Variations in Mental Health Diagnosis and Prescribing Across Pediatric Primary Care Practices

Stephanie L. Mayne, MHS,[a,b] Michelle E. Ross, PhD,[c] Lihai Song, MS,[a,b] Banita McCarn, MEd,[d] Jennifer Steffes, MSW,[d] Weiwei Liu, MS,[d] Benyamin Margolis, PhD, MPH,[e] Romuladus Azuine, DrPH,[f] Edward Gotlieb, MD,[d] Robert W. Grundmeier, MD,[g,h] Laurel K. Leslie, MD, MPH,[i] Russell Localio, PhD,[c] Richard Wasserman, MD, MPH,[d,j] Alexander G. Fiks, MD, MSCE[a,b,d,g,h,k]

abstract

BACKGROUND: Primary care pediatricians increasingly care for children's mental health problems, but little is known about practice-level variation in diagnosis and psychotropic medication prescribing practices.

METHODS: This retrospective review of electronic heath records from 43 US primary care practices included children aged 4 to 18 years with ≥1 office visit from January 1, 2009, to June 30, 2014. We examined variability in diagnosis and psychotropic prescribing across practices using logistic regression with practice fixed effects and evaluated associations of the availability of colocated or community-based mental health providers or the proportion of children in foster care with diagnosis and prescribing using generalized linear mixed models.

RESULTS: Among 294 748 children, 40 932 (15%) received a mental health diagnosis and 39 695 (14%) were prescribed psychotropic medication. Attention deficit/hyperactivity disorder was most commonly diagnosed (1%–16% per practice). The proportion of children receiving any psychotropic medication (4%-26%) and the proportion receiving ≥2 medication classes (1%-12%) varied across practices. Prescribing of specific medication classes also varied (stimulants, 3%–18%; antidepressants, 1%–12%; α-agonists, 0%–8%; second-generation antipsychotics, 0%–5%). Variability was partially explained by community availability of psychiatrists (significantly higher odds of a diagnosis or prescription when not available) but not by colocation of mental health professionals or percentage of children in foster care.

CONCLUSIONS: The prevalence of mental health diagnosis and psychotropic medication prescribing varies substantially across practices and is only partially explained by psychiatrist availability. Research is needed to better define the causes of variable practice-level diagnosis and prescribing and implications for child mental health outcomes.

[a]Center for Pediatric Clinical Effectiveness, [b]PolicyLab, [k]Pediatric Research Consortium, and [g]Department of Biomedical and Health Informatics, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; [d]Pediatric Research in Office Settings, American Academy of Pediatrics, Elk Grove Village, Illinois; Departments of [c]Biostatistics and Epidemiology, and [h]Pediatrics, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania; [e]Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia; [f]Maternal and Child Health Bureau, Health Resources and Services Administration, US Department of Health and Human Services, Rockville, Maryland; [i]American Board of Pediatrics, Chapel Hill, North Carolina; and [j]Department of Pediatrics, University of Vermont College of Medicine, Burlington, Vermont

Ms Mayne drafted the initial manuscript; Ms Mayne and Drs Ross and Localio contributed to the analysis and interpretation of the data; Dr Ross critically reviewed the manuscript; Mr Song, Ms McCarn, Ms Steffes, Ms Liu, and Drs Margolis, Azuine, Gotlieb, Grundmeier, Wasserman, and Fiks contributed to the acquisition of the data; Mr Song and Drs Grundmeier, Wasserman, and Fiks contributed to the analysis of the data; Mr Song, Ms McCarn, Ms Steffes, Ms Liu, and Drs Margolis,

WHAT'S KNOWN ON THIS SUBJECT: Primary care pediatricians' comfort in caring for children with mental health conditions varies widely. Although previous studies have documented variability in diagnosis and prescribing by geographic region and provider type, primary care practice–level variability has not been examined in depth.

WHAT THIS STUDY ADDS: Through a detailed review of electronic health record data, we found substantial practice variation in mental health diagnosis and psychotropic medication prescribing. Community availability of psychiatrists, but not colocation of mental health providers, partly explained this variation.

To cite: Mayne SL, Ross ME, Song L, et al. Variations in Mental Health Diagnosis and Prescribing Across Pediatric Primary Care Practices. *Pediatrics.* 2016;137(5):e20152974

In 1991, the American Academy of Pediatrics (AAP) policy statement, "The Pediatrician and the 'New Morbidity,'" highlighted pediatricians' expanding role in managing children's psychosocial problems.[1] In the years since adoption of the statement, primary care pediatricians have cared for an increasing number of children with mental health conditions.[2] Currently, a majority of psychotropic medications are prescribed by primary care providers rather than specialists.[3,4] Surveys have found that many pediatricians felt it was their responsibility to identify children with mental health concerns but not to manage these conditions,[5–7] with the exception of attention deficit/hyperactivity disorder (ADHD).[5,8] Lack of confidence,[6,7,9] knowledge/skills,[7,9,10] or time[7,9,10] are barriers that limit pediatricians' ability to care for children with mental health issues.

In an effort to help primary care pediatricians manage behavioral, developmental, and other mental health conditions, the AAP released toolkits providing resources for managing ADHD,[11] autism,[12] and other mental health concerns.[13] However, these kits are not used consistently,[14] and mental health care among children and adolescents continues to vary widely in the United States. Prior studies have identified more than twofold variation in the rate of mental health service use across states.[15–17] Variation is even greater among children in the child welfare system, particularly foster care.[18,19] Whereas patient characteristics have been linked to variation in mental health care,[19,20] several studies have demonstrated variation in mental health care that was explained by geography rather than patient characteristics.[15,21] These results are especially concerning given known regional variation in unmet mental health care needs.[22]

Although prior studies have documented variability by geographic setting, they have not focused on primary care practice–level variability, an area of importance since practices are the microsystems through which care is delivered.[23] Several practice-level characteristics might affect the primary care delivery of mental health services. In response to family difficulties in accessing mental health specialists,[24,25] primary care practices increasingly include colocated mental health providers,[26–30] a model that may improve access, identification, and treatment.[26,31] Second, practices with higher numbers of patients in foster care may manage more mental health care owing to prevalent psychotropic medication use.[18,32] Finally, practices located in communities where mental health providers, particularly psychiatrists, are not available may need to fill this gap by providing psychotropic medication management.[33] These factors may drive practice differences; however, their association with practice-level variability has not been examined.

To address this gap, we investigated practice-level variability in mental health diagnosis and psychotropic medication prescribing for children cared for by primary care pediatricians in 2 practice-based research networks. We examined whether variability in prescribing and diagnosis was explained by practice-level characteristics including colocated or available community mental health providers (including psychiatrists) and the proportion of children in foster care. We hypothesized that diagnosis and prescribing would be more common at practices with colocated mental health providers, a higher proportion of children in foster care, and in communities without psychiatrists. We also hypothesized that, given the growing comfort with ADHD treatment among pediatricians,[34] practice variation would be smaller for the diagnosis and management of ADHD versus other conditions.

METHODS

Setting and Population

This study was conducted within 2 electronic health record (EHR)-based practice-based research networks: the Pediatric Research Consortium (PeRC) of the Children's Hospital of Philadelphia, a hospital-owned network including 24 practices (29 sites) serving >200 000 children,[35] and the Electronic Pediatric Research in Office Settings (ePROS) network of the AAP, including 19 practices (21 sites) using 7 different EHR vendors and serving ~90 000 children in 15 states.[35] All practices in the PeRC network participated, and ePROS practices joined the network because of an interest in participating in EHR-based research; practices were not recruited for this specific study. We conducted a retrospective review of EHRs from these 43 practices to identify a cohort of children aged 4 to 18 years with visits from January 1, 2009, to June 30, 2014. As the child was the unit of analysis for this study, we created a child-level dataset that included all children meeting the inclusion criteria.

Outcome Measures

The primary endpoints included mental health diagnosis and psychotropic medication prescribing. Mental health diagnoses were identified with codes from the International Classification of Diseases, Ninth Revision, and children were considered to have a diagnosis if there was evidence of that diagnosis in the EHR at any time during the study period.

The following diagnostic categories were included: ADHD (314.0–314.9), autism spectrum disorder (299.00–299.99), schizophrenia (295.00–295.99), bipolar (296.00–296.10, 296.36–296.89), anxiety (300.00–300.29, 301.4), conduct disorder

(312.00–312.89), oppositional defiant disorder (313.81), and depression (311, 296.20–296.35). Children who received a diagnosis of seizure disorder (345.00–345.91) were excluded to prevent confusion between treatment with antiepileptics and mood stabilizers.

Psychotropic medication prescribing was defined as evidence of any psychotropic medication prescription from EHR orders or medication lists for each child at any time during the study period. Medications were entered into the EHR when prescribed or when abstracted into the record by clinicians at participating practices. The prescription of psychotropic medications was identified from the National Drug Code or Generic Product Identifier specific to each drug, as well as by examining medication names. We classified psychotropic medications into 7 therapeutic classes as follows: stimulants, selective norepinephrine reuptake inhibitors (atomoxetine), α-agonists (clonidine and guanfacine), antidepressants (selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, tricyclics), second-generation antipsychotics (SGAs), anxiolytics (benzodiazepines, others), and mood stabilizers (carbamazepine, valproic acid, gabapentin, lamotrigine, oxcarbazepine anticonvulsants, and lithium).

Independent Variables

Patient-level independent variables were extracted from the EHR. Child gender and age at the first visit during the study period (categorized as 4–11 years and 12–18 years) were available for all children. Race was inconsistently available (missing for 29%) and highly correlated with practice. Because it was difficult to separate the effects of race and the effects of practice, race was included only in sensitivity analyses. Insurance status was available only for PeRC patients (missing for 39% overall) and was not included in multivariable models.

Practice-level variables, assessed using survey items developed through review of the 2013 AAP 85th Periodic Survey[34,36] and iterative consultation with pediatric primary care practitioners and behavioral health specialists for face validity, were collected from the lead physician at each practice (Supplemental Appendix). Clinicians reported whether the practice included colocated mental health practitioners (yes/no, separately for each of the following types of providers: child psychiatrists, child psychologists, developmental behavioral pediatricians, substance abuse counselors, mental health counselors, social workers, and adult psychologists/psychiatrists). The survey also assessed the perceived availability of mental health practitioners within the practice's community (not available, somewhat available, and very available, separately for each of the above provider types) and the estimated proportion of patients who were in foster care. We also recorded the practice setting (urban, suburban, or rural) based on practice self-report. Finally, we calculated the number of patients cared for and the average age of patients at the practice.

Statistical Analyses

The study cohort and practice characteristics were described using proportions. We first calculated the proportion of children with any, ≥2, and specific mental health diagnoses. Medication prescribing in the entire study population was examined by calculating the proportion of children receiving any, ≥2, and specific classes of psychotropic medication. Differences in diagnosis and prescribing by child age and gender were described.

We examined rates of diagnosis and prescribing separately within each primary care practice. We used multivariable logistic regression models with a fixed effect for practice to statistically assess variation in each diagnosis and medication class while controlling for patient age and gender. Sensitivity analyses considered race as a covariate, and results were consistent (data not shown). To assess whether variability was significant, likelihood ratio tests compared these models with reduced models that did not include the practice ($P < .05$ significant).

We then examined the association of practice characteristics with diagnosis and prescribing, including colocation of mental health professionals (overall, and among only those with prescribing authority [psychiatrists and developmental behavioral pediatricians]); perceived community availability of psychiatrists and other mental health providers (not at all available versus somewhat/very available); percentage of patients in foster care (≥6% vs 0%–5%); practice setting (urban/rural versus suburban); practice size; and age distribution of the practice. To examine practice characteristics, a distinct approach from that described above was required. Generalized linear mixed models with a logit link, practice characteristics as fixed effects, and practice site as a random intercept (meqrlogit in Stata) examined whether practice characteristics explained variation in diagnosis and prescribing, adjusting for patient-level covariates. Interactions were tested between practice characteristics and child age and gender. When interaction terms were significant, stratified odds ratios were calculated. However, because patterns were consistent between strata even when interaction terms reached statistical significance, only overall results are presented.

All analyses were conducted in Stata version 13.1 (StataCorp, College Station, TX) and SAS version 9.3 (SAS Institute, Cary, NC). The institutional review board at the AAP approved this study, and the institutional review board at the Children's Hospital of Philadelphia determined that this study was not human subjects research.

RESULTS

Study Population

The study cohort included 294 748 children from 43 primary care practices. During the study period, 40 932 children (15%) had ≥1 mental health diagnosis, and 8719 (3%) had >1 diagnosis (Table 1). Consistent with national data,[16] the most common diagnosis was ADHD (25 307 children, 9% overall and 62% of those with a mental health diagnosis). In total, 39 695 children (14%) received a prescription for ≥1 psychotropic medication during the study period. The most commonly prescribed medications were stimulants (9%) and antidepressants (4%). Consistent with previous findings,[16] boys were more likely to receive any psychotropic medication than girls (17% compared with 10%), as were those aged 12 to 18 compared with those aged 4 to 11 (17% compared with 12%) (P < .001 for both). Overall, 14 397 children received prescriptions from ≥2 medication classes (5% of the entire cohort and 36% of those on any psychotropic medication), most commonly stimulants and α-agonists (5123, 36% of those on ≥2 medication classes).

Practice Characteristics

Sixteen practices (37%) reported onsite mental health professionals, most commonly child psychologists (9 practices, 21%) and social workers (8 practices, 19%) (Table 2). Clinicians reported low levels of availability of mental health professionals in their communities, particularly for child psychiatrists and developmental behavioral pediatricians [12 (28%) and 13 (30%) practices reported these clinicians were not at all available, respectively]. Additionally, only 8 practices (19%) reported that foster care patients made up ≥6% of their total patient population. The number of children per practice included in the analysis ranged from 575 to 21 549 (median 5662), and the average age in practices ranged from 8.2 to 10.9 years (median 10.0). One practice did not complete the survey at all, and 2 others did not respond to specific sections as noted in Table 2.

TABLE 1 Demographic and Clinical Characteristics of the Study Cohort

Variable	Sample
n	294 748
Age, y	
4–11	194 886 (66.1)
12–18	99 862 (33.9)
Gender	
Female	146 202 (49.6)
Male	148 546 (50.4)
Race	
White	125 051 (42.4)
Black/African American	55 986 (19.0)
Asian/Pacific Islander	5033 (1.7)
American Indian/Alaskan Native	689 (0.2)
Mixed	323 (0.1)
Other	22 323 (7.6)
Missing	85 343 (29.0)
Diagnoses	
Any mental health diagnosis	40 932 (14.9)
≥2 mental health diagnoses	8719 (3.0)
ADHD	25 307 (8.6)
Anxiety	10 414 (3.5)
Depression	6321 (2.1)
Autism spectrum disorder	4502 (1.5)
Oppositional defiant disorder	2329 (0.8)
Conduct disorder	1607 (0.6)
Bipolar disorder	998 (0.3)
Medication prescribing	
Receiving any psychotropic medication	39 695 (13.5)
Receiving ≥2 psychotropic medication classes	14 397 (4.9)
Receiving specific medication classes:	
Stimulant	27 029 (9.2)
Antidepressant	12 917 (4.4)
α-Agonist	7075 (2.4)
SGA	6013 (2.0)
Atomoxetine	3724 (1.3)
Anxiolytic	3325 (1.1)
Mood stabilizer	2378 (0.8)

Values are expressed as *n* (%). Children could have >1 mental health diagnosis or medication prescription class and would be counted in multiple categories.

Practice Variability in Diagnosis and Prescribing

There was significant variability in all mental health diagnoses and psychotropic medication classes across practices (P < .001 for all comparisons based on likelihood ratio tests) (Table 3). The proportion of children with any mental health diagnosis ranged from 2.3% to 22.2%. Contrary to our hypothesis, we observed substantial variability in the proportion of children receiving an ADHD diagnosis (1.3%–15.8%) across practices relative to other diagnoses. Differences in other diagnoses were smaller, but still meaningful: 0.5% to 7.7% for anxiety, 0.0% to 4.8% for depression, 0.2% to 3.0% for autism, 0.0% to 3.1% for conduct disorder, and 0.0% to 2.3% for oppositional defiant disorder. Bipolar disorder was uncommon (≤1.0%).

As with diagnosis, the proportion of patients receiving any psychotropic medication varied substantially across practices (Fig 1, Table 3), ranging from 4.3% to 25.8%. In addition, there was >20-fold variation in the proportion of patients receiving prescriptions from ≥2 medication groups, with a range of 0.5% to 11.5%. Practice variability in prescribing was observed for the 4 most commonly prescribed medication classes in this sample: stimulants, antidepressants, α-agonists, and SGAs. Stimulant prescribing was the most variable (range 3.3%–17.9% compared with 0.9%–11.8% for antidepressants, 0.1%–8.0% for α-agonists, and 0.1%–5.0% for SGAs). Atomoxetine, anxiolytics, and mood stabilizers were uncommon across sites (maximum of 3.5%).

TABLE 2 Characteristics of Study Practices Based on Clinician Survey

Variable	Sample
n	43
Practice setting	
Urban	10 (23.3)
Suburban	27 (63.8)
Rural	6 (13.9)
Region of the United States	
Northeast	27 (62.8)
Midwest	3 (7.0)
South	9 (20.9)
West	4 (9.3)
Practice has onsite mental health	
Any onsite mental health	16 (37.2)
Child psychiatrists	3 (7.0)
Child psychologists	9 (20.9)
Developmental behavioral pediatricians	2 (4.7)
Substance abuse counselors	0 (0.0)
Mental health counselors	5 (11.6)
Social workers	8 (18.6)
Adult psychologists/psychiatrists	0 (0.0)
Missing this section	1 (2.3)
Availability of mental health professionals in the community	
Child psychiatrists	
Very available	0 (0.0)
Somewhat available	29 (67.4)
Not at all available	12 (27.9)
Child psychologists	
Very available	7 (16.3)
Somewhat available	30 (69.8)
Not at all available	4 (9.3)
Developmental/behavioral pediatricians	
Very available	1 (2.3)
Somewhat available	26 (60.5)
Not at all available	13 (30.2)
Substance abuse counselors	
Very available	2 (4.7%)
Somewhat available	33 (76.7)
Not at all available	5 (11.6)
Social workers	
Very available	8 (18.6)
Somewhat available	26 (60.5)
Not at all available	7 (16.3)
Adult psychologists/psychiatrists	
Very available	5 (11.6)
Somewhat available	31 (72.1)
Not at all available	5 (11.6)
Missing this section	2 (4.7)
Percentage of foster care patients	
0% to 5%	32 (74.4)
≥6%	8 (18.6)
Missing this section	3 (7.0)

Values are expressed as *n* (%). Data were obtained by survey of the lead clinician at each practice.

Variability in Mental Health Diagnosis and Medication Treatment by Practice Characteristics

Variability in diagnosis and prescribing was partially explained by perceived community availability of psychiatrists. Children at practices reporting that psychiatrists were "not at all available in the community" had significantly higher odds of any mental health diagnosis, ≥2 diagnoses, ADHD, and depression compared with children at practices reporting that psychiatrists were available (Table 4). Children at practices where clinicians reported no available community psychiatrists also had significantly higher odds of psychotropic medication prescribing. Results were statistically significant for any psychotropic medication, ≥2 medication classes, stimulants, antidepressants, and α-agonists. However, perceived community availability of child psychologists was not associated with diagnosis and prescribing.

Although significant, differences in perceived community availability of psychiatrists did not entirely explain the variability in diagnosis and prescribing observed. Likelihood ratio tests indicated that practice variability was still statistically significant after adjustment for community availability of psychiatrists for all models ($P < .001$).

TABLE 3 Variability in Mental Health Diagnosis and Prescribing Among 43 Pediatric Primary Care Practices

Item	%
Mental health diagnosis	
Any mental health diagnosis	14.7 (2.3–22.2)
≥2 mental health diagnoses	3.1 (0.1–6.3)
ADHD	8.9 (1.3–15.8)
Anxiety	3.7 (0.5–7.7)
Depression	2.2 (0.0–4.8)
Autism spectrum disorder	1.6 (0.2–3.0)
Psychotropic prescribing	
Any psychotropic medication	12.8 (4.3–25.8)
≥2 psychotropic medication classes	4.8 (0.5–11.5)
Stimulants	8.6 (3.3–17.9)
Antidepressants	4.6 (0.9–11.8)
α-Agonist	2.0 (0.1–8.0)
SGA	1.9 (0.1–5.0)

Values are expressed as median (range). *P* value for variability across practices <.001 for all diagnoses and medication classes. Statistical significance based on likelihood ratio tests for the null hypothesis that diagnoses and prescribing proportions were the same across sites. Multivariable logistic regression models controlling for age and gender with a fixed effect for practice were used.

Contrary to our hypothesis, colocation of mental health providers was not associated with diagnosis or prescribing (Table 4). Results were similar when we included only colocated professionals with prescribing authority. Similarly, a high prevalence of foster care children in the practice was not associated with diagnosis or prescribing (except for anxiety diagnosis), nor were practice setting, practice size, or age distribution of patients at the practice.

DISCUSSION

Previous research has focused on the diagnosis and treatment of mental health problems at the population level as well as individual pediatrician willingness to treat mental health concerns. Using a database of 43 practices' EHRs covering a 5-year period, we identified significant variation in mental health care at the practice level. We found the highest levels of variability for ADHD diagnosis and prescribing of psychotropic medications, especially stimulants. This variability was partially explained by the perceived availability of psychiatrists in the communities in which practices were located. Children at practices reporting no availability of psychiatrists were more likely to have a diagnosis or prescription recorded in their primary care EHR, a pattern that was not observed for other types of mental health professionals. Other practice characteristics, including the colocation of onsite mental health professionals and the prevalence of foster care children in the practice, were not associated with diagnosis nor prescribing.

The high level of variability observed in this study at the practice level is consistent with prior research

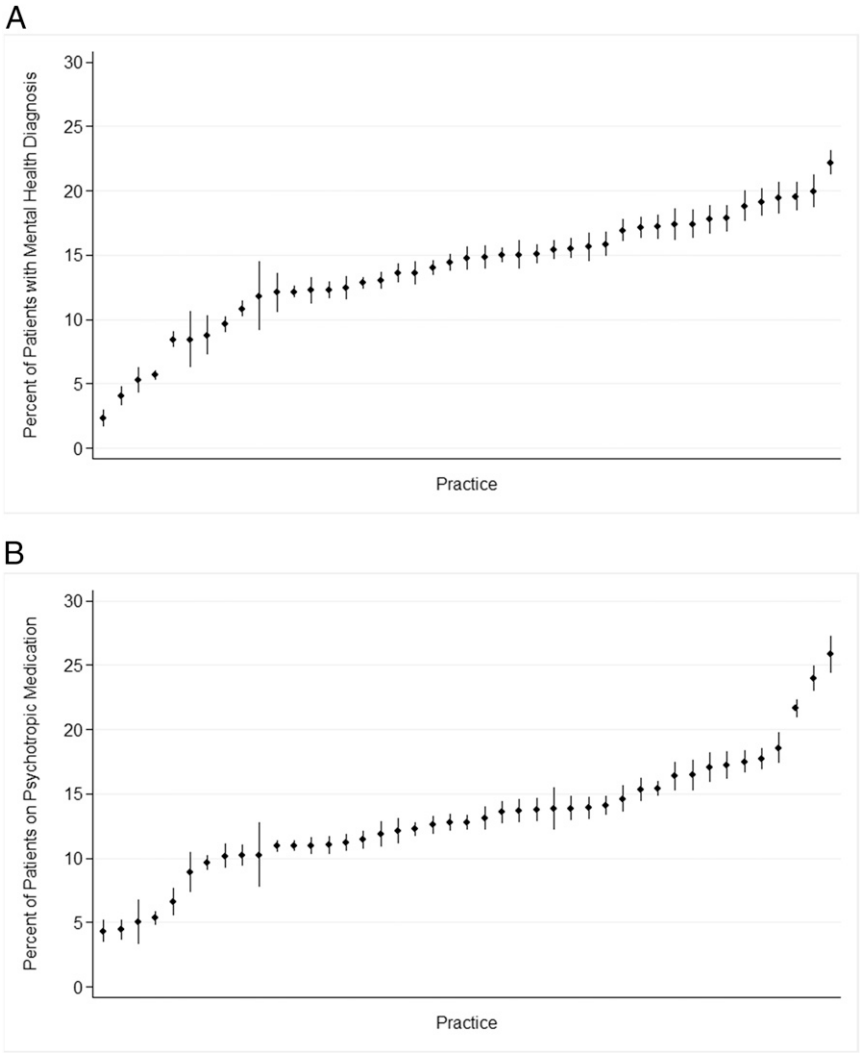

FIGURE 1
Practice variation in any mental health diagnosis (A) and any psychotropic medication (B) across 43 primary care practices, with 95% confidence intervals.

assessing patterns in the population. A national survey found more than twofold variation in the use of mental health care across states, from 5% to 11%,[15] whereas a study in Washington State found that the percentage of Medicaid-eligible children receiving mental health care ranged from 3% to 8% throughout the state.[21] We found even greater variation in psychotropic medication prescribing in our cohort of children in primary care, although not as large as several national studies of children in the child welfare system.[18,37] In our study, this significant variability was only partially explained by community availability of psychiatrists, and was not associated with other characteristics we hypothesized would increase diagnosis and prescribing.

Shortages in child and adolescent psychiatrists, particularly common in rural areas or in communities with more children living in poverty,[38] may make it necessary for pediatricians in certain areas to treat mental health conditions beyond ADHD, a trend that has been described previously.[39] In a survey of nearly 3000 primary care providers, two-thirds reported they were unable to obtain mental health services for at least some of their patients, and in counties with few psychiatrists available, primary care providers were more likely to report shortages of providers as a barrier to accessing services.[40] Additionally, previous research has documented that the availability of nonpharmacological treatments such as behavior therapy is highly variable throughout the country (33%–61% among children with current ADHD as of 2009–2010)[41] and depends on system-level factors such as insurance coverage and state policies. In this context, our study suggests that pediatricians may, out of necessity, prescribe psychotropic medications to manage a larger percentage of mental health care in areas lacking available psychiatrists. This association was not observed for psychologists. Nonetheless, psychologists, who may be more focused on prevention and early intervention and less likely to formally diagnose children, may impact child well-being without influencing diagnosis and prescribing.

Colocation of mental health providers in primary care practices has been proposed to remove barriers to access.[26,28,30,42,43] Previous studies have found that colocation improved access to mental health care[30,44] and engagement with mental health care providers[31,45] and improved patient satisfaction and outcomes.[46,47] We hypothesized that colocation would result in increased diagnosis and prescribing by bringing expertise with these conditions to the practice and potentially drawing additional children needing these services. However, our finding that colocation was not associated with diagnosis or prescribing rates suggests that care by nonprescribing mental health professionals (psychologists and social workers) may have limited impact on practice-level prescribing. Additionally, even with colocation, barriers such as financial differences in reimbursement for medical

TABLE 4 Association of Practice-Level Characteristics With Mental Health Diagnosis and Psychotropic Medication Prescribing in Primary Care

Item	Child Psychiatrists Not Available in Community (vs somewhat available)	*P*[a]	Colocated Mental Health Provider Present (vs not)[b]	*P*[a]	Foster Care Prevalence ≥6% (vs 0%–5%)	*P*[a]
Mental health diagnosis						
Any mental health diagnosis	1.40 (1.09–1.80)	.01	0.88 (0.68–1.12)	.3	0.86 (0.63–1.18)	.3
≥2 mental health diagnoses	1.59 (1.02–2.49)	.04	0.78 (0.51–1.19)	.3	0.80 (0.47–1.38)	.4
ADHD	1.37 (1.06–1.77)	.02	0.87 (0.68–1.12)	.3	0.95 (0.69–1.31)	.7
Anxiety	1.48 (0.92–2.37)	.1	0.78 (0.50–1.21)	.3	0.45 (0.27–0.76)	.004
Depression	1.56 (1.00–2.42)	.05	0.97 (0.63–1.49)	.9	0.97 (0.56–1.68)	.9
Autism spectrum disorder	1.09 (0.73–1.63)	.7	0.92 (0.64–1.33)	.7	0.81 (0.51–1.28)	.4
Psychotropic prescribing						
Any psychotropic medication	1.60 (1.25–2.04)	.0005	1.00 (0.77–1.30)	.9	0.92 (0.66–1.28)	.6
≥2 medication classes	1.88 (1.32–2.66)	.001	1.06 (0.73–1.53)	.8	0.93 (0.58–1.49)	.8
Stimulants	1.51 (1.20–1.89)	.0009	0.97 (0.76–1.23)	.8	0.92 (0.68–1.25)	.6
Antidepressants	1.96 (1.32–2.92)	.002	0.91 (0.60–1.37)	.6	0.81 (0.48–1.37)	.4
α-Agonist	2.02 (1.38–2.98)	.0008	0.91 (0.60–1.37)	.9	1.08 (0.64–1.84)	.8
SGA	1.56 (0.99–2.47)	.06	1.24 (0.80–1.94)	.3	1.27 (0.73–2.22)	.4

Values are expressed as adjusted odds ratio (95% confidence interval). From mixed effects logistic regression models adjusting for age and gender and including a random intercept for each practice. Because practice setting, size, and age distribution were not associated with diagnosis or prescribing, they were not included in final models. Interaction terms were not included in these models.

[a] *P* values from likelihood ratio tests comparing models with and without the practice characteristic of interest.

[b] The practice reported including any of the following types of provider: child psychiatrist, child psychologist, developmental behavioral pediatrician, social worker, or mental health counselor.

and mental health services,[48,49] difficulties with information sharing,[49] differing expertise,[48,49] and limited hours may impede integration.

The high level of practice variability in our study also suggests that patients with mental health conditions may have different care experiences by practice due to differences in clinician familiarity with treating children with behavioral health problems. This variability underscores the need to continue to evaluate and implement approaches to support practices in treating affected children. As community availability of psychiatry only partially explained the wide variation in diagnosis and prescribing, additional factors that may drive variability require future study. For example, primary care providers' level of agreement with current guidelines, perceived self-efficacy in diagnosing or treating particular conditions, training, relationships with schools, and reimbursement from insurers might affect prescribing practices.[50]

This study had several limitations. Although primary care practices typically reconcile diagnoses given and medications prescribed by outside providers, medications and diagnoses may have been underestimated if physicians were unaware of or did not document them, children did not attend recommended preventive visits, or EHRs did not provide a shared record. However, given high levels of variability in ADHD diagnosis and stimulant prescribing that are primarily managed in primary care, it is unlikely that the observed variability is a documentation artifact. The data reflect psychotropic medication prescribing, but not necessarily use. Furthermore, as a majority of practices were in one region of the country, we were unable to test for regional variation. Also, information on prevalence of mental health providers was based on practice leader report but may not reflect actual availability. In addition, it is unknown whether any practices had systematic screening programs to identify behavioral or emotional disorders, which might have resulted in higher rates. Because we conducted a child-level analysis and children often received care from multiple providers, we were unable to examine variability between clinicians within practices. Finally, as this study focused on practice-level variability and practice characteristics, we were unable to focus on several important areas relevant to mental health care for children: trajectories of medication use or episodes of care among children over time (since we considered whether diagnoses or prescriptions were received at all by a child over the study period), child-level concurrent polypharmacy, use of community mental health or psychiatric consultation services, and child mental health outcomes. Such topics should be explored in the future.

CONCLUSIONS

Mental health diagnosis and prescribing for children in primary care are highly variable. Community availability of psychiatrists only partly explained this variation. Other factors, including presence of onsite mental health professionals or prevalence of foster care children, were not associated with variation in this study. Given the magnitude of the observed variability, further study is needed to better understand

the causes of variable practice-level diagnosis and prescribing and the implication for child mental health outcomes.

ACKNOWLEDGMENTS

We thank the practitioners, patients, and their families from PeRC and ePROS.

The ePROS pediatric practices that participated in this study are listed by AAP Chapter. California: Shasta Community Health Center (Redding), practice of Mark M. Simonian, MD (Clovis); Colorado: Fort Collins Youth Clinic PC (Fort Collins); Georgia: The Pediatric Center (Stone Mountain), Roswell Pediatrics (Cumming); Indiana: Jeffersonville Pediatrics (Jeffersonville); Kentucky: Union Pediatrics (Union); Maryland: Main Street Pediatrics (Towson); New Jersey: Delaware Valley Pediatric Associates PA (Lawrenceville), PASE Healthcare PC (Millburn); New York: East End Pediatrics (East Hampton); Missouri: Priority Care Pediatrics LLC (Kansas City); Ohio: Oxford Pediatrics and Adolescents (Oxford); Oklahoma: OUCP Sooner Pediatric Clinic (Oklahoma City); Oregon: Childhood Health Associates of Salem (Salem); Tennessee: Plateau Pediatrics (Crossville), Cool Springs Pediatrics PLLC (Franklin); and South Carolina: AnMed Health Children's Health Center (Anderson).

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADHD: attention deficit/hyperactivity disorder
EHR: electronic health record
ePROS: Electronic Pediatric Research in Office Settings
PeRC: Pediatric Research Consortium
SGA: second-generation antipsychotic

Azuine, Gotlieb, Grundmeier, Leslie, Localio, Wasserman, and Fiks critically reviewed the manuscript; Drs Grundmeier, Wasserman, and Fiks contributed to the conception and design of the study; Drs Grundmeier, Leslie, Wasserman, and Fiks contributed to the interpretation of the data; and all authors approved the final manuscript as submitted.

This information or content and conclusions are those of the authors and should not be construed as the official position or policy of, nor should any endorsements be inferred by, the Health Resources and Services Administration, the US Department of Health and Human Services, or the US government.

DOI: 10.1542/peds.2015-2974

Accepted for publication Feb 18, 2016

Address correspondence to Alexander G. Fiks, MD, MSCE, The Children's Hospital of Philadelphia, 3535 Market St, Rm 1546, Philadelphia, PA 19104. E-mail: fiks@email.chop.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Fiks is the co-principal investigator of an independent research grant from Pfizer for work in ADHD; the other authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by the Health Resources and Services Administration (HRSA) of the US Department of Health and Human Services (HHS) under grants R40MC24943 ("Primary Care Drug Therapeutics CER in a Pediatric EHR Network"), UB5MC20286 ("Pediatric Primary Care EHR Network for CER"), and UA6MC15585 ("National Research Network to Improve Child Health Care"). Funding was provided, in part, by a grant from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development under the Best Pharmaceuticals for Children Act. Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: Dr Fiks is the co-principal investigator of an independent research grant from Pfizer for work in ADHD; the other authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health. The pediatrician and the "new morbidity." *Pediatrics*. 1993;92(5). Available at: www.pediatrics.org/cgi/content/full/92/5/e731
2. Kelleher KJ, McInerny TK, Gardner WP, Childs GE, Wasserman RC. Increasing identification of psychosocial problems: 1979-1996. *Pediatrics*. 2000;105(6). Available at: www.pediatrics.org/cgi/content/full/105/6/e1313
3. Anderson LE, Chen ML, Perrin JM, Van Cleave J. Outpatient visits and medication prescribing for US children with mental health conditions. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1178
4. Goodwin R, Gould MS, Blanco C, Olfson M. Prescription of psychotropic medications to youths in office-based practice. *Psychiatr Serv*. 2001;52(8):1081–1087
5. Stein RE, Horwitz SM, Storfer-Isser A, Heneghan A, Olson L, Hoagwood KE. Do pediatricians think they are responsible for identification and management of child mental health problems? Results of the AAP periodic survey. *Ambul Pediatr*. 2008;8(1):11–17
6. Heneghan A, Garner AS, Storfer-Isser A, Kortepeter K, Stein RE, Horwitz SM. Pediatricians' role in providing

mental health care for children and adolescents: do pediatricians and child and adolescent psychiatrists agree? *J Dev Behav Pediatr*. 2008;29(4):262–269

7. Olson AL, Kelleher KJ, Kemper KJ, Zuckerman BS, Hammond CS, Dietrich AJ. Primary care pediatricians' roles and perceived responsibilities in the identification and management of depression in children and adolescents. *Ambul Pediatr*. 2001;1(2):91–98
8. Williams J, Klinepeter K, Palmes G, Pulley A, Foy JM. Diagnosis and treatment of behavioral health disorders in pediatric practice. *Pediatrics*. 2004;114(3). Available at: www.pediatrics.org/cgi/content/full/114/3/e601
9. Horwitz SM, Kelleher KJ, Stein RE, et al. Barriers to the identification and management of psychosocial issues in children and maternal depression. *Pediatrics*. 2007;119(1). Available at: www.pediatrics.org/cgi/content/full/119/1/e208
10. Davis DW, Honaker SM, Jones VF, Williams PG, Stocker F, Martin E. Identification and management of behavioral/mental health problems in primary care pediatrics: perceived strengths, challenges, and new delivery models. *Clin Pediatr (Phila)*. 2012;51(10):978–982
11. American Academy of Pediatrics. *Caring for Children with ADHD: A Resource Toolkit for Clinicians*, 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2011
12. American Academy of Pediatrics. *Caring for Children with Autism Spectrum Disorders: A Resource Toolkit*. Elk Grove Village, IL: American Academy of Pediatrics; 2012
13. American Academy of Pediatrics. *Addressing Mental Health Concerns in Primary Care: A Clinician's Toolkit*. Elk Grove Village, IL: American Academy of Pediatrics; 2010
14. Wasserman RC, Kelleher KJ, Bocian A, et al. Identification of attentional and hyperactivity problems in primary care: a report from pediatric research in office settings and the ambulatory sentinel practice network. *Pediatrics*. 1999;103(3). Available at: www.pediatrics.org/cgi/content/full/103/3/e38
15. Sturm R, Ringel JS, Andreyeva T. Geographic disparities in children's mental health care. *Pediatrics*. 2003;112(4). Available at: www.pediatrics.org/cgi/content/full/112/4/e308
16. Visser SN, Danielson ML, Bitsko RH, Holbrook JR, Kogan MD, Ghandour RM, et al Trends in the parent-report of health care provider-diagnosed and medicated attention-deficit/hyperactivity disorder: United States, 2003-2011. *J Am Acad Child Adolesc Psychiatry*. 2014;53(1):34-46.e2
17. Cox ER, Motheral BR, Henderson RR, Mager D. Geographic variation in the prevalence of stimulant medication use among children 5 to 14 years old: results from a commercially insured US sample. *Pediatrics*. 2003;111(2). Available at: www.pediatrics.org/cgi/content/full/111/2/e237
18. Leslie LK, Raghavan R, Hurley M, Zhang J, Landsverk J, Aarons G. Investigating geographic variation in use of psychotropic medications among youth in child welfare. *Child Abuse Negl*. 2011;35(5):333–342
19. Raghavan R, Lama G, Kohl P, Hamilton B. Interstate variations in psychotropic medication use among a national sample of children in the child welfare system. *Child Maltreat*. 2010;15(2):121–131
20. Epstein JN, Kelleher KJ, Baum R, et al. Variability in ADHD care in community-based pediatrics. *Pediatrics*. 2014;134(6). Available at: www.pediatrics.org/cgi/content/full/134/6/e1136
21. Ellis WR, Huebner C, Vander Stoep A, Williams MA. Washington State exhibits wide regional variation in proportion of Medicaid-eligible children who get needed mental health care. *Health Aff (Millwood)*. 2012;31(5):990–999
22. Fulda KG, Johnson KL, Hahn K, Lykens K. Do unmet needs differ geographically for children with special health care needs? *Matern Child Health J*. 2013;17(3):505–511
23. Nelson EC, Godfrey MM, Batalden PB, et al. Clinical microsystems, part 1. The building blocks of health systems. *Jt Comm J Qual Patient Saf*. 2008;34(7):367–378
24. American Academy of Child and Adolescent Psychiatry Committee on Health Care Access and Economics Task Force on Mental Health. Improving mental health services in primary care: reducing administrative and financial barriers to access and collaboration. *Pediatrics*. 2009;123(4). Available at: www.pediatrics.org/cgi/content/full/123/4/e1248
25. Power TJ, Mautone JA, Manz PH, Frye L, Blum NJ. Managing attention-deficit/hyperactivity disorder in primary care: a systematic analysis of roles and challenges. *Pediatrics*. 2008;121(1). Available at: www.pediatrics.org/cgi/content/full/121/1/e65
26. Auxier A, Runyan C, Mullin D, Mendenhall T, Young J, Kessler R. Behavioral health referrals and treatment initiation rates in integrated primary care: a Collaborative Care Research Network study. *Transl Behav Med*. 2012;2(3):337–344
27. Beacham AO, Herbst A, Streitwieser T, Scheu E, Sieber WJ. Primary care medical provider attitudes regarding mental health and behavioral medicine in integrated and non-integrated primary care practice settings. *J Clin Psychol Med Settings*. 2012;19(4):364–375
28. Bird DC, Lambert D, Hartley D, Beeson PG, Coburn AF. Rural models for integrating primary care and mental health services. *Adm Policy Ment Health*. 1998;25(3):287–308
29. Miller BF, Petterson S, Brown Levey SM, Payne-Murphy JC, Moore M, Bazemore A. Primary care, behavioral health, provider colocation, and rurality. *J Am Board Fam Med*. 2014;27(3):367–374
30. Williams J, Shore SE, Foy JM. Co-location of mental health professionals in primary care settings: three North Carolina models. *Clin Pediatr (Phila)*. 2006;45(6):537–543
31. Yeung A, Kung WW, Chung H, et al. Integrating psychiatry and primary care improves acceptability to mental health services among Chinese Americans. *Gen Hosp Psychiatry*. 2004;26(4):256–260

32. Raghavan R, Zima BT, Andersen RM, Leibowitz AA, Schuster MA, Landsverk J. Psychotropic medication use in a national probability sample of children in the child welfare system. *J Child Adolesc Psychopharmacol*. 2005;15(1):97–106

33. Majzoub Perez K, Flier L, D'Couto H, et al. Behavioral health integration in primary care at Brigham and Women's Advanced Primary Care Associates, South Huntington. *Healthc (Amst)*. 2015;3(3):169–174

34. Stein RE, Storfer-Isser A, Kerker BD, et al. Beyond ADHD: how well are we doing? *Acad Pediatr*. 2015;S1876-2859(15)00279-X

35. Fiks AG, Grundmeier RW, Margolis B, et al. Comparative effectiveness research using the electronic medical record: an emerging area of investigation in pediatric primary care. *J Pediatr*. 2012;160(5):719–724

36. Horwitz SM, Storfer-Isser A, Kerker BD, et al. Barriers to the identification and management of psychosocial problems: changes from 2004 to 2013. *Acad Pediatr*. 2015;15(6):613–620

37. Rubin DM, Feudtner C, Localio R, Mandell DS. State variation in psychotropic medication use by foster care children with autism spectrum disorder. *Pediatrics*. 2009;124(2). Available at: www.pediatrics.org/cgi/content/full/124/2/e305

38. Thomas CR, Holzer CE III. The continuing shortage of child and adolescent psychiatrists. *J Am Acad Child Adolesc Psychiatry*. 2006;45(9):1023–1031

39. Olfson M, Kroenke K, Wang S, Blanco C. Trends in office-based mental health care provided by psychiatrists and primary care physicians. *J Clin Psychiatry*. 2014;75(3):247–253

40. Cunningham PJ. Beyond parity: primary care physicians' perspectives on access to mental health care. *Health Aff (Millwood)*. 2009;28(3):w490–w501

41. Visser SN, Bitsko RH, Danielson ML, et al. Treatment of attention deficit/hyperactivity disorder among children with special health care needs. *J Pediatr*. 2015;166(6):1423–30.e1, 2

42. Blount A. Integrated primary care: organizing the evidence. *Fam Syst Health*. 2003;21(2):121–133

43. Miller BF, Petterson S, Burke BT, Phillips RL Jr, Green LA. Proximity of providers: colocating behavioral health and primary care and the prospects for an integrated workforce. *Am Psychol*. 2014;69(4):443–451

44. Kates N, McPherson-Doe C, George L. Integrating mental health services within primary care settings: the Hamilton Family Health Team. *J Ambul Care Manage*. 2011;34(2):174–182

45. Wildman BG, Langkamp DL. Impact of location and availability of behavioral health services for children. *J Clin Psychol Med Settings*. 2012;19(4):393–400

46. Asarnow JR, Jaycox LH, Duan N, et al. Effectiveness of a quality improvement intervention for adolescent depression in primary care clinics: a randomized controlled trial. *JAMA*. 2005;293(3):311–319

47. Reiss-Brennan B, Briot PC, Savitz LA, Cannon W, Staheli R. Cost and quality impact of Intermountain's mental health integration program. *J Healthc Manag*. 2010;55(2):97–113, discussion 113–114

48. Butler M, Kane RL, McAlpine D, et al. Integration of Mental Health/Substance Abuse and Primary Care. Report 09-E003. Rockville, MD: Agency for Healthcare Research and Quality; 2009.

49. Druss BG, Newcomer JW. Challenges and solutions to integrating mental and physical health care. *J Clin Psychiatry*. 2007;68(4):e09

50. Fiks AG, Hughes CC, Gafen A, Guevara JP, Barg FK. Contrasting parents' and pediatricians' perspectives on shared decision-making in ADHD. *Pediatrics*. 2011;127(1). Available at: www.pediatrics.org/cgi/content/full/127/1/e188

Variations in Mental Health Diagnosis and Prescribing Across Pediatric Primary Care Practices

Stephanie L. Mayne, Michelle E. Ross, Lihai Song, Banita McCarn, Jennifer Steffes, Weiwei Liu, Benyamin Margolis, Romuladus Azuine, Edward Gotlieb, Robert W. Grundmeier, Laurel K. Leslie, Russell Localio, Richard Wasserman and Alexander G. Fiks

Pediatrics 2016;137;
DOI: 10.1542/peds.2015-2974 originally published online April 1, 2016;

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Variations in Mental Health Diagnosis and Prescribing Across Pediatric Primary Care Practices

Stephanie L. Mayne, Michelle E. Ross, Lihai Song, Banita McCarn, Jennifer Steffes, Weiwei Liu, Benyamin Margolis, Romuladus Azuine, Edward Gotlieb, Robert W. Grundmeier, Laurel K. Leslie, Russell Localio, Richard Wasserman and Alexander G. Fiks

Pediatrics 2016;137;
DOI: 10.1542/peds.2015-2974 originally published online April 1, 2016;