



# Treatment of mental illness in American adolescents varies widely within and across areas

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**Many mental health disorders first manifest in adolescence, and early treatment may affect the course of the disease. Using a large national database of insurance claims, this study focuses on variations in the type of care that adolescent patients receive when they are treated for an initial episode of mental illness. We found large variations in the probability that children receive follow-up care and in the type of follow-up care received across zip codes. We also found large variations in the probability that children receive drug treatments that raise a red flag when viewed through the lens of treatment guidelines: Overall, in the first 3 mo after their initial claim for mental illness, 44.85% of children who receive drug treatment receive benzodiazepines, tricyclic antidepressants, or a drug that is not Food and Drug Administration-approved for their age. On average, these children are 12 y old. While the supply of mental health professionals impacts treatment choices, little of the overall variation is explained by supply-side variables, and at least half of the variation in treatment outcomes occurs within zip codes. These results suggest that other factors, such as physician practice style, may play an important role in the types of treatment that children receive.**

adolescent | mental health | treatment

Small-area variations in healthcare utilization and expenditures are ubiquitous and well documented, and they do not seem to be strongly related to variations in health outcomes (1, 2). Several recent studies argue that much of the variation is coming from the supply-side of the market for medical care and not from differences in patient demand for medical services (3, 4). Writing about this phenomenon, Fuchs cited “the idiosyncratic beliefs of physicians [and] the parochial character of much clinical practice” (5).

This study focuses on variations in the type of care that adolescent patients receive when they are treated for an initial episode of mental illness. Many mental health disorders first manifest in adolescence, and mental health disorders are often more debilitating and harmful for a child’s future education and employment than common physical health problems (6, 7). Clearly, initial treatment offers an important opportunity to forestall some of these negative consequences. Yet there is relatively little information available on how adolescents are typically treated or what determines variation in their care. Some observers point to shortages in the supply of mental health professionals as an important factor affecting treatment (8, 9).

We focused on a large national sample of children who were covered by private health insurance for at least 1 y between 2012 and 2018. We used administrative insurance claims data from the Blue Cross Blue Shield (BCBS) Alliance for Health Research, a collaborative effort involving most of the regional BCBS plans. This limited dataset was made available through a secure data portal and was drawn from BCBS Axis, the largest source of commercial insurance claims data in the United States. Because all of the children in our sample had private health insurance, we did not focus on lack of insurance coverage as a reason for disparities in care, but rather on other drivers of disparities in care among insured children.

We selected children who were observed before age 11 y (typically from age 7 or 8) who had their first mental illness claim between the ages of 10 and 17 y. The mean age of these children’s first claim was 12 y. See *SI Appendix, Table S1* for the frequencies of the most common diagnoses. We focused on first episodes because there are relatively clear guidelines about how these children should be treated. First, it is important that follow-up treatment begin promptly. Hence, we asked whether children received any follow-up treatment in the 3 mo following an initial claim. Second, in most cases, one would expect to see the child receive therapy either with or without drug treatment (10–12). We therefore looked at the fraction of treated children who received therapy alone, therapy and drugs, or drugs alone.

When children initially receive drug treatment, there are also widely agreed-upon guidelines. For example, the American Psychiatric Association points to Fluoxetine (the generic for Prozac) as the first-line treatment for depression in adolescents (13), while the American Academy of Child and Adolescent Psychiatry notes that selective serotonin reuptake inhibitors (SSRIs, the class that includes Fluoxetine) are generally well tolerated (10). One would not then expect to see children initially prescribed tricyclic antidepressants (TCAs)—which have a more severe side-effect profile—as their first medication, particularly since they have not been shown to be effective in adolescents (14). Side effects of TCAs include sedation as well as cardiac problems, which should be monitored via electrocardiogram. TCAs are also more likely than SSRIs to be fatal in overdose. While benzodiazepines are frequently prescribed for anxiety in adults, the American Academy of

## Significance

**This study uses a large national database of insured adolescent children who have an initial insurance claim for a mental illness. Many of these children either fail to receive follow-up care within 3 mo, or receive care that appears to fall short of standard guidelines for the initial treatment of mental illness in children. The majority do not receive therapy, and many children receive drugs that raise a red flag, such as benzodiazepines, tricyclic antidepressants, and drugs that are not Food and Drug Administration-approved for use in children. Very little of the variation in these outcomes can be explained by shortages of mental health professionals.**

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Adolescent Psychiatrist’s guidelines note that “benzodiazepines have not shown efficacy in controlled trials in childhood anxiety disorders . . . Clinicians should use benzodiazepines cautiously because of the possibility of developing dependence” (11). Given this guidance, we looked at whether children were initially prescribed TCAs or benzodiazepines.

We also looked at whether children received a drug that is Food and Drug Administration (FDA)-approved for their age. The FDA has approved a wide variety of psychiatric drugs for use in children, depending on the indication. For example, while only two SSRIs are FDA-approved for depression in children (Fluoxetine and Escitalopram), several others are approved for the treatment of obsessive-compulsive disorder and anxiety. The FDA has approved one TCA, Clomipramine, for obsessive-compulsive disorder, and six atypical antipsychotics. Of the children receiving drug treatment in our sample, 49.1% receive an antidepressant (36.7% get SSRIs), 53.2% get anti-anxiety medications, 2.2% get a mood stabilizer, and 3.9% get antipsychotic medications. Of the children receiving antipsychotics, 43.9% take them with an SSRI, which is a common combination treatment for depression.

While one cannot use claims data to say that any given child should not have received a particular drug, if large numbers of children in an area are receiving TCAs, benzodiazepines, or drugs that are not FDA-approved for children, then we argue that this is a red flag that deserves further investigation. In what follows, we will refer to these as “red flag” treatments. This is a conservative definition of red-flag treatments that does not include, for example, practices such as polypharmacy, which have also been criticized. However, we wanted to focus on areas where there seemed to be wide agreement about appropriate prescribing.

In addition to characterizing variation in the types of treatment that children receive, we asked how much of the small-area variation in treatment patterns can be explained by the supply of providers. Specifically, we examined the per capita number of psychiatrists and therapists available to treat the BCBS children in our sample.

## Results

In our sample of 2,201,566 BCBS-covered children, there were 202,066 with at least one claim related to mental illness, for a rate of 9.18%. The rate of mental illness we obtained is very comparable to what one might expect based on estimates from the 2016 National Survey of Child Health, in which parents reported that

6.1% of 12- to 17-year-old children had been diagnosed with depression, and 10.5% had been diagnosed with anxiety (15).

A possible concern with using claims data is that many mental health providers may be out of network or might not accept health insurance. However, even in these cases, families can file claims to BCBS and can usually be at least partially reimbursed. Hence, we would still expect to see these cases appear in the claims data.

Table 1 shows descriptive statistics for these children. Column 1 shows that in the full BCBS sample of children, we began following children at age 7.58 on average. BCBS children have rates of hospitalization and emergency room (ER) utilization of 1.2% and 10.3% per year, respectively, and average monthly costs of \$157.00 (in real 2018 dollars). This figure includes the actual total cost of services paid for by both insurers and families. About 13.3% of children have a preexisting neurodevelopmental condition, such as attention deficit hyperactivity disorder (ADHD) (10%) or autism spectrum disorder. Since these disorders are present from a very young age and are generally life-long, we treated them as preexisting conditions rather than new illnesses and included these children in our baseline analysis sample. We also reproduced our main results excluding these children, as discussed below.

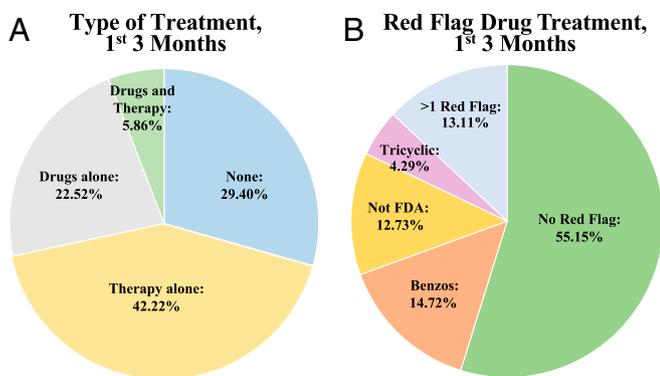
The second column of Table 1 shows the characteristics of our analysis sample. Children are 12 y old on average when they have their first claim related to mental illness, and 88.7% have their first claim between the ages of 10 and 14 y. These children have been followed since the age of 8 y, so we can be fairly certain that they have not previously had an insurance claim for a mental illness, such as anxiety or depression. As discussed below, 29.8% of the mental health sample children do not initially receive a diagnosis, but receive procedures or medications consistent with mental illness. These children are included in the main analysis, but we obtain very similar results if they are excluded, as discussed below.

Children in the mental illness sample are somewhat more likely to be girls (52.8%). They use more medical care on average, with annualized rates of hospitalization and ER utilization of 3.5% and 15.6%, respectively, and average monthly costs of \$302.00. These figures are based on averages taken over all of the months that children appear in the sample. A nontrivial fraction (4.5%) had their first claim for a mental illness visit in conjunction with a hospitalization or an ER visit, although a much larger fraction (42.1%) had their first mental illness claim in conjunction with a psychiatric evaluation. While it is possible for

**Table 1. Descriptive statistics**

	All BCBS	Mental illness sample	Therapy only	Therapy and drugs	Drugs	Red-flag drugs
Female	0.490	0.528	0.523	0.617	0.563	0.576
Age first appearance in sample	7.581	8.395	8.324	8.685	8.594	8.619
Hospitalized, any reason (annualized)	0.012	0.035	0.024	0.092	0.047	0.070
ER, any reason, (annualized)	0.103	0.156	0.156	0.613	0.186	0.186
Average monthly costs (in real 2018 dollars)	\$157	\$302	\$253	\$433	\$412	\$552
Neurodevelopmental condition	0.133	0.318	0.329	0.390	0.238	0.216
Neuro condition is ADHD	0.100	0.233	0.248	0.277	0.174	0.152
Age first mental illness episode	NA	12.023	11.862	12.577	12.299	12.354
Hospitalized, first mental illness	NA	0.012	0.005	0.062	0.020	0.019
ER, first mental illness	NA	0.033	0.026	0.060	0.029	0.026
First episode is an evaluation	NA	0.421	0.710	0.418	0.107	0.075
No. of observations	2,201,566	202,066	85,358	11,932	57,717	26,030

Data are from the BCBS Axis database of insurance claims for 2012 to 2018. It covers children who have a valid master member ID, pharmacy coverage, valid geographic information, and who were observed both before age 11 y and for at least 1 y between the ages of 10 and 18 y. Children in column 2 had at least one claim related to mental illness. Column 3 includes all children who received only therapy (no drugs) in the 3 mo following the initial claim. Column 4 includes all children who received both therapy and drugs in the 3 mo following the initial claim. Column 5 includes all children who received only drug treatment (no therapy) in the 3 mo following the initial claim. Column 6 includes children who received benzodiazepines, TCAs, or a non-FDA-approved drug in the 3 mo following the first claim. The variables “Hospitalized, any reason,” “ER, any reason,” and “Average monthly costs” are computed taking the average over all of the months that a child appears in the data. NA indicates “not applicable.”



**Fig. 1.** Breakdowns of the type of treatment received in the first 3 mo after an initial mental illness claim (A) and the type of drug received, if any drug treatment was received (B). The numbers of observations for A and B are 202,066 and 57,717, respectively. Red-flag prescribing includes benzodiazepines, TCA, and drugs that are not FDA-approved given the child’s age.

an evaluation to show that a child does not have a mental illness, the majority of these children (85.6%) went on to be treated for mental illness.

The last four columns of Table 1 examine the types of treatment that children received in the 3 mo following an initial claim for mental illness. Girls are overrepresented in the group that receives drug therapy, and also in the group that receives a red-flag drug. Children who used the hospital or ER in the past year and who had higher costs were more likely than other children to be treated with drugs, and especially with red-flag drugs. They were also less likely to be treated with therapy alone. And while children with preexisting neurodevelopmental conditions were more likely to appear in the mental illness sample, they were less likely to be treated with drugs or red-flag drugs and more likely to be treated with therapy. Finally, children whose first mental illness claim was associated with a hospitalization or ER visit were much more likely than other children to receive drugs, while children whose first claim was for an evaluation were much more likely to receive therapy alone.

Fig. 1A summarizes the data on treatment modalities, while Fig. 1B breaks down red-flag drug prescribing. Fig. 1A shows that 29.4% of children received no treatment in the 3 mo following an initial claim. For comparison, in the 2016 National Survey of Child Health, parents reported that 79.0% of 12- to 17-y-old

children with depression diagnoses and 63.7% of children with anxiety diagnoses had been treated (15). Fig. 1A indicates that only 5.9% of children received both drug treatment and therapy, which is surprising in view of current guidelines for adolescent mental health treatment.

Fig. 1B examines the types of drugs received by children who get drug treatment in the 3 mo after their initial claim for mental illness. Over 45% of children were receiving benzodiazepines, TCAs, or drugs that are not FDA-approved for children as their initial treatment. Most guidelines would have recommended that, if they were prescribed drugs, the majority of children in our sample would have started with an FDA-approved SSRI in combination with therapy (10–12).

Table 2 shows that there is a great deal of small-area variation in the types of treatment offered across the country, where small areas are defined using zip codes. For each zip code, we defined a reference area to be the geographical market that serves the BCBS children who live in a particular zip code, as described further below. Table 2 indicates that in the best zip codes in terms of follow-up care, almost 90% of children receive follow-up care within 3 mo of an initial claim, while in the worst areas, only 50% of children do.

There is also wide variation in the types of treatment. Rates at which children receive therapy alone vary from 17 to 62%. The fraction receiving therapy and drugs together varies from 0 to 17%. The fraction of children receiving only drug treatment varies from 0 to 45%, a tremendous range. The fraction receiving a red-flag drug treatment varies even more widely from 0 to 100%. Note that 100% is the 90th percentile of the distribution, indicating that in at least 10% of the zip codes we considered, all of the drug treatment raises a red flag. Examining the types of red-flag treatments shows that rates of receiving benzodiazepines or drugs that are not FDA-approved vary from 0 to 50% across zip codes, while the rate of receiving TCAs varies from 0 to 33%.

The variation shown in Table 2 raises the question of what is driving these area-level variations? A hypothesis raised in the literature is that shortages of qualified mental health professionals are an important determinant of treatment (16, 17). Shortages may leave primary care physicians providing mental health care, even though many pediatricians report that they are uncomfortable in this role (18).

The last two rows of Table 2 show that the number of psychiatrists available to treat BCBS children (measured using all of the psychiatrists who treat BCBS children living in a particular zip code in a particular year) varies tremendously, from 3.52 per

**Table 2. Small-area variation in treatment and provider supply**

	Percentiles of the area-level distribution				
	10th	25th	50th	75th	90th
Child treated within 3 mo	0.50	0.61	0.71	0.80	0.88
Therapy only (if any treatment)	0.17	0.29	0.40	0.52	0.62
Drugs and therapy (if any treatment)	0.00	0.00	0.03	0.10	0.17
Drugs only (if any treatment)	0.00	0.13	0.21	0.33	0.45
Red-flag drug (if any drug treatment)	0.00	0.17	0.43	0.60	1.00
Benzodiazepines	0.00	0.00	0.14	0.33	0.50
Tricyclic antidepressants	0.00	0.00	0.00	0.14	0.33
Not FDA-approved	0.00	0.00	0.20	0.38	0.50
Psychiatrists per 1,000 BCBS children 10–17 y	3.52	5.06	7.86	12.67	19.03
Therapists per 1,000 BCBS children 10–17 y	15.91	21.23	29.02	41.06	57.43

This table is calculated by computing small-area level rates and then calculating percentiles of the distributions of those rates. Small areas are defined using information about where children in a particular zip code actually go to receive mental health care; areas with fewer than five first-spell children are excluded (*Materials and Methods*). Each row represents a separate distribution. For example, places at the 90th percentile in terms of psychiatrists per capita could be at the 10th percentile in terms of the fraction of PCPs treating mental health.

1,000 to 19.03 per 1,000. Similarly, there is wide variation in the number of therapists available (from 15.91 per 1,000 BCBS children to 57.43 per 1,000).

Table 3 shows linear probability models for the probability of receiving any treatment in the 3 mo following the initial claim for mental illness, as well as for the type of treatment received, if any. The control variables can be divided into child-level measures, which may impact the demand for care, and Zip Code Tabulation Area (ZCTA)-level “supply-side” measures. For brevity, Table 3 shows only the coefficients on the child-level variables. Coefficients on the supply-side variables are illustrated in Fig. 2 and shown in *SI Appendix, Table S2*.

The child-level measures show that the probability of treatment increases with age, at a rate of about 1 percentage point (pp) per year. Conditional on being treated, the probability of being treated only with drugs is about 1.1 pp higher with each year of age, while the probability of receiving any red-flag drug treatment is 1.4 pp higher per year of age. Girls are 1.7 pp more likely to be treated than boys, and more likely to receive any therapy. They are also slightly more likely to receive red-flag treatments.

Children whose first claim stemmed from a hospitalization are more likely to be treated with drugs and therapy and more likely to receive red-flag drug treatments. Surprisingly, children whose first claim was associated with an ER visit are 12.3 pp less likely to receive follow-up treatment in the next 3 mo. It is possible that these children lack access to care, which may be why they were being seen in the ER to begin with. Children who were hospitalized in the past 6 mo for any reason and those with the highest medical spending in the past 6 mo are more likely to be treated

with drugs alone, and much more likely to receive red-flag drug treatment compared to other children.

Turning to the supply-side measures, the patterns of coefficients in Table 3 are summarized in Fig. 2, which show the percentage change in the probability of a given outcome that is associated with moving from the first quartile to the Nth quartile of the distribution of supply, other things being held constant. Fig. 24 shows that both drug-only treatment and red-flag treatments rise with increases in the supply of psychiatrists. The probability that a child is treated at all falls slightly with increases in the number of psychiatrists per BCBS child, while the probability of therapy alone or in conjunction with drug treatment falls more sharply.

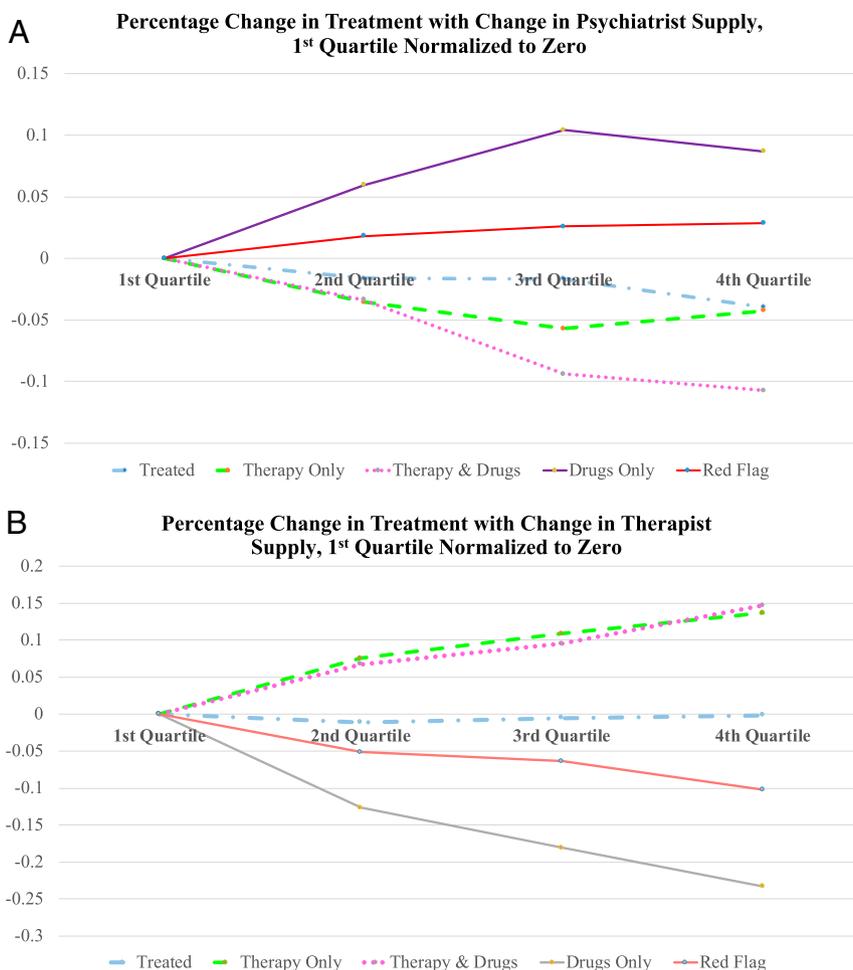
Fig. 2B shows that the number of therapists per BCBS child is weakly associated with the probability that a child receives treatment in the 3 mo following an initial claim, but is strongly associated with the types of treatment. Having more therapists per capita (holding the number of psychiatrists per capita constant) increases the probability of therapy alone or in conjunction with drugs and decreases the probability of drugs-only treatment and of red-flag treatments. Moving from the first to the fourth quartile of therapist supply implies a nearly 25% decline in the use of drugs alone.

While these patterns of coefficients suggest that the supply of mental health professionals is an important determinant of care, the  $R^2$ s in these models show that the variables included explain relatively little of the overall variation in treatment probabilities. Table 4 puts these  $R^2$ s into perspective. The first row shows  $R^2$ s from regressions similar to Table 3, except that they exclude the supply-side variables. The second row repeats the  $R^2$ s from Table

**Table 3. Models of the probability of treatment, and the type of treatment received**

Independent variables	1	2	3	4	5
	Treated in 3 mo	Therapy only	Therapy and drugs	Drugs only	Red-flag drugs
<b>Child-level characteristics</b>					
Years of age	0.0100*** (0.0006)	-0.0244*** (0.0007)	0.0135*** (0.0005)	0.0109*** (0.0006)	0.0135*** (0.0006)
Indicator for female	0.0165*** (0.0021)	-0.0051** (0.0021)	0.0252*** (0.0014)	-0.0201*** (0.0020)	0.0084*** (0.0020)
Indicator for first claim in hospital	0.0289*** (0.0102)	-0.1175*** (0.0125)	0.3535*** (0.0128)	-0.2359*** (0.0121)	0.0278** (0.0122)
Indicator for first claim in ER	-0.1232*** (0.0075)	0.0260*** (0.0074)	0.0655*** (0.0062)	-0.0915*** (0.0067)	-0.0266*** (0.0062)
Indicator first claim an evaluation	0.1428*** (0.0025)	0.5630*** (0.0027)	-0.0090*** (0.0015)	-0.5540*** (0.0027)	-0.2743*** (0.0021)
Indicator for hospitalization prior 6 mo for any reason	0.0025 (0.0043)	-0.0265*** (0.0046)	0.0006 (0.0032)	0.0258*** (0.0045)	0.0283*** (0.0048)
Indicator for second quartile of health spending previous 6 mo	0.0153*** (0.0028)	-0.0038 (0.0030)	-0.0023 (0.0020)	0.0062** (0.0028)	0.0149*** (0.0026)
Indicator for third quartile of health spending previous 6 mo	0.0215*** (0.0029)	-0.0182*** (0.0030)	0.0005 (0.0020)	0.0176*** (0.0028)	0.0259*** (0.0026)
Indicator for fourth quartile of health spending previous 6 mo	0.0486*** (0.0030)	-0.0602*** (0.0032)	0.0071*** (0.0022)	0.0531*** (0.0031)	0.0831*** (0.0030)
Indicator for neurodevelopmental condition	-0.1062*** (0.0025)	0.0579*** (0.0025)	0.0321*** (0.0018)	-0.0899*** (0.0023)	-0.0452*** (0.0021)
Include supply side indicators	Yes	Yes	Yes	Yes	Yes
Include year and month fixed-effects	Yes	Yes	Yes	Yes	Yes
Constant	0.4929*** (0.0110)	0.5097*** (0.0112)	-0.0917*** (0.0074)	0.5820*** (0.0111)	0.1786*** (0.0109)
No. of Observations	202,066	143,075	143,075	143,075	143,075
$R^2$	0.0467	0.3707	0.0360	0.3905	0.1532

Each column is from a single regression model. SEs are clustered at the zip code level and appear in parentheses. Significance levels: \*\* $P < 0.05$ ; \*\*\* $P < 0.01$ . Models also include indicators for whether the zip code is in the second, third, or fourth quartile of physician supply; whether it is a zip code with fewer than five BCBS first-spell children; and fixed effects for each claim year and for the month of the first mental illness claim. See *SI Appendix, Table S2* for supply-side coefficients, as well as Fig. 2.



**Fig. 2.** This figure plots regression coefficients from *SI Appendix, Table S2*, normalized to show the percent change in outcomes associated with a movement to the second, third, or fourth quartile of the distribution of psychiatrists per 1,000 BCBS children (A) or therapists per 1,000 BCBS children (B) relative to the first quartile of the distribution.

3, which include supply-side variables. Comparing the two rows, one can see that the supply-side variables collectively add little explanatory power once child-level variables are included.\*

The last row of Table 4 shows the  $R^2$ s from models similar to Table 3 except that they also include zip code-level fixed effects. These fixed effects control for any fixed characteristics of zip codes that are correlated with treatment choices. For example, average median income in the zip code, whether it is urban or rural, and the average share minority over the sample period would all be absorbed by these fixed effects. Adding them increases the explanatory power of the models significantly, although the maximum  $R^2$  in any model is still less than 0.5. Hence, the supply of mental health professionals, while statistically and economically significant in its own right, explains little of the overall variation in treatment across areas.

It is possible that much of the red-flag prescribing is being done by primary care physicians (PCPs) who fill the gaps due to shortages of mental health professionals. *SI Appendix, Table S3* shows that there is a great deal of variation in the number of PCPs

who are prescribing psychiatric medications to children, and in the share of mental health treatment that is being provided by PCPs. The results of adding these variables to models similar to Table 3 are shown in *SI Appendix, Table S4*. While including these variables changes the estimated coefficients on the variables for psychiatrist and therapist supply, it makes almost no difference to the explanatory power of the models (see panel 2 of *SI Appendix, Table S5*). This suggests that PCPs step in when there is a shortage of mental health professionals, but that this is not a major driver of variations in treatment.

Our baseline model also includes children who did not have a diagnosis on their claims for the first 3 mo. We have reestimated our models excluding these children, and including indicators for each separate mental health diagnosis shown in *SI Appendix, Table S1*. The estimates are shown in *SI Appendix, Table S6* and the  $R^2$ s associated with three versions of this model are shown in panel 3 of *SI Appendix, Table S5*. Including detailed diagnosis improves the models' fit greatly, but supply-side variables still explain very little of the overall variation in treatment.

Our baseline model includes children with neurodevelopmental conditions, the majority of whom are being treated for ADHD. *SI Appendix, Table S7* reproduces Table 3 excluding these children, and panel 4 of *SI Appendix, Table S5* shows  $R^2$  results analogous to Table 4. The results are remarkably similar to those in Tables 3 and 4.

\*In an alternative specification, we aggregated the individual-level data on treatment to the ZCTA level and re-estimated, using controls for average severity within the ZCTA. Adding the supply-side variables to these models similarly resulted in only small gains in  $R^2$ s. For example, only 4.6% of the variation in the "any treatment" outcome is explained by a model with the supply-side variables. The analogous  $R^2$ s for the remaining outcomes, as shown in columns 2 to 5 of Table 4, are 26.7%, 2.4%, 22.4%, and 9.2%.

**Table 4. Goodness of fit for linear probability models for treatment and type of treatment**

	Any treatment	Therapy only	Therapy and drugs	Drugs only	Red flag drugs
Child-level variables only	0.046	0.367	0.036	0.386	0.153
Adding ZCTA-level supply-side measures	0.047	0.371	0.036	0.391	0.153
Adding ZCTA-level fixed effects	0.138	0.463	0.143	0.485	0.262

The first row reports  $R^2$  from linear probability models that include only the child-level variables shown in Table 3. The second row repeats the  $R^2$ s shown in Table 3 for comparison. The third row shows  $R^2$ s from models that also include fixed effects for each ZCTA.

As another way of considering the role of psychiatrist supply, we reestimated our models using the subsample of zip codes that are above the median in terms of psychiatrists per capita. As shown in *SI Appendix, Table S8*, the results are very similar in the sense that there are still many children who do not get treatment in the first 3 mo and do not receive therapy. And there is much red-flag-prescribing even in these relatively well-served areas.

### Discussion

This study uses insurance claims data from BCBS to explore variation in the treatment children receive following a first health insurance claim for mental illness. We found that there is a great deal of small-area variation in the treatment children receive following a first mental illness claim. Only 70.8% receive any follow-up treatment in the next 3 mo, a rate that varies from 50% to over 90%, depending on the zip code. Many children receive only drug therapy despite guidelines that suggest that in most cases, it would be appropriate to combine drug treatment and therapy, and this rate varies from 0 to 45% across areas. Perhaps most disturbing, there is a great deal of variation in whether the child receives several red-flag drug treatments.

There are several strengths of using claims data. The most obvious is the large sample size and the detailed information about the types of treatments. Previous large-scale analyses of mental health treatment for adolescents relied on surveys of parents and caregivers (15, 19, 20). The questions asked about mental illness treatment in survey data are typically very general (i.e., whether the child has ever been treated). They often do not include detailed information about the setting or type of treatment, or how the child was treated on their first follow-up visit, making it impossible to say whether the treatment is broadly consistent with evidence-based treatment guidelines. By focusing on a group of insured children, most of whom were stably covered for several years, we are also able to rule out lack of insurance coverage as one of the explanations for the small-area variations we see in our data. While lack of insurance coverage is an important problem, our analysis shows that it is not the only driver of variations in the probability of treatment or of questionable treatments among adolescents with emerging mental illness.

While all of the treatments we single out may be appropriate in some cases, guidelines suggest that their use should be rare. And yet, 45.15% of children are receiving benzodiazepines, TCAs, or drugs that are not FDA-approved for these initial spells of mental illness treatment, with the rate varying from 0 to 100% of children in some zip codes. Rates of receiving benzodiazepines or drugs that are not FDA-approved vary from 0 to 50%, while the rate of receiving TCAs varies from 0 to 33%. By construction, we focused on young children who were not taking medications for mental illness at the time we observed their first claim. Hence, most of these children would have received therapy, or an SSRI in combination with therapy, had they been treated according to evidence-based guidelines.

In the literature, shortages of mental health professionals are the leading explanation for variation in mental health treatment.

We investigated this issue directly by estimating models that control for the number of psychiatrists and therapists available per 1,000 BCBS children. By examining only psychiatrists and therapists who actually treat any BCBS children, we ensured that we focused on the relevant group of mental health professionals for the children in our sample. For example, we ruled out psychiatrists who only treat adults or who are not actively practicing. It would not be possible to focus on this more relevant group of clinicians using other sources, such as the National Plan and Provider Enumeration System (NPES).

We also use a definition of a market area for each zip code that is based on where children from a particular zip code actually go rather than on an arbitrary market definition, such as a county or Health Service Area (HSA). We argue that this approach yields a Goldilocks market size that is “just right” rather than being too big or too small and provide more information in Materials and Methods. *SI Appendix, Fig. S1* illustrates the definition of the geographic market for psychiatrists in Princeton, New Jersey, for example.

Our results suggest that the availability of clinicians does have a statistically significant impact on treatment modalities. For example, having more psychiatrists available in the child’s zip code increases the probability that children receive only drugs, and also that they receive red-flag drug treatments. Having more therapists available increases the probability that a child receives therapy and reduces the probability that they receive drugs alone. However, while these effects are statistically significant, supply-side measures of the prevalence of mental health professionals account for little of the variation in treatment once child-level variables are accounted for.

In all of our models, even including zip code-level fixed effects in addition to the other variables, explains at most half of the observed variation in treatment. This analysis shows that much of the variation in treatment is occurring not across small areas, but within them. What then is driving the within-area variation in treatment?

Every analysis of small-area variations must confront the possibility that individual patients are demanding certain treatments. We cannot rule out this possibility. Differences in parental attitudes, preferences, or financial considerations (copays) could explain at least some of the variation in the probability that any follow-up treatment is obtained in the 3 mo after the initial claim and in treatment modalities. We think it less plausible that parental demand could be the main driver of variation in the types of drugs prescribed, or that large numbers of parents are demanding that their children be initially treated with non-FDA approved drugs, benzodiazepines, or TCAs. It is also unlikely that much of the variation in drug treatment is driven by the cost of different therapies because many SSRIs are available as generics and are very inexpensive.

Provider knowledge and preferences for different treatments may be important. It is possible to use claims data to find doctors who are “outliers” in terms of their practice styles in many settings (21–23). Previous work has shown that many psychiatrists have “favorite drugs” for most conditions, and that there are cohort-effects in physician practice styles (24, 25).

Our work suggests that further exploration of individual clinician treatment patterns could shed light on the considerable variations in treatment that we observed for children with emerging mental illness. Our work also leaves open the question of whether existing guidelines from professional associations are adequate to protect the interests of these vulnerable children.

## Materials and Methods

**BCBS Claims Data.** The administrative claims data come from a limited dataset made available through a secure data portal and are drawn from the BCBS Axis database. Every time a claim is made, either by a provider or by a patient requesting reimbursement, a record is generated. Each record includes a description of the service and the charge. They also often (but not always) include a diagnosis code. Accessing private insurance claims data often requires extended negotiations with individual insurance carriers or with government entities. Further information about the BCBS Health of America Initiative, including information about their Axis database and contact information is available at: <https://www.bcbs.com/the-health-of-america/about>. These data included 2,201,566 children who met the following criteria: They had a master member ID (which means that they can be followed over time), all medical claims occurred within the coverage period and met the age criteria for our study, which was that they were observed before the age of 11 y and for at least 1 y between the ages of 10 and 18 y ( $n = 4,356,831$ ). They had drug coverage that has never been “carved out” over the time period that we observed them ( $n = 2,223,930$ ). If drug coverage was carved out of the BCBS plan, this would mean that they could have been making claims for psychiatric drugs under a drug plan that was not BCBS, and we would not have observed these claims. They had valid geographic information, and they had consistent demographic information (age and sex) over the period that we observed them ( $n = 2,201,566$ ). Of these children, we observed 227,846 children with a first claim for mental illness between the ages of 10 and 18 y. We excluded children who could not be followed for at least 3 mo and who moved for 3 mo after the initial claim, which left 206,571 children. Finally, we excluded children who were missing provider information, to yield a sample of 202,066.

**Mental Illness.** Claims related to mental illness were included if they involved: A diagnosis code related to mental illness (F10-F69, F93, and F98, in the Internal Classification of Diseases [ICD]10, or equivalent codes in the ICD9); a procedure code indicating a mental health service, such as therapy; or the prescription of a psychiatric drug. See *SI Appendix, Table S1* for diagnosis counts. Of our sample of children with a first mental illness spell, 70.2% initially received a mental health diagnosis, while 18.6% received drug treatment without a diagnosis on the claim, and 11.2% received a mental health procedure without a diagnosis on the claim. When children in our mental illness sample were followed until the end of our sample period in December 2018, 79.7% of them had received a mental health diagnosis. Children with neurodevelopmental conditions were identified based primarily on ICD10 codes F80-89, F90-92, F94-F97, and F99. Seventy-five percent of these children had ADHD.

**Small-Area Market Definition.** We followed previous research by defining the market facing people who live in a particular zip code by using information

about where children in that zip code actually go to receive mental health care in each year (22, 26). For all children who live in a given ZCTA, we examined up to 10 of the ZCTAs that children from these places most commonly visited for mental health treatment over the entire sample period. For example, *SI Appendix, Fig. S1* illustrates the definition of the market area for the ZCTA that includes Princeton, New Jersey. This procedure has several advantages relative to defining a small area based on an arbitrary geographical definition, such as a county or HSA. First, only providers who are actually available to treat BCBS children at some point over the sample period were included. Second, the measure scales naturally. In a rural setting where people must drive long distances to get to a grocery store or to get a haircut, for example, it may be more natural to drive a relatively long distance to see a psychiatrist. Third, providers do not have to be arbitrarily assigned to one market or another. They can serve clients from more than one ZCTA. Fourth, the market definition is specific to psychiatric services, unlike HSAs, which are defined using hospital utilization patterns in elderly Medicare patients. On average in ZCTAs that have at least 20 BCBS children, 8.6% of BCBS children have a first mental health spell per ZCTA. We focused on areas with at least five first-spell children and percentiles between the 10th and 90th percentiles in Table 2, and included indicators for areas that have fewer than five first-spell children in our regressions, as discussed below. A potential weakness of this market measure is that if children never visited a ZCTA over our observation period, then it would be excluded even if practitioners in that period were in some sense available. This is why we excluded the smallest ZCTAs and looked at travel patterns over the entire sample period.

**PCPs and Therapists.** PCPs are largely pediatricians, but may also include family medicine, general practice, adolescent medicine, or developmental/behavioral pediatrics (NPPES codes 208000000X, 2080A0000X, 2080P0006X, 207Q00000X, 208D00000X). Therapists included psychologists, social workers, and mental health counselors (NPPES codes 1041C0700X, 101YM0800X, 101YP2500X, 103TC0700X, 103T00000X, 106H00000X, 101Y00000X, 104100000X, 103TC2200X). Psychiatrists included NPPES codes 2084P0800X and 2084P0804X. We constructed the supply measures by tagging all providers who rendered mental health treatment to at least one child in the BCBS claims data. We merged provider records in the claims data with annual NPPES data extracts using provider National Provider Identifiers to recover the taxonomy codes above. The final supply measure was calculated by dividing the total number of providers within each specialty in the ZCTA market and year by the number of BCBS children present—regardless of mental health status—in the ZCTA.

**Regression Models.** We estimated linear probability models for the probability that a child received any treatment in the first 3 mo after an initial mental illness claim. If the child received treatment, we then estimated linear probability models for the probability that a child received only therapy, therapy and drugs, only drugs, or any of the red-flag drug treatments.

In small ZCTAs, rates for the supply-side variables, such as psychiatrists per capita, may be computed inaccurately. Hence, if a child is from a ZCTA with fewer than five first-spell mental health kids, then the variable “indicator for <5 BCBS 1st claim children” was set to 1, and indicators were also included for indeterminate values of the supply-side variables. We also repeated our analysis using a Logit model, as shown in *SI Appendix, Table S9*, and obtained very similar results.

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