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Impact of Comorbid Conditions on the Community-Based Pediatric Treatment and Outcomes of Children with ADHD

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Abstract

Objective—Children with ADHD often exhibit psychiatric comorbidities, which may impact illness presentation, diagnosis, and treatment outcomes. Guidelines exist for dealing with these complex cases but little is known about how comorbidities are being handled in community pediatric settings. The purpose of this study was to evaluate how mental health comorbidities affect community physicians' ADHD care practices and patients' symptom trajectories.

Methods—Medical charts of 319 children presenting at primary care clinics for ADHD-related concerns were reviewed. Physician assessment and treatment behaviors were extracted and parents rated ADHD symptoms at the time of diagnosis and at 3, 6, and 12 months. Baseline ratings were used to group children as no comorbid mental health condition, internalizing, or externalizing comorbid condition. Multilevel analyses compared community physician care behaviors and ADHD symptom trajectories across groups.

Results—Approximately 50 percent of the sample met screening criteria for a comorbid mental health condition. For children diagnosed with ADHD and treated with medication, community physician care largely did not differ across groups, but children with internalizing comorbidities made significantly smaller improvements in inattentive and hyperactive/impulsive symptoms compared to children with no comorbidities.

Conclusion—Children with ADHD and mental health comorbidities, particularly internalizing disorders, exhibit less robust response to ADHD medication and may require additional testing prior to starting medication and/or alternative treatment approaches. Potential barriers to conducting comprehensive assessments and to providing multi-modal treatment are discussed.

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Keywords

ADHD; comorbidities; pediatric; community; medication response

Children with ADHD often exhibit comorbid conditions, such as depression, anxiety, and oppositional defiant disorder (ODD), with psychiatric comorbidity rates around 50%.^{1,2} Mental health comorbidity can influence the presentation, diagnosis, and long-term outcomes of children with ADHD. For example, in comparison to children with ADHD alone, children with ADHD and comorbidities experience greater social and educational impairments and use more mental health services.³ Psychiatric comorbidities are common in ADHD populations and the harm they cause highlights the importance of correct diagnosis and appropriate treatment.

Primary care providers often find themselves responsible for diagnosing and treating mental health issues.^{4,5} As a result, best-practice recommendations have been developed and disseminated to guide pediatric practice. The American Academy of Pediatrics (AAP) ADHD guidelines highlight that the majority of children who present to community practices with ADHD will also have a comorbid condition.⁶ The guidelines specify that “the primary care clinician should include assessment for other conditions that might coexist with ADHD” and note that in some cases these coexisting conditions will “alter the treatment of ADHD.”⁶ However, the guidelines do not describe how to accurately assess or modify treatment for children with ADHD when mental health comorbidities are present. Further, the guidelines acknowledge that assessing for comorbidities may require more time and effort than is afforded in typical community practice. Accordingly, when physicians cannot assess for comorbid conditions, they should refer children to specialists for further evaluation.⁶

Pediatric Care Practices for Youth with Comorbidities

Despite the importance of assessing and treating mental health conditions comorbid with ADHD, there is minimal research on how community pediatricians are actually caring for these children. There is evidence that primary care providers are more confident in assessing and treating ADHD than internalizing conditions. For example, Williams et al. (2004) found that while the majority of community-based pediatricians frequently diagnosed ADHD, less than half regularly diagnosed anxiety or depression. Additionally, pediatricians perceive themselves to be more responsible for the management of some mental health conditions than other disorders. For example, in the AAP Periodic Survey, less than one-third of pediatricians felt responsible for treating depression and anxiety in their practice, but a majority indicated that they should treat ADHD.⁷ There is some evidence that community physicians fail to identify the presence of moderate mental health symptoms nearly 45% of the time, and perhaps these attitudes contribute to this problem.⁸

With respect to treatment, almost nothing is known about how children with ADHD and mental health comorbid conditions respond to medication in the community context. Evidence from clinical trials suggests that youth with ADHD and externalizing comorbid conditions respond well to stimulant medications, whereas youth with ADHD and comorbid

internalizing conditions may respond poorly.⁹ However, medication titration practices in controlled trials and in the community vary significantly,^{10,11} and results from clinical trials may not generalize to community samples. Understanding how community-based physicians are caring for youth with mental health comorbidities and whether children are responding to treatment is important for several reasons. These include: 1) informing continuing medical education (CME) programs for community physicians,¹² 2) informing interventions focused on teaching physicians to use evidence-based ADHD practices,¹³ and 3) for further refining guidelines for pediatricians, particularly as related to the feasibility of the recommendations.

Accordingly, the current study evaluates how mental health comorbidities affect community-based physician ADHD care and ADHD symptom response trajectories during the first year of treatment. This study builds upon prior work by evaluating physician care behaviors through systematic chart review rather than through self-report and by evaluating the impact of comorbidities on medication response in a naturalistic setting. Given prior evidence suggesting higher rates of services utilization for children/families with comorbidities, it was predicted that children with comorbid mental health conditions would be significantly more likely to receive some type of psychosocial treatment (e.g., therapy). Further, consistent with evidence from clinical trials⁹ it was hypothesized that the ADHD-alone and ADHD with externalizing comorbidities group would not differ in the magnitude of symptom response but that youth with comorbid internalizing symptoms would exhibit a less robust response to medication.

METHODS

Participants and Setting

Pediatric primary care practices from Northern and Central Ohio were recruited from August 2010 through December 2012 to participate in a study to improve the quality of community ADHD care. A recruitment packet was sent to 128 practices that had at least two pediatricians and no access to an on-site mental health professional. The first 50 practices to respond and provide written informed consent for individual physicians participated. Practices were then randomly assigned to a waitlist condition or to receive a quality improvement intervention. Only participants from the waitlist control condition are included in the present study as we were interested in how children with ADHD and comorbidities are naturally managed in the community.

Across these control practices, mean provider age was 44.5 ($SD = 10.9$) years, 75% of providers were white, and 63% were female. The average time since training completion was 13.5 years ($SD = 10.3$). Approximately 30 % of practices were located in an urban setting, 59 % in a suburban setting, and 11 % in a rural area. The population served varied across practices, with an average of 42 % of Medicaid patients in these practices' panels. Forty-two percent of patients seeking services at these practices were non-white. Across control practices, approximately 3.6 ($SD = 3.4$) families per provider were enrolled.

A sample of 319 children who had not been previously diagnosed with ADHD and were medication naïve was recruited from the waitlist control practices. Practices identified

children in grades 1–5 who presented with ADHD-related behavioral concerns. Families were approached and asked about their interest in participating in the study; the research staff called parent or legal guardian (hereafter, parent) of eligible and willing families to obtain verbal consent. The parent's responses for their child's baseline Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS)¹⁴ were obtained at that time. The BLINDED and BLINDED Institutional Review Boards approved this study. All participants were compensated for completing research measures.

Design

In this observational study, participants were followed for one full year after their diagnosis. The baseline and 3-, 6-, and 12-month follow-up Vanderbilt Rating scales completed by parents are used to assess response to treatment by mental health comorbidity. Because the actual dates of ratings varied considerably among participants, a time variable indicating the number of days from their initial visit was used to account for multiple time points in all multi-level models.

Measures

Chart Reviews—Study staff reviewed charts to assess pediatricians' ADHD care practices and their medication prescriptions for each patient. The physician behaviors extracted are listed in Table 1 and include number of office and total contacts, medication dosages and changes to medication, number of parent and teacher ratings collected for treatment purposes, and referral to mental health services across the year of follow-up. Although physicians were aware that Vanderbilt ratings would be collected for research purposes as part of the study, they did not have access to these ratings. Research staff independently collected Vanderbilt ratings over the phone or through mail for study purposes. The medication dose for children prescribed stimulant medication was calculated in methylphenidate dosage equivalent units by converting daily dosages of all non-methylphenidate stimulant medications using the following conversions (mixed salt amphetamines dose or Focalin® dose $\times$ 2; Vyvanse® $\times$.8).¹⁵ The highest dose from this calculation was recorded for each child for any ADHD prescriptions they were given over the course of their first year of treatment.

Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS)—Primary caregivers reported on their children's symptoms by filling out the VADPRS at baseline, three months, six months, and 12 months. The VADPRS has good internal consistency, factor structure, and concurrent validity for ADHD assessment.¹⁴ Parents rate the frequency of child behaviors on a 4-point scale (0 = *never*, 1 = *occasionally*, 2 = *often*, 3 = *very often*). Items that are rated as a 2 or 3 are included in the total symptom count. Patients were classified as having remitted if fewer than 6 items were rated as a 2 or 3 on the VADPRS in *both* the inattentive and hyperactive/impulsive domains at follow-up.

The full VADPRS, including ADHD and psychiatric comorbidity items, was collected at baseline and thereafter, the short VADPRS containing only the 18 DSM ADHD items was collected. For this study, the 9 ADHD inattention items were summed and the 9 ADHD hyperactive/impulsive items were summed at each time point to measure response to ADHD

medication. The baseline VADPRS contains comorbidity items designed to screen for the presence of oppositional defiant disorder (ODD; 8 items), conduct disorder (CD; 14 items), and anxiety/depression (7 items). The comorbidity screening scales have adequate reliability, factor structure, and preliminary evidence of concurrent validity.¹⁶ Cutoff scores on the VADPRS have also been evaluated as compared to diagnostic interview data and found to be fairly accurate and reliable.¹⁶ These scales have also been found to be clinically useful in identifying the presence of these comorbidities in PCP settings.¹⁶

AAP scoring thresholds for the VADPRS were used to place participants into three groups reflecting baseline comorbidities: 1) no-comorbidity; 2) externalizing comorbidity (4 ODD symptoms endorsed or 3 CD symptoms endorsed); and 3) internalizing comorbidity (3 ANX/DEP symptoms endorsed). If children met thresholds for both internalizing and externalizing comorbid conditions ($n = 19$), they were placed in the category with the greater proportion of symptoms endorsed. Twelve of these children were placed in the internalizing comorbidity group and seven in the externalizing comorbidity group.

Services for Children and Adolescents, Parent Interview (SCAPI)—The SCAPI assesses children's and adolescents' mental health service and medication use.¹⁷ The interview was obtained at baseline and 1 year to assess change in utilization. The SCAPI captured participants' use of non-ADHD medications (e.g. for anxiety and depression) since only ADHD medication use was captured through the chart reviews and participants' receipt of therapy. The SCAPI has excellent reliability and validity.¹⁸

Analyses

For all analyses, participants (level 1) were nested within providers (level 2), providers within practice (level 3); three level analyses were performed using Mplus (Version 7.4).¹⁹ Missing data was handled via the default three-level parameter estimation algorithm (MLR) in Mplus.

The first set of analyses focused on children identified with ADHD and treated with medication. Specifically, we evaluated whether the three mental health comorbidity groups (ADHD and no comorbidity, ADHD and internalizing comorbidity, and ADHD and externalizing comorbidity) differed on potential covariates, including race and sex. We also evaluated whether there were group differences in the proportion of youth coming from high (> 50%) Medicaid practices as a proxy for Socioeconomic Status (SES) and/or on ADHD presentation. ADHD presentation was determined using strict cutoffs on the parent Vanderbilt ADHD Rating Scale; 6 endorsed at a 2 "often" or a 3 "very often" in a domain. In terms of physician care, we examined group differences in medication changes, dose of medication, referrals for therapy, and contacts with the physician. Using the SCAPI, we also tested for group differences on non-ADHD medication use and receipt of mental health therapy. Finally, we tested for potential group differences in proportion of days of medication coverage during the 12-month follow-up period.

A second set of analyses focused on determining if participants' ADHD symptom response trajectories in response to medication differed as a function of a comorbid mental health status. For those children diagnosed with ADHD and prescribed medication, we compared

the trajectories of inattention symptoms and hyperactive/impulsive symptoms from baseline to the 12-month follow-up across the three groups. The first step was testing trend components for significance to obtain a properly specified level 1 model. Next, we tested effects at level 2 and level 3 after demonstrating that the level 1 model was properly specified; analyzing the effects of comorbidity type on the total VADPRS score for hyperactivity and inattentive symptoms. Four-level (repeated longitudinal assessments nested within patients, patients nested within providers, care providers nested within practices) mixed models were conducted to assess differences in patient hyperactive symptomology. When inattention was the primary outcome of interest, however, the response variable variance at the provider level was near zero; therefore, a three-level nested model was used to assess differences in inattention symptoms across comorbidity group. Comorbidity group*time interactions were assessed to indicate differences in symptom trajectory over time. Cohen's *d* effect sizes were calculated to compare the magnitude of the change in inattention and hyperactive/impulsive symptoms from baseline to the final follow-up time point for the three groups. Finally, we tested whether the proportion of children who remitted from an ADHD diagnosis by the 12-month follow-up time-point differed across the comorbidity groups. Remittance was defined as the percentage of the sample whose parents/guardians endorsed fewer than six symptoms in both the inattention and hyperactivity/impulsivity domains on the VADPRS at the 12-month follow-up.

RESULTS

A total of 319 charts were extracted for this study; three charts were not reviewed. Of the included 316 participants, 106 children did not have an ADHD diagnosis noted in the chart, 2 children had a diagnosis recorded but were not prescribed medication, and 208 children were diagnosed by the pediatrician with ADHD and prescribed ADHD medication. Two of the medicated children had missing data on psychiatric comorbidity variables at baseline and were excluded from analyses, resulting in an N of 206 for children who were diagnosed with ADHD and prescribed ADHD medication. Mean child age was 7.8 years ($SD = 1.4$). The majority were males ($n = 226$; 72%) and the sample was diverse ($n = 182$; 58% white). This sample was cared for by 89 pediatricians from 23 different practices.

Children who were diagnosed with ADHD and placed on medication did not differ significantly from those who did not receive the diagnosis on prevalence rates of *other* mental health conditions (i.e., no internalizing/externalizing disorders, internalizing only, externalizing only; $\chi^2 = .71$, $p = .71$). As expected, the group not diagnosed with ADHD endorsed significantly fewer ADHD inattention and hyperactive/impulsive symptoms as compared to the ADHD group ($t = -2.42$, $p = .01$ and $t = -2.12$, $p = .03$ respectively). Physicians were more likely to refer children not diagnosed with ADHD for additional assessment ($n = 34$, 31.5%) and mental health treatment ($n = 41$, 38.0%) compared to diagnosed children ($\chi^2 = 8.13$, $p = .004$ and $\chi^2 = 12.32$, $p < .001$ respectively). Subsequent analyses focused on the 206 children with ADHD documented in the chart and who were prescribed ADHD medication.

Mental Health Comorbidity Prevalence

Mental health comorbidity prevalence rates are displayed in Table 1. 103 children (49.5%) who were diagnosed with ADHD and placed on medication did not meet criteria for a comorbidity based on their parent's ratings. In contrast, 44 children (21.1%) had an internalizing comorbidity and 59 children (28.4%) met criteria for an externalizing comorbidity according to parent VADPRS ratings. Group differences on race and sex were not significant and the percentage of participants referred from high Medicaid practices did not differ significantly ($\chi^2 = 4.67, p = .10$). Consistent with the groupings, children in the externalizing comorbid group were most likely to meet criteria for ADHD Combined Presentation (68%), with at least six symptoms of inattention and six symptoms of hyperactivity/impulsivity endorsed on the VADPRS,¹⁴ in comparison to children in the internalizing (48%; $\chi^2 = 3.72, p = .05$) and no comorbidity (36%; $\chi^2 = 26.75, p < .001$) groups. Thirty-seven percent of children in the no comorbidity group met for ADHD Predominately Inattentive Presentation compared to 28% in the internalizing group and 19% of the externalizing group. There were no significant differences in the distribution of Inattentive or Hyperactive/Impulsive Presentations across the three groups (all p 's $> .05$).

Differences in Pediatric Care

For children diagnosed with ADHD, the internalizing, externalizing, and no-comorbidity groups did not differ significantly with regards to demographic characteristics or pediatrician practices with one exception (referral to therapy; see Table 1 for breakdown by comorbid status group). Children had an average of 4.67 ($SD = 1.90$) office visits and 6.65 ($SD = 2.70$) total contacts in the year of care after their diagnosis. In that same period, physicians collected an average of .52 ($SD = 1.28$) parent ratings and .29 ($SD = .80$) teacher ratings with each of their patients.

Overall, physicians referred 38 children (18.3%) diagnosed with ADHD for additional assessment. Additionally, 19.7% ($n = 41$) of the children with ADHD were referred to specialists for therapy. The three mental health comorbidity groups differed significantly, with participants in the internalizing and externalizing groups being significantly more likely to be referred to therapy than the no comorbidity group (see Table 1). However, according to the parent-report on the SCAP, only 18 children (8.7%) actually received mental health therapy during the year after initiating treatment and between group differences were not significant.

Differences in Treatment Response

ADHD Inattention Symptoms—Analyses including all patients diagnosed with ADHD and prescribed medication (practice-level proportion of response variable variance: .04; patient-level proportion of response variable variance: .21; see Figure 1), revealed a significant internalizing*time effect ($b = .008, p = .001$) but no time*externalizing effect ($b < .01, p = .58$) on parent-rated ADHD inattention ratings. Overall, there was a decrease in inattentive symptoms over time in this sample (time $b = -.04, p < .0001$). Children with ADHD who did not have a comorbid mental health condition showed a faster rate of improvement than those who had an internalizing condition (internalizing*time $b = 0.008, p = .001$). In contrast, children with externalizing comorbidities did not differ in their change

of inattentive symptoms over time in comparison to the no mental health comorbidity group ($b < .01$, $p = .58$). There was a significant main effect for the externalizing group ($b = 1.40$, $p < .001$) in comparison to the no comorbidity group. In other words, children with externalizing comorbidities had significantly greater inattention symptoms at all time points in comparison to children with no comorbidities. Cohen's d effect sizes evaluating baseline to the final follow-up change in symptoms of inattention revealed that the no-comorbidity group made the largest gains ($d = 1.19$) followed by the externalizing group ($d = 1.13$) and the internalizing group ($d = .58$).

ADHD Hyperactive/Impulsive Symptoms—Similar to the analyses with inattention, there was a significant internalizing*time effect ($b = .008$, $p = .006$) but no effect for time*externalizing ($b = -.00$, $p = .61$; provider-level proportion of response variable variance: .07; practice-level proportion of response variable variance: .02; patient-level proportion of response variable variance: .29; see Figure 2). There was an overall decrease in symptoms of hyperactivity/impulsivity over time ($b = -.03$, $p < .0001$). The no-comorbidity group also made significantly greater improvements in comparison to the internalizing group over time (internalizing*time $b = 0.008$). There were no differences in hyperactive/impulsive symptom changes over time between the externalizing and no comorbidity groups (time*externalizing $b = -.00$, $p = .61$). However, the externalizing comorbidity group had significantly greater hyperactive/impulsive symptoms at all time points in comparison to the no comorbidity group ($b = 3.97$, $p < .0001$). Cohen's d effect sizes evaluating baseline to 1 year follow-up change in hyperactivity/impulsivity revealed that the externalizing comorbidity group made the largest gains ($d = .73$) followed by the no-comorbidity ($d = .55$) and internalizing groups ($d = .19$).

Finally, whereas 70.8% of children in the no mental health comorbidity group fell below the ADHD diagnostic threshold at follow-up, only 48.1% of the internalizing and 46.5% of the externalizing group had remitted by 1 year ($X^2 = 9.54$, $p = .008$).

DISCUSSION

This study evaluated the presence of comorbid mental health conditions in children referred to community pediatric practices for ADHD-related behavioral concerns. Consistent with previous literature,^{3,20} about half of children receiving care for ADHD met AAP screening criteria for a mental health comorbidity according to the VADPRS. Children who did not receive an ADHD diagnosis had similar comorbidity profiles to those who were diagnosed with ADHD and prescribed medication. Interestingly, physicians referred children they did not diagnose with ADHD for additional assessment and treatment at higher rates than diagnosed children. This suggests that some pediatricians recognized that conditions other than ADHD may be responsible for the patients' behavioral concerns.

Among children diagnosed with ADHD and prescribed medication, physician assessment and treatment behaviors differed little across mental health comorbidity groups (see Table 2). There were no group differences in medication titration practices, including time to first medication change, highest dose assigned, and number of dose changes. One notable exception was that physicians referred youth with ADHD and a comorbid mental health

condition for therapy more often than they referred youth with ADHD and no comorbidities. Further, although not statistically significant, the time to first medication change was shorter by about 1 month for children with ADHD and a comorbid mental health condition. This suggests that physicians may have noticed that symptoms improvement was not as robust as expected and titrated accordingly.

There is some evidence from prior research that children with elevated internalizing symptoms, such as anxiety or depression, benefit from receiving non-stimulant based ADHD medications such as atomoxetine.²¹ However, in this sample, stimulants were by far the frontline medication choice (97.2%) and other medications were rarely used. This is not surprising given that this was a newly-diagnosed sample and children were only followed for 1 year. Leading with stimulants and evaluating response before trying other types of medications is consistent with the AAP guidelines for children newly diagnosed with ADHD. Given that physician care differed little for children with and without mental health comorbidities, it is important to understand whether children with these comorbid conditions were responding to treatment similarly to children with ADHD alone.

ADHD Symptom Response

The mental health comorbidity groups differed substantially in response to ADHD medication. Children with internalizing conditions had a weaker treatment response for their inattention and hyperactive/impulsive symptoms in comparison to children with no comorbidities. Additionally, children with internalizing or externalizing comorbidities had much lower remission rates. Overall, although it appears that ADHD medication was not contraindicated or detrimental given the presence of a moderate response for inattention symptoms, it is clear that the response for children with ADHD and internalizing comorbidities was not sufficient and that other treatment approaches were needed.

These results differ from prior findings suggesting that comorbid anxiety diagnoses do not negatively impact outcomes associated with ADHD medication treatment.^{22,23} These differences may be explained by the fact that the MTA medication management protocol was complex, and involved regular collection of rating scales, frequent visits with physicians for medication titration, and the use of “best dose” algorithms.²⁴ This level of care is rarely achieved in community settings,^{25,26} and these care differences may have significant implications for outcomes.²⁷ For example, in the medication only group in the MTA, the average highest stimulant dose was 32.8 mg/day,¹¹ as compared to the average highest dose in our sample of 23 mg/day. To the best of our knowledge, the present study is the first to evaluate the impact of internalizing comorbid conditions on treatment response under typical community ADHD treatment conditions.

Clinical Implications

AAP ADHD guidelines recommend that in the presence of other mood and anxiety conditions, physicians should refer children to specialists for additional assessment and/or treatment of comorbidities.⁶ In this sample, less than a third of children diagnosed with ADHD who screened positive for a comorbid mental health condition were referred for additional assessment or treatment. This suggests that although physicians in this

community sample were screening and accurately recognizing the presence of psychiatric comorbidities in some cases, there is room for improvement. Accurate assessment is important because without additional evaluation, difficulties with attention and concentration may be mistakenly attributed to ADHD rather than to the presence of anxiety or depression.

Although some children in the sample were referred to therapy (e.g. around 30% of internalizing group), there are numerous barriers to receiving multi-modal care in many communities that physicians cannot control.²⁸ Indeed, data collected from the service utilization interviews in this sample suggests that only a small proportion of those referred actually received therapy. As such, most children with ADHD and an internalizing comorbidity in the sample were not receiving evidence-based care. This indicates that better screening and assessment by community pediatricians is not enough. Improvements in care for children with ADHD and comorbid mental health conditions must include increased access to therapy and increased family support to fulfill referrals to therapy.

Limitations

This study's primary limitation is the reliance on chart reviews and parent-completed standardized rating scales. Lacking diagnostic interviews, it is unknown how many of the children who screened positive for a comorbid mental health condition with the VADPRS would actually meet full diagnostic criteria. Further, comorbid internalizing status was based upon parent ratings when children are thought to be the best reporters of their own internalizing symptoms.^{29,30} Additionally, when extracting information from medical charts, minimal patient level data were obtained other than race and sex. Accordingly, differences in symptom trajectories may be explained by patient level factors not measured in this study, such as parental education level, mental health, and stress, or child intelligence or achievement scores or learning disability status. This is important because learning, physical, or developmental disabilities may influence ADHD diagnosis and treatment.^{31,32} Further, although mental health comorbidity rates were not different across high and low Medicaid-serving practices, data about insurance type or SES were not available at the patient level to be considered as a covariate. This is important to note as past studies have documented that SES can influence ADHD treatment outcomes.³³

Another limitation is that only parent ratings were evaluated in this study. Best-practice guidelines note the importance of collecting teacher ratings in addition to parent ratings as medication effects may be more robust in school settings.⁶ Thus, future research would benefit from the inclusion of teacher perspectives in evaluating response to treatment based upon comorbid condition status. Further, although the pediatric practices in this study were diverse in terms of the urban, rural, and suburban locations and the socioeconomic backgrounds of patients, they were all recruited from the same geographic region in the Midwest. Physician care behaviors are known to vary across geographic locations in the United States.³⁴ It is important to note that the period of data collection corresponded with the release of the 2011 AAP ADHD guidelines which could have influenced care. However, ADHD care behaviors, as outlined as best practice in the guidelines, remained low throughout the study period in the control group, with an average of .54 parent rating scales and .26 teacher rating scales collected per participant throughout the year. Additionally,

previous research indicates that the release of guidelines alone does not typically impact care in a significant way.^{35,36}

Finally, all practices volunteered to participate in this web-based quality improvement (QI) study, and thus, results may not generalize to all community practices. These practices all received the QI intervention two years after data collection, which included training sessions for providers focused on evidence-based ADHD care per AAP guidelines.⁶ A previous cluster-randomized trial design demonstrated significant improvements in ADHD assessment and treatment behaviors following this QI intervention.³⁷

Conclusions

The present study is novel in that, to date, research in this area has focused on physicians' adherence to AAP ADHD guidelines broadly,^{37,38} treating all children with ADHD as a single group. Findings from the present study suggest that future research and clinical practice guidelines should pay careful attention to comorbidity in the treatment of ADHD. Specifically, half of the children seen for ADHD-related behavioral concerns in this community sample met AAP screening criteria for a comorbid condition. Among those, children with internalizing comorbidities exhibited a less robust response to ADHD medication. These findings highlight the importance of physicians screening for comorbid conditions when evaluating children for the presence of ADHD. Additional research is needed to focus on specific reasons why children with comorbid conditions may respond differently to ADHD medication. The study also highlights the need for children with ADHD and comorbid internalizing conditions to receive evidence-based multi-modal therapy including medication and therapy. Further work is needed to both improve provider care behaviors and to enhance the availability of effective treatments in community settings.

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Figure 1.
ADHD Inattention Symptom Trajectories by Comorbid Condition Status

Figure 2.
ADHD Hyperactive/Impulsive Symptom Trajectories by Comorbid Condition Status

Table 1

Comparison of Demographic and Pediatric Care Practices across Comorbidity Groups for Children Diagnosed with ADHD and Prescribed Medication

	Groups				Group differences			
	No-comorbidity (N = 103)		Internalizing Comorbidity (N = 44)		Externalizing Comorbidity (N = 59)			
	N	%	N	%	N	%	χ^2	P
Male	80	77.7	30	68.2	45	76.3	1.54	.46
Race							6.84	.55
White	66	64.1	28	63.6	31	52.5		
African American	20	19.4	9	20.5	20	33.9		
Other	17	16.5	7	15.9	8	13.6		
Referred for Therapy	12	11.7	13	29.5	16	27.1	8.89	.012*
Receipt of Therapy	7	6.8	5	11.4	6	10.2	1.67	.44
Non-ADHD medication	0	.00	1	2.2	1	1.6	2.47	.29
Referred for Assessment	22	21.4	7	15.9	9	15.3	1.17	.56
Office visits ¹	M	SD	M	SD	M	SD	Estimate	P
	4.42	1.78	4.61	2.16	4.77	2.04	-.06	.68
Contacts ²	6.27	2.82	6.70	2.80	6.74	2.65	-.11	.76
Number of parent ratings ³	.56	1.33	.52	1.44	.34	.93	-.05	.89
Number of teacher ratings ⁴	.26	.74	.27	.79	.28	.73	-.02	.95
Proportion of days medicated	.55	.25	.52	.29	.55	.23	.33	.48
Highest dose (milligrams)	23.39	9.88	22.80	10.31	23.27	9.42	-.33	.76
Days to 1 st med change	93.80	90.55	63.88	58.45	72.83	77.08	-11.22	.48
Dose changes	.97	.93	.89	.99	1.04	1.05	-.04	.65

Note.

* Associations significant at the $p < .05$ level;** Associations significant at the $p < .01$;¹ Number of total office visits during treatment;² Number of total contacts includes number of office visits and phone contacts during the year of treatment after diagnosis;

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- 3. Number of parent ratings obtained for treatment purposes over the course of the year;
- 4. Number of teacher ratings obtained for treatment purposes over the course of the year;
- 5. Sum Vanderbilt scores on each subscale at initial timepoint;
- 6. Total number of symptoms endorsed for each ADHD presentation at initial timepoint