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# Cardiac Screening Prior to Stimulant Treatment of ADHD: A Survey of US-Based Pediatricians

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# Cardiac Screening Prior to Stimulant Treatment of ADHD: A Survey of US-Based Pediatricians

**WHAT'S KNOWN ON THIS SUBJECT:** Over the past decade, drug oversight committees and professional organizations have debated the evidence regarding cardiac screening to identify undiagnosed disorders associated with sudden cardiac death in youth with attention-deficit/hyperactivity disorder before beginning treatment with stimulants.

**WHAT THIS STUDY ADDS:** How practicing pediatricians have responded to this controversy is not known. We present results from a national sample of pediatricians regarding current attitudes, barriers, and practices for cardiac screening in youth with attention-deficit/hyperactivity disorder before prescribing stimulants.


## abstract

**OBJECTIVES:** To determine pediatricians' attitudes, barriers, and practices regarding cardiac screening before initiating treatment with stimulants for attention-deficit/hyperactivity disorder.

**METHODS:** A survey of 1600 randomly selected, practicing US pediatricians with American Academy of Pediatrics membership was conducted. Multivariate models were created for 3 screening practices: (1) performing an in-depth cardiac history and physical (H & P) examination, (2) discussing potential stimulant-related cardiac risks, and (3) ordering an electrocardiogram (ECG).

**RESULTS:** Of 817 respondents (51%), 525 (64%) met eligibility criteria. Regarding attitudes, pediatricians agreed that both the risk for sudden cardiac death (SCD) (24%) and legal liability (30%) were sufficiently high to warrant cardiac assessment; 75% agreed that physicians were responsible for informing families about SCD risk. When identifying cardiac disorders, few (18%) recognized performing an in-depth cardiac H & P as a barrier; in contrast, 71% recognized interpreting a pediatric ECG as a barrier. When asked about cardiac screening practices before initiating stimulant treatment for a recent patient, 93% completed a routine H & P, 48% completed an in-depth cardiac H & P, and 15% ordered an ECG. Almost half (46%) reported discussing stimulant-related cardiac risks. Multivariate modeling indicated that ≥1 of these screening practices were associated with physicians' attitudes about SCD risk, legal liability, their responsibility to inform about risk, their ability to perform an in-depth cardiac H & P, and family concerns about risk.

**CONCLUSIONS:** Variable pediatrician attitudes and cardiac screening practices reflect the limited evidence base and conflicting guidelines regarding cardiac screening. Barriers to identifying cardiac disorders influence practice. *Pediatrics* 2012;129:222–230



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**KEY WORDS**

attention-deficit/hyperactivity disorder, stimulants, sudden cardiac death, pediatrics, electrocardiogram


**ABBREVIATIONS**

AAP—American Academy of Pediatrics
ADHD—attention-deficit/hyperactivity disorder
CI—confidence interval
ECG—electrocardiogram
H & P—history and physical
OR—odds ratio
SCD—sudden cardiac death


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The past decade has witnessed an increased focus on the identification of risk factors for undiagnosed heart disease, which may predispose children and adolescents (hereafter "children") to sudden cardiac death (SCD). This focus recently extended to children initiating treatment with stimulant medications for attention-deficit/hyperactivity disorder (ADHD). The possibility of a stimulant medication triggering SCD in children with unidentified heart disease garnered national attention after the release in 2004 of postmarketing reports of SCD in pediatric patients with ADHD who were taking Adderall XR. In 2006, 2 US Food and Drug Administration committees, the Drug Safety and Risk Management Advisory Committee and the Pediatric Advisory Committee, reviewed the reports of cardiac problems associated with stimulants and drew different conclusions about the potential SCD risk; however, the US Food and Drug Administration–approved package inserts for stimulant medication recommended physicians screen patients and families for "heart problems, heart defects, or high blood pressure."[1] Two years later, the American Heart Association released a policy statement widely interpreted as recommending the routine use of electrocardiograms (ECGs) (class IIa, level of evidence C) to evaluate children before beginning treatment with stimulant medication.[2] Subsequently, the American Academy of Pediatrics (AAP) and the American Heart Association published a joint statement, endorsed by the American Academy of Child and Adolescent Psychiatry, revising the American Heart Association's original recommendation of the ECG. Instead, the joint statement established that pediatricians should conduct in-depth cardiac history and physicals (H & P) evaluation before beginning stimulant treatment and obtain ECGs for those children with positive findings.[3] Then, the AAP independently stated that medications used to treat ADHD had not been shown to cause SCD, and sufficient evidence for obtaining routine ECGs before starting treatment with stimulants was unavailable.[4] The AAP concluded that "until these questions are answered, a recommendation to obtain routine ECGs for children receiving ADHD medications is not warranted."[4]

The debate about pediatric practice standards regarding SCD risk associated with stimulant use continues in the medical literature and popular media.[5] A recent case-control study revealed that there may be an increased rate of SCD in children taking stimulants.[6] In contrast, a recent study comparing cardiac events in children treated with ADHD medications with cardiac events in untreated children showed no significant difference between the groups.[7] Some have advocated the addition of an ECG to an in-depth cardiac H & P as an effective and inexpensive screening tool. In a recent pilot study of ECG screening by Vetter et al,[8] ECGs were found to be a useful tool for discovering previously unidentified cardiac disorders but also generated large numbers of nonspecific findings. Others caution that routine ECGs could have multiple unintended consequences, including overdiagnosis, overtreatment, and over-referral to a limited pool of pediatric cardiologists[9] caused by nonspecific and false-positive findings within the current, strained health care system.[10–12] In addition, a nonspecific ECG finding can aggravate familial uncertainty and anxiety. Most physicians attempt to balance the effects of parent and patient uncertainty about an abnormal ECG with the risk of a cardiac event or SCD.

Little is known about pediatricians' current cardiac screening practices before initiating treatment with stimulants in children with ADHD. We undertook this study to elucidate US pediatricians' attitudes regarding cardiac risks of ADHD treatment, barriers to identifying cardiac disorders in children regardless of ADHD status, and current cardiac screening practices for children with ADHD.

## METHODS

### Participants

Participants were a national, randomly selected sample of 1600 members from the AAP's ~65 000 members. To be eligible, respondents had to provide direct patient care to children between the ages of 5 and 17 years old with ADHD. Exclusion criteria included (1) non–U.S.-based, (2) retired, and (3) trainee (resident/fellow).

### Procedures

Data were collected through a cross-sectional, self-administrated survey (Supplemental Information) developed by study investigators with consultation from the AAP's department of research. After institutional review board approval and pilot testing, the survey was distributed by using 3 rounds of alternating mailings (ie, hard copy, electronic [using www.surveymonkey.com], hard copy) sent at 3-week intervals from September to December 2010. Subjects who did not return surveys after 3 weeks from the final mailing were designated nonresponders (Fig 1).

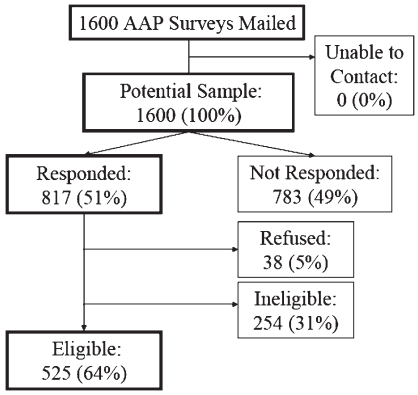


**FIGURE 1**
Survey response.

### Measures

The 26-question survey addressed (1) demographics and setting characteristics, (2) attitudes about initiating treatment with stimulants and the perceived cardiac risks, (3) barriers to identifying cardiac disorders in children regardless of ADHD status, and (4) screening practices for a recent patient with ADHD for whom stimulant treatment was considered.

### Independent Variables

Independent variables were operationalized based on physicians' responses to items on demographic and setting characteristics, attitudes about initiating treatment with stimulants and perceived cardiac risks, and barriers to identifying cardiac disorders regardless of ADHD status.

### Dependent Variables

We created 3 binary-dependent (ie, outcome) variables characterizing cardiac screening practices: (1) performing an in-depth cardiac H & P (primary dependent variable), defined as examining pulse, blood pressure, jugular blood pressure, and performing auscultation;[13] (2) discussing the potential stimulant-related cardiac risks with the patient and family (hereafter "family"); and (3) ordering an ECG. These variables were based on the physician's recall of the most recent patient seen for whom stimulants were considered for the treatment of ADHD. Other surveys have successfully used this most recent patient methodology,[14,15] which helps to anchor the respondent's thinking to a particular patient rather than general concepts of practice.

### Statistical Analysis

Descriptive statistics were used to describe independent variables (ie, demographic and setting characteristics, attitudes, and barriers) and the 3 dependent variables. Based on the distribution of results, the 4-level response set for questions about attitudes was collapsed into "agree" ("strongly agree" and "agree") versus "disagree" ("strongly disagree" and "disagree"), whereas the 3-level response set for questions about barriers was collapsed into "barrier" (including "minor barrier" and "major barrier") versus "not a barrier."

Bivariate analyses using logistic regression were done to test associations between (1) demographic and setting characteristics and attitudes and barriers; and (2) demographic and setting characteristics, attitudes, and barriers, and the 3 dependent variables.

Separate multivariate logistic models were created for each dependent variable. Independent variables that were associated with the dependent variable at an $\alpha$ level of .05 were considered for inclusion along with physician gender and race/ethnicity, years in practice, practice setting, and prespecified interaction terms. Age was not included because it was collinear with years in practice. Physicians were classified as non-Hispanic/white versus all other ethnicities and races, based on their responses to separate questions in the survey about ethnicity and race. Years in practice and visits per week were continuous variables, but because they were categorized to ease interpretation. Backward-selection model-building procedures, with an exit criterion of $\alpha >$ .05, were used to create a model for each dependent variable.

All calculations were performed using SAS software, Version 9.2 (SAS Institute, Inc, Cary, NC). Odds ratios (ORs) were reported for both bivariate and multivariate analyses. The $\alpha$ level was set to .01 to account for multiple comparisons, and 99% confidence intervals (CIs) were reported for the ORs.

## RESULTS

### Sample Characteristics

Eight hundred seventeen pediatricians (51.0%) responded to the survey (Fig 1), with 94.1% completing the mailed version and 5.9% completing the electronic version. Nonrespondents and respondents did not differ by age or gender (data not shown). Of respondents, 525 (64.3%) met eligibility criteria; those not meeting criteria were mostly subspecialists who did not provide direct care for children with ADHD. All analyses reported focus on eligible respondents.

Most respondents were female, non-Hispanic/white, and practicing for an average of 17.5 years (SD = 10.2) (Table 1). General pediatrics (86.9%) was the predominant clinical area. Most worked in private practice (81.6%); approximately half were suburban (56.8%). More than half (61.5%) reported seeing 50% or more children with private insurance. The mean number of outpatient visits per week was 91.5 (SD = 45.9). Respondents indicated interest in further education regarding the risks and benefits of ADHD treatment (n = 341, 65.0%) and the evaluation of children for cardiac disorders associated with SCD (369, 70.3%).

### Attitudes About Stimulants and Cardiac Risk

Only 23.5% of physicians agreed that the risk of SCD was sufficiently high to warrant cardiac assessment before initiating treatment with stimulants, whereas 29.8% agreed the risk for potential legal liability was sufficiently high to warrant cardiac assessment (Table 1). Most (74.6%) agreed that physicians have a responsibility to inform families about the risk of SCD before initiating treatment with stimulants. Approximately one-third (35.8%) agreed that family knowledge of SCD risk would unnecessarily deter use of stimulants.

**TABLE 1** Bivariate Analyses of Demographics and Setting Characteristics by Attitudes and Barriers

| Variable | Attitudes About Stimulants and Cardiac Risks | | | | | Barriers to Identifying Cardiac Disorders | |
|---|---|---|---|---|---|---|---|
| | Overall, *n* (%) | Sufficient SCD Risk | Legal Liability | Responsibility To Inform Family | Family Knowledge Deters Use | Ability To Perform Cardiac H & P | Ability To Interpret ECG |
| Overall, *n* (%) | 525 | 121 (23.5) | 154 (29.8) | 387 (74.6) | 185 (35.8) | 92 (17.8) | 365 (70.7) |
| Physician gender | | | | | | | |
| Male | 235 (45.7) | 2.2 (1.2–3.8)** | 1.7 (1.0–2.8)** | 2.2 (1.3–3.8)** | 0.7 (0.5–1.2) | 0.5 (0.3–1.0)** | 0.6 (0.3–1.0)** |
| Female | 279 (54.3) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Race/ethnicity | | | | | | | |
| Non-Hispanic/white | 379 (75.4) | 2.0 (1.1–3.6)** | 2.5 (1.4–4.4)** | 1.3 (0.7–2.4) | 1.2 (0.7–2.0) | 0.5 (0.3–0.9)** | 0.6 (0.3–1.2)* |
| Other | 124 (24.7) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Years in practice | | | | | | | |
| <9 y | 132 (25.9) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| 10–16 y | 135 (26.5) | 1.5 (0.7–3.0) | 1.1 (0.5–2.1) | 1.4 (0.6–3.1) | 0.8 (0.4–1.6) | 1.0 (0.5–2.3) | 0.8 (0.4–1.7) |
| 17–25 y | 119 (23.3) | 2.0 (0.9–4.4)* | 1.6 (0.8–3.3) | 2.7 (1.2–6.0)** | 0.4 (0.2–0.9)** | 0.9 (0.4–2.0) | 0.8 (0.4–1.7) |
| >25 y | 124 (24.3) | 2.2 (1.0–4.8)* | 1.4 (0.7–2.9) | 2.4 (1.1–5.4)** | 0.6 (0.3–1.1)* | 1.1 (0.5–2.5) | 0.7 (0.3–1.4) |
| Practice setting | | | | | | | |
| Private practice | 395 (81.6) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Community health center | 37 (7.6) | 0.9 (0.3–2.6) | 1.1 (0.4–3.0) | 0.8 (0.3–2.3) | 2.3 (0.8–6.7)* | 2.0 (0.7–5.6) | 1.8 (0.6–5.4) |
| General hospital | 10 (2.1) | 0.6 (0.1–3.8) | 0.2 (0.0–1.3)* | 0.3 (0.0–4.4) | 1.0 (0.2–5.1) | 0.6 (0.0–9.0) | 1.7 (0.2–13.3) |
| Academic medical center | 42 (8.7) | 0.9 (0.3–2.4) | 1.0 (0.4–2.6) | 0.4 (0.1–1.4) | 1.4 (0.6–3.4) | 1.8 (0.7–4.9) | 0.9 (0.4–2.3) |
| Practice location | | | | | | | |
| Urban | 159 (31.2) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| Suburban | 289 (56.8) | 1.4 (0.8–2.6) | 1.2 (0.7–2.0) | 1.1 (0.6–2.0) | 1.1 (0.6–1.8) | 0.7 (0.4–1.3) | 1.5 (0.8–2.6) |
| Rural | 61 (12.0) | 1.6 (0.6–4.1) | 1.0 (0.4–2.3) | 1.5 (0.6–3.4) | 1.2 (0.5–2.7) | 0.7 (0.3–2.0) | 0.8 (0.3–1.7) |
| Patient insurance | | | | | | | |
| ≥ 50% of patients with private insurance | 306 (61.5) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| > 50% with public, other, or no insurance | 192 (38.6) | 0.9 (0.5–1.5) | 0.8 (0.5–1.3) | 1.0 (0.6–1.7) | 1.0 (0.6–1.7) | 2.2 (1.2–4.2)** | 0.8 (0.5–1.4) |
| Outpatient visits per week | | | | | | | |
| ≤60 | 139 (28.7) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) | 1 (reference) |
| 61–90 | 105 (21.7) | 1.2 (0.6–2.7) | 2.4 (1.1–5.2)** | 1.7 (0.7–3.7) | 0.5 (0.2–1.0)** | 0.6 (0.2–1.5) | 0.8 (0.4–1.8) |
| 91–120 | 141 (29.1) | 1.4 (0.7–2.9) | 1.8 (0.9–3.4)* | 1.7 (0.8–3.6) | 0.6 (0.3–1.1)* | 0.9 (0.4–1.9) | 0.8 (0.4–1.6) |
| >120 | 99 (20.5) | 1.0 (0.5–2.2) | 1.2 (0.6–2.4) | 3.0 (1.4–6.6)** | 0.5 (0.3–1.1)* | 0.8 (0.3–2.0) | 0.9 (0.4–1.9) |

Data are OR (99% CI) unless indicated otherwise. "Agree" includes both "agree" and "strongly agree"; barrier includes "minor" and "major" barriers. Missing data were not included in the denominator. Variable definitions: sufficient SCD risk, sufficient SCD risk to warrant cardiac screening; legal liability, sufficient risk of legal liability to warrant cardiac screening; responsibility to inform family, it is the physician's responsibility to inform the patient and family of the risk of SCD before initiating treatment with stimulants; ability to perform cardiac H & P, the ability to perform an in-depth cardiac H & P is a barrier to identifying cardiac disorders; ability to interpret ECG, ability to interpret a pediatric ECG is a barrier to identifying cardiac disorders.

* $P < .05$.

** $P \leq .01$;

## Barriers to Identifying Cardiac Disorders

When asked about barriers to identifying cardiac disorders in children regardless of ADHD status, almost one-fifth (17.8%) recognized their own ability to perform an in-depth cardiac H & P as a barrier (Table 1). In contrast, 70.7% reported that their ability to interpret a pediatric ECG was a barrier. Other barriers included a lack of specialists in their geographic area (18.0%), the waiting period to see qualified specialists (37.1%), and families' inability to pay for needed care (51.7%, data not shown).

## Screening Practices for a Recent Patient With ADHD

For the primary dependent variable, 48.4% (254) reported completing an in-depth cardiac H & P, whereas almost all physicians (487, 92.8%) reported completing a routine H & P, and 70.7% (371) conducted an in-depth cardiac history. Less than half (240, 45.7%) reported discussing cardiac risks associated with stimulants with families (second dependent variable). By contrast, almost all physicians (487, 92.8%) mentioned weight loss/appetite suppression as a side effect, 86.7% (455) warned of sleep disturbance, and 74.7% (392) discussed affective symptoms (eg, moodiness, irritability, suicidality). Other commonly discussed side effects included exacerbation or precipitation of tics (270, 51.4%) and delays in linear growth (218, 41.5%).

Only 77 physicians (14.7% of respondents) ordered an ECG (third dependent variable). Of these, 42 (54.6%) reported ordering an ECG because it was the prevailing practice at their practice setting; approximately one-fourth (19, 24.7%) ordered an ECG because of clinical indications. Sixteen physicians (20.8%) reviewed the ECG themselves,

and the remaining 61 received results from another health care professional.

Although these 3 dependent variables were associated with one another, they did not closely overlap in terms of practices endorsed (Fig 2, Table 2). Of those who performed an in-depth cardiac H & P, 61.4% discussed cardiac risks and 22.1% ordered an ECG. Almost all (94.6%) of the most recent patients seen were recommended for stimulant treatment regardless of cardiac screening status.

## Bivariate Relationships

Table 1 presents bivariate relationships between sample characteristics and attitudes and barriers; several were significant at an $\alpha$ of .01. Compared with female physicians, male physicians were more likely to agree "there is a sufficient SCD risk in children" (OR: 2.2; 99% CI: 1.2–3.8), "there is sufficient legal liability to warrant cardiac assessment" (OR: 1.7; 99% CI: 1.0–2.8), and that "it is the physician's responsibility to inform families of SCD risk" (OR: 2.2; 99% CI: 1.3–3.8); men were less likely to recognize their ability to perform an in-depth cardiac H & P (OR: 0.5; 99% CI: 0.3–1.0) and to interpret a pediatric ECG (OR: 0.6; 99% CI: 0.3–1.0) as barriers to identifying cardiac disorders in children regardless of ADHD status. Non-Hispanic/white physicians were more likely to agree that there is sufficient SCD risk (OR: 2.0; 99% CI: 1.1–3.6) and legal liability (OR: 2.5; 99% CI: 1.4–4.4) to warrant cardiac assessment; non-Hispanic/white physicians were less likely to report performing an in-depth cardiac H & P as a barrier (OR: 0.5; 99% CI: 0.3–0.9).

Table 2 reveals bivariate relationships between sample characteristics, attitudes, and barriers and the 3 dependent variables. Attitudes regarding sufficient SCD risk to warrant cardiac assessment, sufficient legal liability to warrant cardiac assessment, and physicians' responsibility to inform families of SCD risk were associated positively with all 3 dependent variables (see Table 2 for ORs). Physicians who responded that family knowledge of SCD risk would unnecessarily deter stimulant use were less likely to perform an in-depth cardiac H & P (OR: 0.6; 99% CI: 0.4–1.0) or discuss stimulant-related cardiac side effects (OR: 0.4; 99% CI: 0.2–0.6). Physicians who recognized performing an in-depth cardiac H & P as a barrier to identifying cardiac disorders were less likely to perform one (OR: 0.4; 99% CI: 0.2–0.8).

## Multivariate Modeling of 3 Dependent Variables

Three models were constructed (Table 3). For the model examining performing an in-depth cardiac H & P, 2 attitudes were positively associated: sufficient legal liability to warrant cardiac assessment (OR: 2.3; 99% CI: 1.3–4.0) and the physician's responsibility to inform families of SCD risk (OR: 1.8; 99% CI: 1.0–3.1). Recognizing the ability to perform an in-depth cardiac H & P as a barrier remained negatively associated with performing one (OR: 0.3; 99% CI: 0.2–0.7) on multivariate modeling. The dependent variable for the second model was discussing stimulant-related cardiac side effects, and 2 attitudes were positively associated: agreement that there is sufficient SCD risk to warrant cardiac assessment (OR: 2.4; 99% CI: 1.3–4.6), and that it is the physician's responsibility to inform families of SCD risk (OR: 11.8; 99% CI: 5.1–27.8). In contrast, the attitude that family knowledge of SCD will unnecessarily deter stimulant use (OR: 0.5; 99% CI: 0.3–0.8) was negatively associated. The third model showed that ordering an ECG was positively associated with the attitude that legal liability is sufficiently high to warrant cardiac assessment (OR: 8.4; 99% CI: 4.0–17.6).

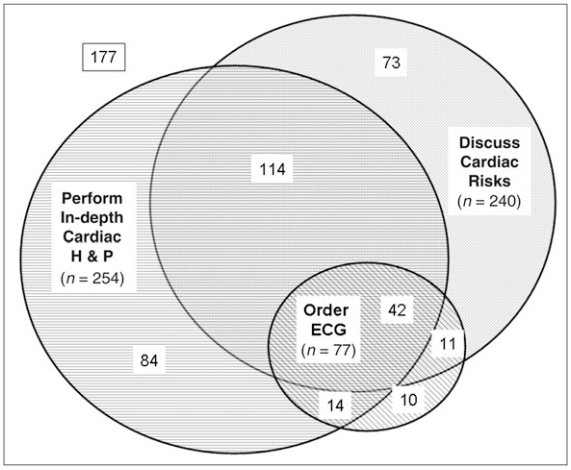


**FIGURE 2**
Overlap of screening practices of most recent patient seen; $N = 525$.

## DISCUSSION

This national, randomly selected sample of pediatricians provides current attitudes, barriers, and practices for cardiac screening in children with ADHD for whom the use of stimulants is being considered. Respondent demographic (age and gender) and setting characteristics resembled results from recent AAP Periodic Surveys,[16] suggesting that this group was a representative sample of AAP members.

Although almost all pediatricians conducted a routine H & P, just more than two-thirds performed an in-depth

**TABLE 2** Associations Between Demographics and Setting Characteristics, Attitudes and Barriers, and Cardiac Screening Practices of Most Recent Patient Seen

| Independent Variable | Overall, *n* (%) | Performed Cardiac H & P | Discussed Cardiac Risks | Ordered ECG |
|---|---|---|---|---|
| Overall, *n* (%) | 525 | 254 (48.4) | 240 (45.7) | 77 (14.7) |
| Demographics and setting characteristics | | | | |
| Physician gender | | | | |
| Male | 235 (45.7) | 1.0 (0.6–1.6) | 0.7 (0.5–1.2) | 0.8 (0.4–1.5) |
| Female | 279 (54.3) | 1 (reference) | 1 (reference) | 1 (reference) |
| Race/ethnicity | | | | |
| Non-Hispanic/white | 379 (75.4) | 0.9 (0.5–1.5) | 1.1 (0.7–1.9) | 1.0 (0.5–2.0) |
| Other | 124 (24.7) | 1 (reference) | 1 (reference) | 1 (reference) |
| Years in practice | | | | |
| <9 y | 132 (25.9) | 1 (reference) | 1 (reference) | 1 (reference) |
| 10–16 y | 135 (26.5) | 0.8 (0.4–1.5) | 1.4 (0.7–2.7) | 1.6 (0.6–4.0) |
| 17–25 y | 119 (23.3) | 0.6 (0.3–1.1)* | 0.6 (0.3–1.2)* | 1.9 (0.7–4.7) |
| >25 y | 124 (24.3) | 0.5 (0.3–1.0)** | 1.0 (0.5–1.9) | 0.9 (0.3–2.6) |
| Practice setting | | | | |
| Private practice | 395 (81.6) | 1 (reference) | 1 (reference) | 1 (reference) |
| Community health center | 37 (7.6) | 1.2 (0.5–3.0) | 1.4 (0.6–3.5) | 1.2 (0.4–4.2) |
| General hospital | 10 (2.1) | 1.6 (0.3–8.6) | 0.5 (0.1–3.2) | 3.7 (0.5–25.3) |
| Academic medical center | 42 (8.7) | 1.1 (0.5–2.4) | 2.0 (0.8–4.7)* | 2.2 (0.8–6.1)* |
| Attitudes about stimulants and cardiac risk | | | | |
| Sufficient SCD risk | 121 (23.5) | 1.8 (1.1–3.2)** | 2.9 (1.7–5.1)** | 4.7 (2.4–9.2)** |
| Legal liability | 154 (29.8) | 2.2 (1.3–3.7)** | 2.6 (1.6–4.4)** | 8.2 (4.0–16.6)** |
| Responsibility to inform family | 387 (74.6) | 2.1 (1.2–3.5)** | 14.3 (6.3–32.7)** | 2.7 (1.1–6.6)** |
| Family knowledge deters use | 185 (35.8) | 0.6 (0.4–1.0)** | 0.4 (0.2–0.6)** | 1.0 (0.5–2.0) |
| Barriers to identifying cardiac disorders | | | | |
| Ability to perform cardiac H & P | 92 (17.8) | 0.4 (0.2–0.8)** | 0.8 (0.4–1.4) | 2.1 (1.0–4.4)* |
| Ability to interpret ECG | 365 (70.7) | 0.8 (0.5–1.3) | 0.9 (0.5–1.5) | 1.1 (0.5–2.2) |
| Screening practices | | | | |
| Performed in-depth cardiac H & P | 254 (48.4) | 1 (reference) | 3.5 (2.2–5.7)** | 3.0 (1.5–6.0)** |
| Discussed cardiac risks | 240 (45.7) | 3.5 (2.2–5.7)** | 1 (reference) | 2.7 (1.4–5.4)** |
| Ordered ECG | 77 (14.7) | 3.0 (1.5–6.0)** | 2.7 (1.4–5.4)** | 1 (reference) |

Data are OR (99% CI) unless indicated otherwise. "Agree" includes both "agree" and "strongly agree"; barrier includes "minor" and "major" barriers. Missing data were not included in the denominator. Variable definitions: sufficient SCD risk, sufficient SCD risk to warrant cardiac screening; legal liability, sufficient risk of legal liability to warrant cardiac screening; responsibility to inform family, it is the physician's responsibility to inform the patient and family of the risk of SCD before initiating stimulants; ability to perform cardiac H & P, the ability to perform an in-depth cardiac H & P is a barrier to identifying cardiac disorders; ability to interpret ECG, ability to interpret a pediatric ECG is a barrier to identifying cardiac disorders.

* $P < .05$.

** $P \leq .01$;

cardiac history, and slightly less than half performed an in-depth cardiac H & P. Only 14.6% ordered ECGs for their most recent patient, with one-half of pediatricians ordering ECGs because of prevailing practices in their practice setting, rather than clinical indication. Multivariate modeling identified several attitudes and barriers associated with these practices. Legal liability and physician responsibility to inform families of SCD risk were positively associated with an in-depth cardiac H & P, whereas barriers in ability to perform an in-depth cardiac H & P (16.8%) were negatively associated.

Discussing cardiac risks was associated with physician responsibility and perception of significant cardiac risk. Interestingly, on modeling, pediatricians who were concerned families would be unnecessarily deterred from using stimulants were less likely to discuss their risks. The belief that legal liability is sufficiently high to warrant cardiac assessment was positively associated with ordering an ECG.

Our data indicate several areas of concern. First, findings suggest significant attitude and resulting practice variation. Of note, legal liability concerns drove alternative cardiac screening practices for a number of pediatricians. Although there have been no recent media reports of SCD in children taking stimulant medications, the medicolegal implications of publicized court cases after SCD in adolescent athletes[17] weigh heavily on physician decision-making. Given the disparate approaches recommended by national experts, this result indicates an urgent need for data clarifying the risk of SCD with stimulant medications.

It also suggests the role of malpractice in determining clinical approaches. Malpractice standards vary by state, with approximately half having physician-based (ie, actions of other physicians) standards and the other half having objective patient-based standards (ie, "a reasonable person in the patient's position would be likely to attach significance to the risk or cluster of risks in deciding whether or not to forego the proposed therapy").[18] Physician knowledge of malpractice standards was beyond the scope of our study, and its role in clinical assessments warrants future research. From our survey, only 14.7% of pediatricians ordered an ECG, suggesting that it is not a common screening practice.

Second, although only a quarter of respondents felt that SCD risk was sufficiently high to warrant cardiac assessments, three-fourths agreed the physician was responsible for informing families about SCD risk. In fact, almost one-half of respondents reported discussing stimulant-related cardiac risks. Notably, discussion of stimulant-related cardiac risks closely paralleled discussion of linear growth effects of

**TABLE 3** Multivariate Logistic Regression Models Explaining 3 Cardiac Screening Practices

| Independent Variable | Model 1: Performed Cardiac H & P[a] | Model 2: Discussed Cardiac Risks[b] | Model 3: Ordered ECG[c] |
|---|---|---|---|
| Demographics | | | |
| Years in practice | Did not reach model selection criterion | | |
| <9 y | — | 1 (reference) | 1 (reference) |
| 10–16 y | — | 1.8 (0.9–3.8)* | 1.7 (0.6–4.7) |
| 17–25 y | — | 1.0 (0.5–2.2) | 2.7 (1.0–7.5)* |
| >25 y | — | 1.7 (0.8–3.7) | 1.1 (0.4–3.3) |
| Attitudes about stimulants and cardiac risk | | | |
| Sufficient SCD risk | Did not reach model selection criterion | 2.4 (1.3–4.6)** | Did not reach model selection criterion |
| Legal liability | 2.3 (1.3–4.0)** | Did not reach model selection criterion | 8.4 (4.0–17.6)** |
| Responsibility to inform family | 1.8 (1.0–3.1)** | 11.8 (5.1–27.8)** | Did not reach model selection criterion |
| Family knowledge deters use | Excluded from model because not bivariate significant | 0.5 (0.3–0.8)** | Excluded from model because not bivariate significant |
| Barriers to identifying cardiac disorders | | | |
| Ability to perform a cardiac H & P | 0.3 (0.2–0.7)** | Excluded from model because not bivariate significant | Excluded from model because not bivariate significant |

Data are OR (99% CI). "Agree" includes both "agree" and "strongly agree"; barrier includes "minor" and "major" barriers. Variable definitions: sufficient SCD risk, sufficient SCD risk to warrant cardiac screening; legal liability, sufficient risk of legal liability to warrant cardiac screening; responsibility to inform family, it is the physician's responsibility to inform the patient and family of the risk of SCD before initiating treatment with stimulants; ability to perform cardiac H & P, the ability to perform an in-depth cardiac H & P is a barrier to identifying cardiac disorders.

[a] Variables considered for cardiac H & P model. Main effects: categorical years in practice, practice setting, gender, race, sufficient SCD risk, legal liability, physician informs family, family knowledge deters stimulant use, ability to perform cardiac H & P is a barrier. Interaction terms: sufficient SCD risk×gender, sufficient SCD risk×race, legal liability×gender, legal liability×race, physician informs family×gender, ability to perform cardiac H & P is barrier×gender, ability to perform cardiac H & P is barrier×race.

[b] Variables considered for discussed cardiac side effects model. Main effects: categorical years in practice, practice setting, gender, race, sufficient SCD risk, legal liability, physician informs family, family knowledge deters stimulant use. Interaction terms: sufficient SCD risk*gender, sufficient SCD risk×race, legal liability×gender, legal liability×race, physician informs family×gender.

[c] Variables considered for ordered ECG model: Main effects: categorical years in practice, practice setting, gender, race, sufficient SCD risk, legal liability, physician informs family, family knowledge deters stimulant use, ability to perform cardiac H & P is a barrier, ability to interpret pediatric ECG is a barrier. Interaction terms: sufficient SCD risk×gender, sufficient SCD risk×race, legal liability×gender, legal liability×race, physician informs family×gender, ability to perform cardiac H & P is barrier×gender, ability to perform H & P is barrier×race, ability to interpret pediatric ECG is a barrier×gender.

* $P < .05$. ** $P \leq .01$;

stimulants, despite the paucity of data regarding cardiac risks compared with that for growth delay.[19] On multivariate models, attitudes regarding SCD risk with stimulants and physician's responsibility were both associated with discussing stimulant-related cardiac side effects.

A large proportion of the sample (81.2%) agreed that family knowledge of SCD would unnecessarily deter stimulant use; those expressing that attitude were less likely to discuss stimulant-related cardiac side effects. This situation may reflect pediatrician concerns about the unintended consequences of cardiac screening and nonspecific cardiac findings from an examination or ECG. This issue is raised in the landmark article by Bergman and Stamm,[20] which demonstrated that children diagnosed with innocent heart murmurs had functional consequences in adolescence due to familial misunderstanding of risk.

The fact that physicians might not discuss potential risks with families, despite lay media publicity, suggests that, as a field, we are not adequately prepared to discuss these risks in an efficient, negotiated manner. Balancing beneficence (the benefit from ADHD medications) and the obligation to respect autonomy (informed consent regarding an uncertain SCD risk) remains a challenge for these patient, family, and physician discussions.[18] Shared decision-making extends informed consent by not only exchanging information about treatment options, risks, and benefits but also by sharing viewpoints so that patients, families, and physicians become aware of each other's perspectives with the goal of achieving a mutually agreed on treatment plan.[21] This model of informed consent is consistent with the AAP concept of "family-centered care" wherein families, children, and providers share responsibility in decision-making, and the family is recognized as the expert in the child's care.[22]

Lastly, our finding of perceived barriers in identifying children with cardiac disorders because of physicians' cardiac screening abilities must be addressed in both residency and continuing medical education programs if we continue to embrace the general pediatrician's role in screening. Of note, approximately two-thirds of respondents expressed interest for some type of continuing medical education.

Although less than one-fifth of respondents identified their ability to conduct an in-depth cardiac H & P as a barrier, this barrier was negatively associated with performing an in-depth cardiac H & P, as is currently recommended by the AAP. A large proportion of our sample also identified their ability to interpret a pediatric ECG as a barrier. In addition, the complexities of identifying causes of SCD in children, including ambiguous and negative ECG findings for some disorders associated with SCD, also must be addressed so that pediatricians understand the strengths and limitations of the ECG as a screening tool for SCD.

We acknowledge the study's limitations. Although more than half of subjects responded, our response rate was not as robust as we would have liked, despite 3 rounds of mailings. Also, respondents with strong feelings on this topic may have been more likely to respond, biasing results; however, based on similarities in sample characteristics of respondents, nonrespondents, and AAP membership, the study sample was representative of AAP members. Another limitation was that we did not examine the perspectives of families regarding risks and desired screening practices, which defines an area of important future research. We did not ask about resources available in the practice setting, including access to ECG equipment or a trained ECG technician.

Nevertheless, this study is the first national study to identify pediatricians' attitudes, barriers, and cardiac screening practices with respect to SCD risk before initiating treatment with stimulant mediations. The variability in attitudes, barriers, and practices also echoes the ongoing controversy about the cardiovascular risks associated with stimulants and their impact on clinical practice.

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***ADVERSE DRUG EFFECTS:*** *Yesterday, my parents joined us for dinner. Both my parents are in their 70s and take a large number of medications. My mother travels with a hefty pill box stuffed with pills in separate compartments. Given her memory difficulties these days, I worry that she will become one of the many elderly Americans to suffer an adverse drug effect. As reported in* The New England Journal of Medicine *(Special Article: November 24, 2011), emergency hospitalization for adverse drug effects occurs commonly in the elderly. Researchers from the CDC combed 2007-2009 data from 58 sentinel hospitals across the country. Based on identified emergency hospitalizations for adverse drug effects in this sample, the researchers concluded that approximately 100,000 U.S. adults over the age of 65 are hospitalized each year for adverse drug effects. Four types of drugs accounted for more than two-thirds of all emergency adverse drug effect admissions: warfarin, insulins, oral antiplatelet, and oral hypoglycemic agents. Singly, or in combination, these accounted for 33%, 14%, 13% and 11% of the hospitalizations, respectively. Medications deemed high-risk by most insurance carriers or health groups, such as narcotics, were implicated in only 1.2% of admissions. Almost two-thirds of the hospitalizations were caused by overdosing or unexpected greater drug effect. Warfarin and anti-platelet drugs, not surprisingly, were associated with bleeding. Insulin and oral hypoglycemic agents were associated with change in mental status, confusion, or seizures. Many of the drugs associated with emergency hospitalization have a very narrow therapeutic index meaning the difference between the therapeutic dose and toxic dose can be quite small. The elderly may be particularly prone to adverse events. This may be because of changes in renal or hepatic function. Given that Americans are living longer and that 40% of people over 65 take five to nine medications, preventing adverse drug effects is a key issue for practitioners. So far, too much emphasis has been placed on controlling use of opioids. Better attention preventing adverse effects of drugs designed to prevent thrombosis and treat hyperglycemia will result in a greater return and less morbidity. Fortunately, my mother is not taking one of the top four drugs causing problems in the elderly. Still, I worry about her and remind her to inform her primary care physician if any other physician adds or changes the dose of her medications.*

*Noted by WVR, MD*

# Cardiac Screening Prior to Stimulant Treatment of ADHD: A Survey of US-Based Pediatricians

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