenia, subchronic with acute exacerbation	F2089	Other schizophrenia
295.04	Simple type schizophrenia, chronic with acute exacerbation	F2089	Other schizophrenia
295.05	Simple type schizophrenia, in remission	F2089	Other schizophrenia
295.10	Disorganized type schizophrenia, unspecified	F201	Disorganized schizophrenia
295.11	Disorganized type schizophrenia, subchronic	F201	Disorganized schizophrenia
295.12	Disorganized type schizophrenia, chronic	F201	Disorganized schizophrenia
295.13	Disorganized type schizophrenia, subchronic with acute exacerbation	F201	Disorganized schizophrenia
295.14	Disorganized type schizophrenia, chronic with acute exacerbation	F201	Disorganized schizophrenia
295.15	Disorganized type schizophrenia, in remission	F201	Disorganized schizophrenia
295.20	Catatonic type schizophrenia, unspecified	F202	Catatonic schizophrenia
295.21	Catatonic type schizophrenia, subchronic	F202	Catatonic schizophrenia
295.22	Catatonic type schizophrenia, chronic	F202	Catatonic schizophrenia
295.23	Catatonic type schizophrenia, subchronic with acute exacerbation	F202	Catatonic schizophrenia
295.24	Catatonic type schizophrenia, chronic with acute exacerbation	F202	Catatonic schizophrenia
295.25	Catatonic type schizophrenia, in remission	F202	Catatonic schizophrenia
295.30	Paranoid type schizophrenia, unspecified	F200	Paranoid schizophrenia
295.31	Paranoid type schizophrenia, subchronic	F200	Paranoid schizophrenia
295.32	Paranoid type schizophrenia, chronic	F200	Paranoid schizophrenia
295.33	Paranoid type schizophrenia, subchronic with acute exacerbation	F200	Paranoid schizophrenia
295.34	Paranoid type schizophrenia, chronic with acute exacerbation	F200	Paranoid schizophrenia
295.35	Paranoid type schizophrenia, in remission	F200	Paranoid schizophrenia
295.40	Schizophreniform disorder, unspecified	F2081	Schizophreniform disorder
295.41	Schizophreniform disorder, subchronic	F2081	Schizophreniform disorder
295.42	Schizophreniform disorder, chronic	F2081	Schizophreniform disorder
295.43	Schizophreniform disorder, subchronic with acute exacerbation	F2081	Schizophreniform disorder
295.44	Schizophreniform disorder, chronic with acute exacerbation	F2081	Schizophreniform disorder
295.45	Schizophreniform disorder, in remission	F2081	Schizophreniform disorder
295.50	Latent schizophrenia, unspecified	F2089	Other schizophrenia
295.51	Latent schizophrenia, subchronic	F2089	Other schizophrenia
295.52	Latent schizophrenia, chronic	F2089	Other schizophrenia
295.53	Latent schizophrenia, subchronic with acute exacerbation	F2089	Other schizophrenia

ICD-9-CM	ICD-9-CM Code Description	ICD-10-CM	ICD-10-CM Code Description
295.54	Latent schizophrenia, chronic with acute exacerbation	F2089	Other schizophrenia
295.55	Latent schizophrenia, in remission	F2089	Other schizophrenia
295.60	Schizophrenic disorders, residual type, unspecified	F205	Residual schizophrenia
295.61	Schizophrenic disorders, residual type, subchronic	F205	Residual schizophrenia
295.62	Schizophrenic disorders, residual type, chronic	F205	Residual schizophrenia
295.63	Schizophrenic disorders, residual type, subchronic with acute exacerbation	F205	Residual schizophrenia
295.64	Schizophrenic disorders, residual type, chronic with acute exacerbation	F205	Residual schizophrenia
295.65	Schizophrenic disorders, residual type, in remission	F205	Residual schizophrenia
295.70	Schizoaffective disorder, unspecified	F259	Schizoaffective disorder, unspecified
295.71	Schizoaffective disorder, subchronic	F259	Schizoaffective disorder, unspecified
295.72	Schizoaffective disorder, chronic	F259	Schizoaffective disorder, unspecified
295.73	Schizoaffective disorder, subchronic with acute exacerbation	F259	Schizoaffective disorder, unspecified
295.74	Schizoaffective disorder, chronic with acute exacerbation	F259	Schizoaffective disorder, unspecified
295.75	Schizoaffective disorder, in remission	F259	Schizoaffective disorder, unspecified
295.80	Other specified types of schizophrenia, unspecified	F2089	Other schizophrenia
295.81	Other specified types of schizophrenia, subchronic	F2089	Other schizophrenia
295.82	Other specified types of schizophrenia, chronic	F2089	Other schizophrenia
295.83	Other specified types of schizophrenia, subchronic with acute exacerbation	F2089	Other schizophrenia
295.84	Other specified types of schizophrenia, chronic with acute exacerbation	F2089	Other schizophrenia
295.85	Other specified types of schizophrenia, in remission	F2089	Other schizophrenia
295.90	Unspecified schizophrenia, unspecified	F209	Schizophrenia, unspecified
295.91	Unspecified schizophrenia, subchronic	F209	Schizophrenia, unspecified
295.92	Unspecified schizophrenia, chronic	F209	Schizophrenia, unspecified
295.93	Unspecified schizophrenia, subchronic with acute exacerbation	F209	Schizophrenia, unspecified
295.94	Unspecified schizophrenia, chronic with acute exacerbation	F209	Schizophrenia, unspecified
295.95	Unspecified schizophrenia, in remission	F209	Schizophrenia, unspecified
297.0	Paranoid state, simple	F22	Delusional disorders
297.1	Delusional disorder	F22	Delusional disorders
297.2	Paraphrenia	F22	Delusional disorders
297.3	Shared psychotic disorder	F24	Shared psychotic disorder
297.8	Other specified paranoid states	F22	Delusional disorders
297.9	Unspecified paranoid state	F23	Brief psychotic disorder
298.0	Depressive type psychosis	F323	Major depressive disorder, single episode, severe with psychotic features
298.0	Depressive type psychosis	F333	Major depressive disorder, recurrent, severe with psychotic symptoms
298.1	Excitative type psychosis	F28	Other psychotic disorder not due to a substance or known physiological condition
298.2	Reactive confusion	F4489	Other dissociative and conversion disorders
298.3	Acute paranoid reaction	F23	Brief psychotic disorder
298.4	Psychogenic paranoid psychosis	F23	Brief psychotic disorder
298.8	Other and unspecified reactive psychosis	F23	Brief psychotic disorder
298.9	Unspecified psychosis	F29	Unspecified psychosis not due to a substance or known physiological condition

Appendix 2: Sample SAS code: mental health disorder subset and trend data

SPARCS mental health-related emergency department visit data by year

```
*ED Mental Health Visits 2006;

data ICD.ed06 (keep=Age_N admdate prindiag mhdx);
        set sparcs.edspc06_0714;
if age_n < 21 and hcounty in ('58' '59' '60' '61' '62') and NYCRES2017=1 and hnyc = 1
        and (CLAIMTYPE='E' or CLAIMTYPE='A') and EDIND='Y' and boro2017 ne 'NULL';

*mhdx = mental health-related ED visit;

if prxmatch ("/^290\.?[0123489]|^291\.?[01234589]|^292\.?[0128]|^293\.?[0189]|^294\.?[01289]|^295\.?[0123456789]|^296\.?[01234567
89]|^297\.?[012389]|
^298\.?[0123489]|^299\.?[0189]|^300\.?[0123456789]|^301\.?[0123456789]|^302\.?[0123456789]|^303\.?[09]|^304\.?[0123456789]|
^305\.?[0123456789]|^306\.?[0123456789]|^307\.?[0213456789]|^308\.?[012349]|^309\.?[0123489]|^310\.?[01289]|^311|^312\.?[0123489]|
^313\.?[012389]|^314\.?[01289]|^V628\.?[45]/oi",prindiag) > 0 then mhdx=1;
else mhdx=0;

*divide years into quarters based on admission date;

if prxmatch ("/^200601|^200602|^200603/oi",admdate) >0 then quarter = '2006Q1';
if prxmatch ("/^200604|^200605|^200606/oi",admdate) >0 then quarter = '2006Q2';
if prxmatch ("/^200607|^200608|^200609/oi",admdate) >0 then quarter = '2006Q3';
if prxmatch ("/^200610|^200611|^200612/oi",admdate) >0 then quarter = '2006Q4';
run;
*ED Inpatient Mental Health Visits 2006;

data ICD.ip06 (keep=age_n admdate prindiag mhdx);
        set sparcs.IPSPC06_0714;
if age_n < 21 and hnyc=1 and NYCRES2017=1 and hcounty in ('58' '59' '60' '61' '62') and EDIND='Y' and boro2017 ne
'NULL';

*mhdx = mental health-related ED visit;
if prxmatch ("/^290\.?[0123489]|^291\.?[01234589]|^292\.?[0128]|^293\.?[0189]|^294\.?[01289]|^295\.?[0123456789]|^296\.?[01234567
89]|^297\.?[012389]|
^298\.?[0123489]|^299\.?[0189]|^300\.?[0123456789]|^301\.?[0123456789]|^302\.?[0123456789]|^303\.?[09]|^304\.?[0123456789]|
^305\.?[0123456789]|^306\.?[0123456789]|^307\.?[0213456789]|^308\.?[012349]|^309\.?[0123489]|^310\.?[01289]|^311|^312\.?[0123489]|
^313\.?[012389]|^314\.?[01289]|^V628\.?[45]|^F\.?[01234569]|^F8\.?[2489]|^R45850|^R45851/oi",prindiag) > 0 then mhdx=1;
else mhdx=0;

if prxmatch ("/^200601|^200602|^200603/oi",admdate) >0 then quarter = '2006Q1';
if prxmatch ("/^200604|^200605|^200606/oi",admdate) >0 then quarter = '2006Q2';
if prxmatch ("/^200607|^200608|^200609/oi",admdate) >0 then quarter = '2006Q3';
if prxmatch ("/^200610|^200611|^200612/oi",admdate) >0 then quarter = '2006Q4';
run;
```

Trend data by quarter for each disorder subgroup

```
*ED visits by each transition category's disorder group 2006-2016;

data ED_disorders ;
set ICD.ED06to16;

*Mood disorder one-to-one;
if prxmatch ("/^F06\.?[3]|^F3\.?[012349]|^29383|^296\.?[0123456789]|^311|^3004|^30113/oi", prindiag) > 0 then diagnosis =
'Mood Disorder';

*Schizophrenia and psychosis many-to-one;
if prxmatch ("/^293\.?[01]|^29381|^29382|^295\.?[0123456789]|^297\.?[012389]|^298\.?[0123489]|F2\.?[0123489]|^F06\.?[012]|
^F25\.?[0189]/oi",prindiag) > 0 then diagnosis="Schizophrenia and Psychosis";

*Anxiety disorders one-to-many;
if prxmatch ("/^29384|^300\.?[027]|^30921|^F064|^F4\.?[01]|^F452\.[0129]|^F930/oi",prindiag) > 0 then diagnosis="Anxiety
Disorders";

run;
*Trends in mental health disorders by quarter;
proc freq data=ED_disorders;
table quarter*diagnosis/nocum nopercent norow nocol;
run;
```

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