

A Practice Pathway for the Identification, Evaluation, and Management of Insomnia in Children and Adolescents With Autism Spectrum Disorders

abstract

OBJECTIVE: This report describes the development of a practice pathway for the identification, evaluation, and management of insomnia in children and adolescents who have autism spectrum disorders (ASDs).

METHODS: The Sleep Committee of the Autism Treatment Network (ATN) developed a practice pathway, based on expert consensus, to capture best practices for an overarching approach to insomnia by a general pediatrician, primary care provider, or autism medical specialist, including identification, evaluation, and management. A field test at 4 ATN sites was used to evaluate the pathway. In addition, a systematic literature review and grading of evidence provided data regarding treatments of insomnia in children who have neurodevelopmental disabilities.

RESULTS: The literature review revealed that current treatments for insomnia in children who have ASD show promise for behavioral/educational interventions and melatonin trials. However, there is a paucity of evidence, supporting the need for additional research. Consensus among the ATN sleep medicine committee experts included: (1) all children who have ASD should be screened for insomnia; (2) screening should be done for potential contributing factors, including other medical problems; (3) the need for therapeutic intervention should be determined; (4) therapeutic interventions should begin with parent education in the use of behavioral approaches as a first-line approach; (5) pharmacologic therapy may be indicated in certain situations; and (6) there should be follow-up after any intervention to evaluate effectiveness and tolerance of the therapy. Field testing of the practice pathway by autism medical specialists allowed for refinement of the practice pathway.

CONCLUSIONS: The insomnia practice pathway may help health care providers to identify and manage insomnia symptoms in children and adolescents who have ASD. It may also provide a framework to evaluate the impact of contributing factors on insomnia and to test the effectiveness of nonpharmacologic and pharmacologic treatment strategies for the nighttime symptoms and daytime functioning and quality of life in ASD. *Pediatrics* 2012;130:S106–S124

AUTHORS: Beth A. Malow, MD, MS,^{a,b,c} Kelly Byars, PsyD,^d Kyle Johnson, MD,^e Shelly Weiss, MD,^f Pilar Bernal, MD,^{a,c} Suzanne E. Goldman, PhD,^g Rebecca Panzer, MA, RD, LD,^h Daniel L. Coury, MD,ⁱ and Dan G. Glaze, MD^j

Departments of ^aNeurology and ^bPediatrics and ^cKennedy Center, Vanderbilt University Medical Center, Nashville, Tennessee; ^dDepartment of Pediatrics, University of Cincinnati College of Medicine, Cincinnati Hospital Children's Medical Center, Cincinnati, Ohio; ^eDepartment of Psychiatry, Oregon Health and Science University, Portland, Oregon; ^fHolland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario, Canada; ^gKaiser Permanente Northern, San Jose, California; ^hMassGeneral Hospital for Children, Boston, Massachusetts; ⁱDepartment of Pediatrics, Nationwide Children's Hospital, Columbus, Ohio; and ^jDepartments of Neurology and Pediatrics, Baylor College of Medicine, Houston, Texas

KEY WORDS

actigraphy, education, sleep, sleep latency

ABBREVIATIONS

ASD—autism spectrum disorder
ATN—Autism Treatment Network
CSHQ—Children's Sleep Habits Questionnaire
NICHQ—National Initiative for Children's Healthcare Quality
RCT—randomized controlled trial

This manuscript has been read and approved by all authors. This paper is unique and not under consideration by any other publication and has not been published elsewhere.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-0900l

doi:10.1542/peds.2012-0900l

Accepted for publication Aug 8, 2012

Address correspondence to Beth Malow, MD, MS, Burry Chair in Cognitive Childhood Development, Director, Vanderbilt Sleep Disorders Division, 1161 21st Avenue South, Room A-0116, Nashville, TN 37232. E-mail: beth.malow@vanderbilt.edu

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

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FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

Approximately 1 in 110 children fulfills the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*, diagnostic criteria for autism spectrum disorders (ASDs) as defined by delayed or abnormal social interaction, language as used in social communication, and/or restricted repetitive and stereotyped patterns of behavior, interests, and activities.¹ Children who have ASD are at greater risk for developing sleep problems than typically developing children. Research has documented that the prevalence of sleep disturbances ranges from 53% to 78% for children who have ASD compared with 26% to 32% for typically developing children.^{2,3}

The key components of pediatric insomnia are repeated episodes of difficulty initiating and/or maintaining sleep, including premature awakenings, leading to insufficient or poor-quality sleep. These episodes result in functional impairment for the child or other family members.⁴ In typically developing children, the primary cause of insomnia is behaviorally based.⁵ In the ASD population, however, insomnia is multifactorial. It includes not only behavioral issues but also medical, neurologic, and psychiatric comorbidities; it is also an adverse effect of the medications used to treat symptoms of autism and these comorbidities.⁶

Typically developing children who have insomnia are at increased risk for neurobehavioral problems such as impairments in cognition, mood, attention, and behavior.^{5,7–9} Similar to the behavioral morbidity associated with pediatric insomnia that is observed in the general population, children who have ASD and sleep problems are prone to more severe comorbid behavioral disturbances compared with children without sleep disturbances.¹⁰ In addition, treating insomnia in children who have neurodevelopmental disorders may improve problematic daytime behaviors.¹¹

Despite the prevalence of and morbidity associated with pediatric insomnia, there is evidence that sleep disorders in children often go undetected and untreated.^{12–14} Medical practitioners often do not ask about sleep concerns or parents do not seek assistance.¹⁵ Many parents have poor knowledge about sleep development and sleep problems.¹⁶ This is particularly relevant to children who have ASD, in that parents may present to the pediatrician with concerns regarding aggression, impulsivity, inattention/hyperactivity, or other behavioral issues that may be secondary to a sleep disorder. The contribution of the sleep disorder may be undetected due to emphasis on treating the behavioral issue as opposed to identifying and treating the underlying factors. This deemphasis of underlying factors may be due to the absence of a standardized approach for recognition and treatment of insomnia in children who have ASD.

Guidelines exist for sleep screening and intervention in typically developing children.^{17,18} Guidelines and empirical support also exist for the effectiveness of behavioral treatment of bedtime problems and night wakings in children.^{18–21} Specific behavioral treatments supported include the following: unmodified extinction: leaving the child's bedroom after putting the child to bed and not returning until morning unless the child is ill or at risk for injury; extinction with parent presence: parent is present in the room with the child but does not interact with him or her; graduated extinction: parent returns to child's bedroom to attend to child on request or agitation but increases the time in between requests by the child for the parent to return; preventive parent education: providing education to parent on sleep habits and bedtime routine; bedtime fading: delaying bedtime to promote sleep and then "fading" or advancing bedtime

once child is falling asleep easier; and scheduled awakenings: awakening the child before a spontaneous awakening. Extinction and parent education have strong empirical support whereas the other interventions are less confidently supported.¹⁸ To our knowledge, however, there are no published guidelines related to management of insomnia in children who have ASD, including screening and treatment. The evidence that children who have ASD are at greater risk for insomnia and its morbidity suggests that sleep screening in this population of children is extremely important. The ideal evaluation of insomnia in children who have ASD involves a comprehensive sleep assessment, as outlined in a recent review.²²

To facilitate the evaluation of children with ASD for insomnia, the Autism Treatment Network (ATN) in association with the National Initiative for Children's Healthcare Quality (NICHQ) worked collaboratively to develop the clinical practice pathway presented in this article. The intention of this clinical practice pathway is to emphasize the need for screening of sleep problems in ASD and to provide a framework for decision-making related to best practices in the care of children and adolescents with ASD in primary care settings, when seen by a general pediatrician, primary care provider, or autism medical specialist. The pathway is not intended to serve as the sole source of guidance in the evaluation of insomnia in children who have ASD or to replace clinical judgment, and it may not provide the only appropriate approach to this challenge.

METHODS

Guideline Development

The ATN Sleep Committee consists of pediatric sleep medicine specialists as well as developmental pediatricians, neurologists, and psychiatrists. The

clinical practice pathway was designed to assist primary care providers and others working directly with families affected by ASD in addressing the challenge of insomnia with regard to identification, assessment, and management. Insomnia was defined as “repeated difficulty with sleep initiation, duration, consolidation, or quality that occurs despite age-appropriate time and opportunity for sleep that results in daytime functional impairment for the child and/or family.”¹⁸ The responses of the parents to selected questions on the Children’s Sleep Habits Questionnaire (CSHQ)²³ identified those patients who have insomnia.

After performing a systemic review of the literature, expert opinion and consensus was used to form the basis of the practice pathway (Fig 1). The ATN Sleep Committee’s knowledge of the literature and applicability to clinical practice informed best practices, which in turn created an overarching approach to insomnia within ATN sites by the autism medical specialist.

Systematic Review of the Literature

We conducted a systematic literature review to find evidence regarding the treatment of insomnia in children

diagnosed with ASD (questions and search terms available on request from the authors). We searched OVID, CINAHL, Embase, Database of Abstracts and Review Database of Abstracts of Reviews and Effects, and the Cochrane Database of Systematic reviews databases, with searches limited to primary and secondary research conducted with humans, published in the English language, involving children aged 0 to 18 years, and published between January 1995 and July 2010. Individual studies were graded by using an adaptation of the GRADE system²⁴ by 2 primary reviewers and then reviewed by content experts for consensus. Discrepancies were resolved by a third party.

Pilot Testing of the Pathway

The ATN selected 4 pilot sites (Baylor University, Houston, Texas; Oregon Health and Science University, Portland, Oregon; Kaiser Permanente Northern, San Jose, California; University of Missouri, Columbia, Missouri) to test the feasibility of the practice pathway and provide information regarding needed modifications. The pilot sites collected data to document adherence to the practice pathway and participated in monthly conference calls to provide

updates, understand variance, and recommend changes. Working with the NICHQ, members of the ATN Sleep Committee refined and finalized the practice pathway on the basis of feedback from the pilot sites. In response to recommendations from the pilot sites to increase feasibility, the NICHQ also developed a 1-page checklist designed to guide providers through the practice pathway (Fig 2).

RESULTS

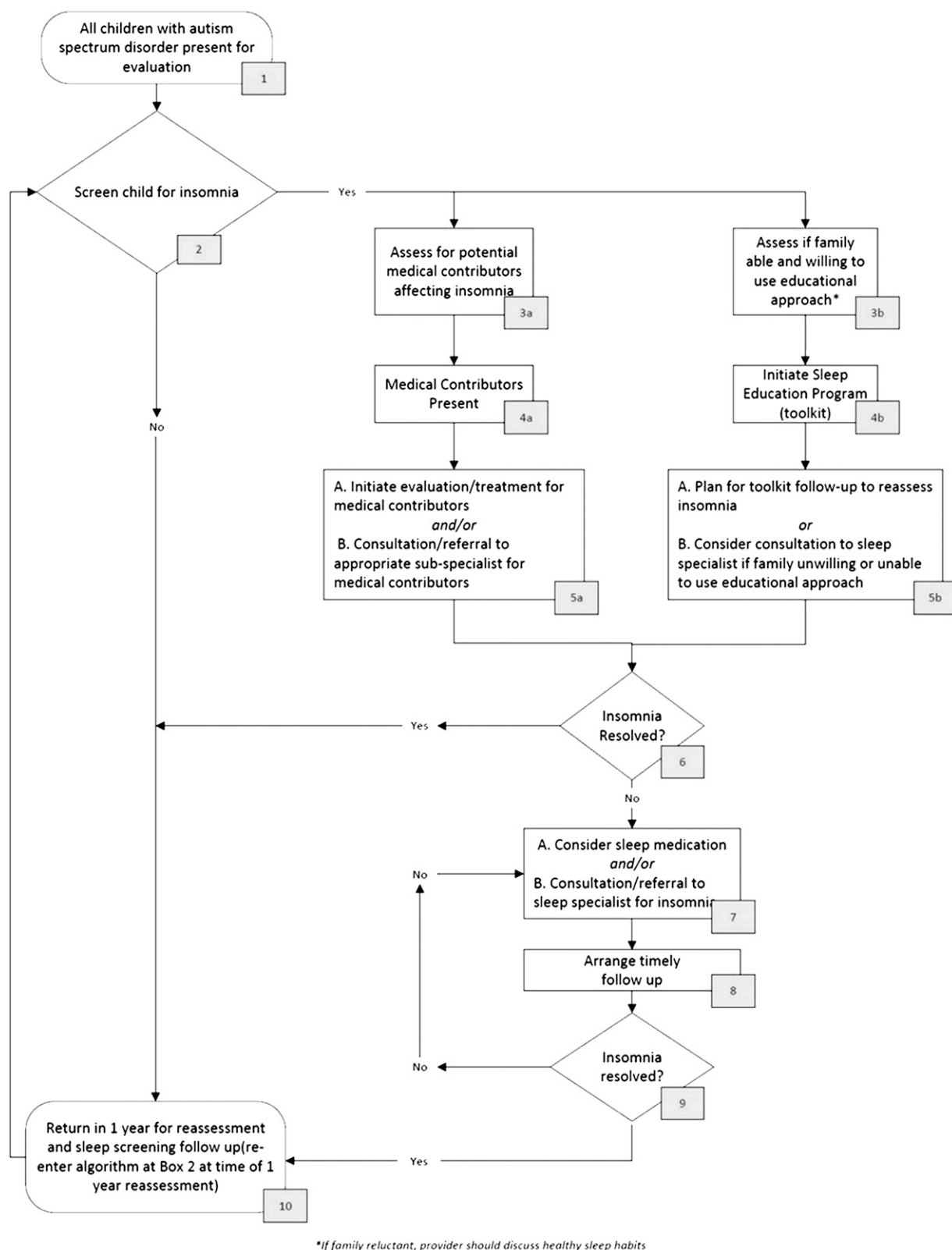
Results of the Literature Review

The search identified 1528 articles. After removing review articles, commentaries, case studies with fewer than 10 subjects, studies that included children who did not have ASD, non-intervention trials, and articles that did not address our target questions, 20 articles remained (Table 1). We reviewed the literature for studies related to other aspects of the practice pathway (eg, screening for insomnia, identifying comorbidities, importance of follow-up) in the ASD population and were unable to identify evidence-based reports for aspects other than treatment. A comprehensive review²⁵ and consensus statement²⁶ related to the pharmacologic management of

New Patients	Follow-up for Returning Patients
Assess: <ul style="list-style-type: none"> <input type="checkbox"/> CSHQ <input type="checkbox"/> Parent or provider concerns <input type="checkbox"/> Assess for medical contributors (if needed) <input type="checkbox"/> Family willingness to use the Sleep Toolkit 	Assess Insomnia resolution: <ul style="list-style-type: none"> <input type="checkbox"/> CSHQ <input type="checkbox"/> Ask family whether insomnia has resolved <input type="checkbox"/> Assess use of the Sleep Toolkit
Treatment: <ul style="list-style-type: none"> <input type="checkbox"/> Treat medical contributors and consult or refer if needed <input type="checkbox"/> Counsel family <input type="checkbox"/> Discuss healthy sleep habits; consider sleep medications 	Treatment: <ul style="list-style-type: none"> <input type="checkbox"/> Consider sleep med and med management <input type="checkbox"/> Re-introduce Sleep Toolkit <input type="checkbox"/> Have discussion with parents
Follow-up: <ul style="list-style-type: none"> <input type="checkbox"/> Arrange timely follow-up 	Follow-up/Referral: <ul style="list-style-type: none"> <input type="checkbox"/> Arrange further follow-up where needed <input type="checkbox"/> Refer patients with unresolved insomnia to specialist

FIGURE 1

Checklist for carrying out the practice pathway in children who have ASD and insomnia. CSHQ, Children’s Sleep Habits Questionnaire.

**FIGURE 2**

Practice pathway for insomnia in children who have ASD.

TABLE 1 Results of Systematic Literature Review

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Pharmacologic interventions Aman et al, 2005 ¹¹	Included: 101 children aged 5 to 17 y from Research Units on Pediatric Psychopharmacology Network with ASD	16 wk (nonresponders) to 6 mo (responders) given placebo or risperidone	Parent report sleep log	Sleep problems and anxiety less common in risperidone group ($P = .02$; $P = .09$). Average sleep duration increased short-term (17 min; 40 min) but not beyond 6 mo (29 min). Adverse events scored as moderate (placebo versus risperidone, respectively): somnolence (12% vs 37%), enuresis (29% vs 33%), excessive appetite (10% vs 33%), rhinitis (8% vs 16%), difficulty waking (8% vs 12%), and constipation (12% vs 10%)	Risperidone improves sleep latency in children with ASD but not sleep duration; high rates of adverse outcomes
RCT, level II	Excluded: Mental age < 18 mo, positive β -human chorionic gonadotropin test result for girls, significant medical condition, previous trial with risperidone, history of neuroleptic malignant syndrome, and/or weight < 15 kg	20 to 44.9 kg = 0.5 mg up to maximum of 2.5 mg/day	Abnormal Involuntary Movement Scale		
		< 20 kg = similar, except slower dosing ≥ 45 kg started at 0.5 mg nightly then titrated to a maximum of 3.5 mg/day in divided doses	Adverse events scored as mild or moderate/severe (parent report)		
Honomichl et al, 2002 ⁴²	Included: 17 children aged 3 to 8 y with autism recruited as subset of larger study (California)	4 wk placebo and 4 wk intervention 2 CU/kg porcine secretin intravenously; no washout	CSHQ	Secretin did not significantly affect CSHQ scores: Bedtime resistance (Pre, mean: 9 [range: 6–17]; Post, mean: 8 [range: 6–13])	Secretin does not significantly improve sleep-onset delay, duration, bedtime resistance, and night wakings in children with ASD
RCT, level III	Excluded: not specified		Sleep diary (bedtime, sleep onset, time/duration night waking, morning rise)	Sleep-onset delay (Pre, mean: 2.1 [range: 1–3]; Post, mean: 1.6 [range: 1–3]) Night wakings (Pre, mean: 4.1 [range: 3–7]; Post, mean: 3.6 [range: 3–5]) Sleep duration (Pre, mean: 4.7 [range: 3–7]; post, mean: 4.3 [range: 3–8])	

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Ellaway et al, 2001 ⁴³	Included: experimental group consisted of 21 females aged 7 to 41 y; recruited from previous 8-wk trial; control group included 62 females aged 4 to 30 y recruited from Australian Rett Syndrome Register Excluded: Not specified	100 mg/kg liquid L-carnitine twice a day for 6 mo	Rett syndrome Symptoms Severity Index	Compared with Rett syndrome controls, L-carnitine significantly improved sleep efficiency ($P < .03$) but not duration ($P = .57$), latency ($P = .15$), daytime sleep ($P = .55$), or night wakings ($P = .25$)	L-carnitine supplementation improves sleep efficiency but not duration, latency, daytime sleep, or number of night wakings in children with Rett syndrome
Pre/post-control, level III			SF-36 Health Survey Hand apraxia scale 7-d sleep diary TriTrac-R3D Ergometer (Hemokinetics, Inc, Madison Wisconsin)		
Possey et al, 2001 ⁴⁴	Included: 26 children and young adults, aged 3 to 23 y with ASD (Indiana); 20 had comorbid intellectual disability; Mirtazapine was prescribed to target symptoms of aggression, self-injury, irritability, anxiety, depression, insomnia, and interfering repetitive behavior Excluded: Not specified	Mirtazapine starting dose of 7.5 mg daily with dosage increases made in 7.5-mg increments up to a maximum of 45 mg daily in divided doses, based on response of target symptoms and side effects (range: 7.5–45 mg). Treatment duration ranged from 11 to 368 d (mean duration: 150 \pm 103 d)	Clinicians used the CGI scale to rate severity and improvement. A modified CGI improvement item assessing sleep quality was also included	Nine participants responded (defined according to a CGI score of much improved or very much improved). Five of 9 responders showed improved sleep. Of 17 nonresponders, 3 showed significant improvement was seen on the CGI severity ratings of sleep ($P = .002$)	Mirtazapine is effective in improving sleep quality in children with ASD
Pre/post-no control, level III Rossi et al, 1999 ⁴⁵	Included: 25 children aged 2 to 20 y with ASD (University of Bologna) with continuous presence (≥ 1 y) of severe mood disorders, aggressiveness, and hyperkinesia Excluded: children nosographically defined congenital or acquired encephalopathy	Niaprazine 1 mg/kg per day TID for 60 d	Behavioral Summarized Evaluation (included sleep disorders; difficulty falling asleep, night wakings, and early waking. Scored 0 to 4 (absent to very severe))	Compared with start of the treatment, Behavioral Summarized Evaluation showed improvement in sleep disorders by the end of the trial ($P < .001$)	Niaprazine is effective in improving sleep latency and night wakings in children with ASD
Pre/post-no control, level III Ming et al, 2008 ⁴⁶	Included: 19 children aged 4 to 16 y with ASD (New Jersey) and sleep and behavioral disorders	Clonidine 1 time per day, initial dose 0.05 mg and gradually advanced to 0.1 mg; oral tablet. Duration for 6 mo to 2 y	Caregiver report (average bedtime, latency, number of wakings) before and during treatment	Sixteen of 17 children experienced improved sleep initiation (2–5 h before treatment; 0.5–2 h during treatment); 16 of 17 with sleep maintenance disorders experienced improvements; 5 still experienced night wakings	Clonidine improves sleep latency and wakings in children with developmental disorders

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Retrospective case control, level III	Excluded: not specified				
Other biologic agents					
Adams and Holloway, 2004 ⁴⁷	Included: 25 children aged 3 to 8 y with ASD with no changes in treatment therapies in previous 2 mo, and no previous use of multivitamin supplements other than standard children's multivitamin (Arizona) Excluded: not specified	Days 0 to 24: 1/8 dose of SS-II (standard multivitamin), increased linearly to maximum Days 25 to 34: held maximum dose of SS-II Days 35 to 50: gradual transition to SS-III Days 50 to 90: continued SS-III; full dose 1 ml/5 lb T1D with food for a total daily intake of 3 ml/5 lb body weight	CGI	Sleep and gastrointestinal symptoms as evidenced by CGI score improved compared with placebo ($P = .03$)	Moderate-dose multivitamin (including vitamin B ₆ and vitamin C) may have a positive impact on CGI sleep score in children with ASD
RCT level II	Excluded: not specified		Blood and urine sample (plasma B ₆ , pyridoxine, pyridoxal, pyridoxamine, α -lipoic acid, vitamin C)		
Dosman et al, 2007 ⁴⁸	Included: 33 children aged 2 to 5 y diagnosed with autism with ferritin measured previously (Toronto)	6 mg elemental iron/kg per day for 8 wk	Sleep Disturbance Scale for Children	Per the sleep disturbance scale scores, restless sleep improved significantly (29%; $P = .04$) and 35% had improved sleep latency; no relation was found with ferritin ($P = .61$), irritability ($P = .83$), or Periodic Leg Movements During Sleep Scale ($P = .82$) Mean ferritin and MCV increased significantly (16 to 29 μ g/L)	Oral iron supplementation improves restless sleep in children with ASD but does not affect irritability, sleep latency, or periodic leg movements
Pre/post-control, level II	Excluded: currently taking iron supplementation	If not tolerated, received 60 mg/day of microencapsulated powdered elemental iron	Periodic Leg Movements During Sleep Scale Blood sample (MCV, mercury, albumin, vitamin B ₁₂ , serum ferritin, transferrin)		

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Wright et al, 2011 ⁴⁹	Included: 20 children, aged 4 to 16 y with ASD and prolonged sleep latency, excessive night waking, and/or reduced total sleep time. Children had undergone behavior management that was not successful and were free of psychotropic medications	Melatonin 2 mg, 30 to 40 min before planned sleep, or placebo and then crossed over to the other agent. The dose was increased by the parent every 3 nights by 2 mg to a maximum dose of 10 mg until "good" sleep was achieved, defined as an improvement of $\geq 50\%$. Treatment phase lasted 3 mo for each agent with a 1 mo washout	Daily sleep diaries (time melatonin taken, bedtime, sleep time, night wakings, time awake) were collected every month for 9 mo	Mean sleep latency was lower ($P = .004$) and total sleep time was longer ($P = .002$) during melatonin treatment compared with placebo. Night wakings did not improve ($P = .2$)	Melatonin improves sleep latency and total sleep time in children with ASD but not night wakings
RCT, level III	Excluded: children previously or currently on melatonin, those currently on psychotropic medications, and those with other neurodevelopmental disorders such as Fragile X or Rett syndrome		Sleep difficulties questionnaire	Dyssomnia subscale improved with treatment ($P = .04$) but not parasomnia, sleep apnea, or other sleep disorders	
Garstang and Wallis, 2006 ²⁷	Included: 7 children aged 4 to 16 y with autism and sleeping difficulty (at least 1 h sleep latency and/or night waking 4 times per week for the last 6 mo) (United Kingdom)	Placebo or 5 mg melatonin for 4 wk, washout 1 wk, then reversed for 4 wk	Parental sleep charts (total sleep time, sleep latency, night wakings, morning awakening)	Baseline, placebo, and melatonin values respectively. Sleep latency improved 1.54 h versus baseline (2.6 h [CI: 2.28–2.93]; 1.91 h [CI: 1.78–2.03]; 1.06 h [CI: 0.98–1.13]) Wakings per night decreased by 0.27 per night versus baseline (0.35 [CI: 0.18–0.53]; 0.26 [CI: 0.20–0.34]; 0.08 [CI: 0.04–0.12]) Duration increased by 1.79 h versus baseline (8.05 h [CI: 7.65–8.44]; 8.75 h [CI: 8.56–8.98]; 9.84 h [CI: 9.68–9.99])	Melatonin is an effective treatment to improve sleep latency number of night wakings and sleep duration
RCT, level II	Excluded: children previously/currently using melatonin and/or taking sedative medications for < 4 wk				

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Wirojjanan et al, 2009 ²³	Included: 18 children aged 2 to 15 y with autism and/or Fragile X syndrome who reported sleep problems (California)	Placebo or 3 mg melatonin given 30 min before bedtime for 2 wk, then reversed for 2 wk (no washout)	Sleep diary (sleep latency, duration, sleep onset, number of night wakings)	Compared with placebo, sleep duration improved in 9 of 12 participants by 21 min ($P = .057$; effect size: 2.12), sleep latency improved in 11 of 12 participants by 28 min ($P = .10$; effect size: 1.79), sleep onset improved by 42 min ($P = .017$; effect size: 2.80), and awakenings were improved by 0.07 but were insignificant ($P = .73$; effect size: 0.3540)	Melatonin is an effective treatment to improve sleep duration, sleep latency, and sleep onset time but not night wakings
RCT level II	Excluded: not specified		Actiwatch (Philips Respironics, Bend, Oregon)		
Paavonen et al, 2003 ⁵⁰	Included: 15 children 5 to 17 y diagnosed with Asperger's syndrome and severe sleep problems in last 3 mo (Helsinki)	Received 3 mg of melatonin 30 min before bed for 14 d	Children's Self-Report for Sleep Problems	Melatonin improved nocturnal activity (31.39 ± 7.86 to 18.74 ± 4.99 ; $P = .041$) and sleep latency (from 40.02 ± 24.09 to 21.82 ± 9.64 ; $P = .002$) but increased number of wakings (from 15.14 ± 6.12 to 17.85 ± 6.25 ; $P = .048$). No significant changes were found in sleep efficiency (85.13 ± 5.57 to 86.03 ± 4.62 ; $P = .331$) or duration (477.40 ± 55.56 to 480.48 ± 50.71 ; $P = .572$).	Melatonin is an effective treatment to improve nocturnal activity and sleep latency but not night wakings, sleep efficiency, or duration in children with Asperger's syndrome
Pre/post-control, Level II	Excluded: children taking psychotropic medications or with major psychiatric comorbidity		Sleep Disturbance Scale for Children		
			CBCL		
			Karolinska Sleepiness Scale		
			Teacher's Daytime Sleepiness Questionnaire		
			Actigraphy		

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Giannotti et al, 2006 ⁵¹	Included: 25 children aged 2.6 to 9.6 y with autism and CARS score <29.5 with sleep disorder (>45 min sleep latency, >3 times per week night wakings, and waking before 5 AM >3 times per week) (Italy)	6- to 24-mo (<i>n</i> = 25 and <i>n</i> = 16, respectively) study	CSHQ	CSHQ values from baseline to 6 mo were significantly improved (65 vs 43; <i>P</i> < .001). CSHQ values regarding latency, duration, resistance, anxiety, night wakings, and daytime sleepiness were significantly improved (<i>P</i> < .001). Sleep-disordered breathing also improved (<i>P</i> < .01). Sleep diaries showed improvements in duration by 2.6 h (<i>P</i> < .001), awake time after sleep onset by from 70 to 10 min (<i>P</i> < .001), cosleeping in 55% (<i>P</i> < .001), parental presence at bedtime in 63% (<i>P</i> < .001), and bedtime irregularity in 61% (<i>P</i> < .001). Those who continued 24 mo showed significant improvement in CSHQ scores in years 1 and 2 (63 vs 44 vs 44; <i>P</i> < .001)	Melatonin is an effective treatment to improve sleep duration, latency, number of night wakings, and bedtime resistance in children with ASD
Pre/post-control, level II	Excluded: children with autism diagnosis but with CARS score below cutoff, coexisting conditions, and/or taking medications for 6 mo previously	3 mg controlled-release melatonin 30 to 40 min before bedtime (1 mg FR and 2 mg CR) Children advised to give 2 mg FR is children awoke for >15 min during the night Physician could increase dose to maximum of 4 mg in children aged <4 y and up to 6 mg in children aged >4 y	Sleep diary (bed time, rise time, duration, night wakings and duration, day naps)		
Malow et al, 2011 ⁵²	Included: 24 children aged 3 to 9 y with ASD and sleep-onset delay of ≥30 min on ≥3 nights per week	Two-week acclimation phase: inert liquid 30 min before bedtime	Actigraphy; CSHQ	With melatonin treatment (compared with acclimation phase), statistically significant improvements were seen in sleep latency (42.9 to 21.6 min; <i>P</i> < .0001) but not total sleep time or wake time after sleep onset	Melatonin is an effective treatment of sleep latency, and improves aspects of daytime behavior and parenting stress in children with ASD. It is safe and well tolerated

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Pre/post-control, Level II	Excluded: children with epilepsy or taking psychotropic medications. Before melatonin treatment, medical comorbidities were addressed, and parents received sleep education training	Optional escalating dose protocol based on 3-wk periods. Dose was escalated from 1 mg to 3 mg to 6 mg based on response (if a satisfactory response occurred, defined as falling asleep within 30 min on ≥ 5 nights per week by actigraphy, the dose was not escalated)	CBCL, RBS, PSI. Laboratory findings (CBC, metabolic profile including liver and renal function, corticotropin, cortisol, estrogen, testosterone, FSH, LH, and prolactin). Hague Side Effects Scale	Significantly significant improvements were also noted in CSHQ subscales of sleep-onset delay and sleep duration, CBCL subscales of withdrawn, attention-deficit/hyperactivity, and affective, RBS stereotyped and compulsive, and the Difficult Child subscale on the PSI. No change in laboratory findings. Loose stools in 1 child; no other adverse effects	
Andersen et al, 2008 ³⁰	Included: 107 children aged 2 to 18 y diagnosed with autism previously recommended to take melatonin sleep disorder (Tennessee)	Aged < 6 y, .75-1 mg melatonin 30 to 60 min before bed. After 2 wk, if no response, increased by 1 mg every 2 wk up to 3 mg	Chart review of clinic notes (including sleep hygiene, other psychiatric conditions, severity of ASD, use of medications)	After initiation, 25% with sleep problems no longer a concern; 60% had improved sleep but still had concerns; for 13% sleep problems remained a major concern, and 1% reported worse sleep after treatment. Three children had adverse effects (morning sleepiness and/or increased enuresis)	Melatonin is a safe, effective treatment to reduce sleep problems in children with ASD
Pre/post-No control, level III	Excluded: children with a diagnosis of bipolar disorder	Aged ≥ 6 y, 1.5 mg melatonin 30 to 60 min before bed time if no response, increased dose to 3 mg after 2 wk All children: if no response after 4 wk, increase dose to 6 mg	Sleep diary		
Behavioral/educational interventions Reed et al, 2009 ³¹	Included: 20 families of children aged 3 to 10 y with clinical diagnosis of ASD with sleep concerns (Tennessee)	• Three 2-h sessions for 3 consecutive weeks; follow-up 1 mo after end	CSHQ	Educational intervention showed improved CSHQ scores for bedtime resistance ($P = .001$), latency ($P = .004$), duration ($P = .003$), and sleep anxiety ($P = .022$) but not night wakings ($P = .508$), parasomnias ($P = .607$), sleep-disordered breathing ($P = .625$), and daytime sleepiness ($P = .096$)	Educational intervention with parents improves bedtime resistance, latency, duration, and sleep anxiety but not night wakings, early morning waking, parasomnias, sleep-disordered breathing, or daytime sleepiness in children with autism

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Pre/post-no control, level II	Excluded: children with primary sleep disorders such as sleep apnea, narcolepsy, and neurologic/medical conditions that may contribute to disordered sleep	Session 1: established daytime and night time habits and a bedtime routine based on FISH and CSHQ Session 2: Strategies to minimize night waking and early morning waking Session 3: address individual sleep concerns	Actigraphy Latency, duration, night wakings	Actigraphy showed improved sleep latency (62.2 ± 33.33 min vs 45.6 ± 27.6 ; $P = .039$) but not waking after sleep onset (24.5 ± 9.8 vs 32.2 ± 24.7 min; $P = 1.0$) 71% of parents reported fewer nights cosleeping; 33% reported improvement in early morning waking	
Weiskop et al, 2005 ³²	Included: 13 children (across 13 families) aged 5 y with either Fragile X syndrome ($n = 7$) or ASD ($n = 6$) with perceived sleep difficulty (Australia)	Five sessions over 7 wk with weekly telephone calls; follow-up at 3 and 12 mo	Sleep Diary (behavior, lights out, sleep onset, waking, cosleeping, morning wake time)	Baseline compared with intervention: 4.6% moderate deterioration of sleep behaviors, 25% no change, 29.7% moderate improvement, and 40.6% substantial improvements Baseline compared with 3 mo: 1.6% substantial deterioration, 4.8% moderate deterioration, 27% no change, 23.8% moderate improvement, and 41.3% substantial improvement Baseline compared with 12 mo: 7.7% moderate deterioration, 19.2% no change, 26.9% moderate improvement, and 46.2% substantial improvement Sleep latency improved in 6 of 10 (60%)	Educational intervention with parents improved sleep latency and night wakings but not duration in children with developmental disabilities
Case series, level III	Excluded: excluded if diagnosed with epilepsy and/or if diagnosed with ASD, were not to be taking medication	Session 1: goal setting Session 2: learning theory; antecedents and consequences. Created intervention with reinforcement and visual representation Session 3: effective instructions and partner support strategies Session 4: extinction techniques Session 5: review session Cosleeping was also addressed		Night waking improved for 7 of 10 (70%) Duration was variable and unchanged 100% of parents reported improved sleep but 50% still considered sleep an issue	

TABLE 1 Continued

Study and Grade	Sample	Intervention and Duration	Measures Used to Arrive at Conclusion	Results	Conclusions
Complementary and alternative medicine Piravej et al, 2009 ³³	Included: 60 children aged 3 to 10 y diagnosed with autism; 30 were put into control group (SI) and 30 were experimental (SI + TTM) (Thailand)	Two 60-min standard SI or Two 60-min TTM and SI for 8 wk	Sleep diary	Massage improved sleep scores (11.5 vs 5.3; $P < .001$). Standard SI improved sleep behavior (13.9 vs 8.2; $P < .001$). The difference between pre- and post-sleep behavior scores of the control and massage groups were not statistically significant (5.7 vs 6.3 respectively; $P = .85$)	TT, before bedtime improves sleep in children with ASD but not more than compared with standard SI
RCT, level II	Excluded: those with contraindications for TTM and those unable to complete 80% of treatment (13 massages)	Two 60-min TTM and SI for 8 wk			
Williams, 2006 ³⁴	Included: 12 children aged 12 to 15 y diagnosed with ASD from a residential school for children with autism (United Kingdom)	Three administrations of aroma therapy (2% lavender oil in grape seed oil) over 24 d via massage of foot and leg ~2 hours before bed	Sleep diary recorded by staff on 30-min interval rounds (sleep onset, duration, wakings)	Participants did not demonstrate statistically significant sleep-onset time ($F = 1.27$; $df = 4, 15, 41.5$; $P = .30$). Night wakings did not differ with and without aromatherapy ($\chi^2 = 20.19$; $df = 16$; $P = .21$). Sleep duration was not affected by aromatherapy ($F = 0.59$; $df = 16, 160$; $P < .89$)	Aroma therapy is not an effective treatment to affect sleep onset, duration, and night wakings
Case series level II Escalona et al, 2001 ³⁵	Excluded: none specified Included: 20 children aged 3 to 6 y recruited from school for children with autism (Florida)	For 1 mo, received 15-min massage therapy by parents (trained by therapist) or 15 min of reading before bedtime	Sleep diaries (fussing, restlessness, crying, self-stimulating behavior, and number of times child left the bed)	Greater declines for the massage therapy group with regard to fussing/restlessness, crying, self-stimulating behavior, and getting out of bed (actual numbers not provided; only provided statistics for day-time behavior)	Massage before bed decreases fussing/restlessness, crying, self-stimulating behavior, and getting out of bed in children with ASD more than reading
RCT, level IV	Excluded: not specified				

CARS, Childhood Autism Rating Scale; CBC, complete blood cell count; CBCL, Child Behavior Checklist; CGI, Clinical Global Impression; CI, confidence interval; CR, controlled release; FISH, Family Inventory of Sleep Habits; FR, fast release; FSH, follicle-stimulating hormone; LH, luteinizing hormone; MCV, mean corpuscular volume; PSI, Parental Stress Index; RBS, Repetitive Behavior Scale; SI, Sensory Integration; SS, Spectrum Support; TTM, Thai Traditional Massage.

TABLE 2 Sleep Questionnaire Options

Questionnaire	Description	Format	Respondent
CSHQ (Owens et al, 2000) ³⁶	Assesses sleep behaviors across a range of behavioral and medical dimensions in children aged 4 to 10 y	Forty-five items that roll into 8 subscales: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep-disordered breathing, and daytime sleepiness	Parent
Children's Sleep Habits Questionnaire in Toddlers and Preschool Children (Goodlin-Jones et al, 2008) ²³	Assesses the CSHQ (see above) in children aged 2 to 5.5 y with autism, developmental delay without autism, and typically developing children	Same as the CSHQ (above)	Parent
Sleep Disturbance Scale for Children ³⁷	Characterizes sleep disorders over the past 6 mo in children aged 5 to 15 y	Twenty-six items that role into 6 subscales: sleep initiation and maintenance, daytime sleepiness, sleep arousal, and sleep-disordered breathing	Parent
Family Inventory of Sleep Habits ³⁸	Autism specific questionnaire assessing sleep hygiene in children aged 3 to 10 y	Twelve items, including daytime and prebedtime habits, bedtime routine, and sleep environment	Parent
Behavioral Evaluation of Disorders of Sleep Scale ³⁹	Assesses sleep behaviors in children aged 5 to 12 y	Five types of sleep problems: expressive sleep disturbances; sensitivity to the environment; disoriented awakening; sleep facilitators; and apnea/bruxism	Parent
BEARS ¹⁷	Assesses 5 sleep domains in children aged 5 to 18 y	Five sleep domains: bedtime problems (difficulty going to bed and falling asleep); excessive daytime sleepiness (includes behaviors typically associated with daytime somnolence in children); awakenings during the night; regularity of sleep/ wake cycles (bedtime, wake time) and average sleep duration; and snoring	Parent
Adolescent Sleep Wake Scale ⁴⁰	Assesses sleep quality in adolescents aged 11 to 21 y	Twenty-eight items role into 5 subscales: going to bed, falling asleep, awakening, reinitiating sleep, and wakefulness	Adolescent

BEARS, B = Bedtime problems, E = Excessive Daytime Sleepiness, A = Awakenings During the Night, R = Regularity and Duration of Sleep, S = Snoring.

insomnia in children (not specific to ASD) were identified.

The results of the systematic literature review demonstrate that treatment trials are limited in the ASD population. There are 3 categories of treatment: pharmacologic/biologic treatments, behavioral/educational interventions, and complementary and alternative medicine.

The evidence base to date shows limited evidence for the use of medications to treat insomnia in children who have ASD. The most evidence exists for the use of supplemental melatonin, an indoleamine with sleep-promoting and chronobiotic (sleep phase shifting) properties considered a nutritional supplement by the US Food and Drug Administration. Several small, randomized controlled trials (RCTs) demonstrated the efficacy of supplemental melatonin in treating insomnia in children who have ASD,^{27–29} although larger studies are needed. Melatonin seems to be relatively safe based on these trials and on other series.³⁰ Other pharmacologic interventions such as risperidone, seletin, L-carnitine, niaprazine, mirtazapine, and clonidine, as well as multivitamins and iron, have limited evidence supporting their use in treating insomnia in ASD. The research evidence to date does not support the efficacy of other supplements or vitamins.

Behavioral interventions are clearly beneficial for typically developing children experiencing significant insomnia.²¹ However, few treatment trials found that behavioral treatments provide consistent success rates in children who have ASD, particularly those experiencing sleep-onset insomnia. The systematic review of the literature identified 2 studies examining the efficacy of behavioral treatment of insomnia in children who have ASD.^{31,32} Each of these studies demonstrated statistically significant improvements in sleep

posttreatment. Both studies used multicomponent treatments, although they varied with respect to the specific components of treatment. However, they were representative of treatments commonly used in clinical practice as well as supported as effective in the general pediatric population. Both studies used extinction and positive reinforcement as treatments. Both studies provided parent training, as follows: (1) identifying a treatment goal/treatment target for therapy; (2) discussion of how the sleep problem is maintained by conditioning/learning; and (3) emphasis on establishing a developmentally appropriate bedtime and a consistent bedtime routine. Other treatment components addressed in a

single study included sleep hygiene instructions, use of effective instructions/directions to shape appropriate sleep behavior, and use of the bedtime pass protocol.²³ The studies did not address relative efficacy of these individual treatment components.

Complementary and alternative medicine therapies addressed in the literature review include massage therapy and aromatherapy.^{33–35} The systematic review found no evidence to support these therapies for insomnia in children who have ASD. Neither of the graded studies examining the efficacy of massage therapy or aromatherapy for insomnia in children who have ASD led to statistically significant improvements in sleep posttreatment.^{33–35}

Results of the Guideline Development

Based on the feasibility testing, a number of observations resulted in the development of resources to assist clinicians in the application of the practice pathway. After reviewing the literature and conducting pilot testing, the ATN Sleep Committee developed and refined the insomnia practice pathway and made the following consensus recommendations:

- A. General pediatricians, family care providers, and autism medical specialists should screen all children who have ASD for insomnia.

This screening is best done by asking a short series of questions targeting insomnia, such as those from the CSHQ, and asking if the parent considers these a problem. These questions are: (1) child falls asleep within 20 minutes after going to bed; (2) child falls asleep in parent's or sibling's bed; (3) child sleeps too little; and (4) child awakens once during the night. These questions were selected on the basis of review of the CSHQ and expert consensus. The ATN database was also reviewed ($n = 4887$), and we found that 81% of parents who reported that their child awakening more than once during the night was a problem also answered affirmatively to the question "Does your child awaken once during the night?" Therefore, to limit the questions asked, we did not include "Does your child awaken more than once during the night?" Asking specific questions is essential because parents may not volunteer concerns about insomnia given their concerns with behavioral issues (although these issues may be secondary to the insomnia). Identifying significant insomnia is paramount given its impact on daytime functioning, not only for the child with ASD but also the family. Table 2 lists available questionnaires.

- B. The evaluation of insomnia should include attention to medical

TABLE 3 Questionnaire to Help Identify Underlying Medical Conditions

	Yes	No
Gastrointestinal		
1. Does your child have a history of reflux? • If yes, when did it resolve?	<input type="checkbox"/>	<input type="checkbox"/>
2. Are there any ongoing symptoms? • If yes, list all:	<input type="checkbox"/>	<input type="checkbox"/>
3. Does your child have constipation? • If yes, is it controlled? • What medication(s) is used for control?	<input type="checkbox"/>	<input type="checkbox"/>
4. Does your child have abdominal pain?	<input type="checkbox"/>	<input type="checkbox"/>
5. Does it occur at night? • How often does this occur?	<input type="checkbox"/>	<input type="checkbox"/>
Seizures and Other Nighttime Events		
1. Does your child have seizures? • If yes, does your child have seizures that happen multiple times a night?	<input type="checkbox"/>	<input type="checkbox"/>
2. Does your child have unusual events (behaviors or movements) during the night? • If yes, is the event similar every time (suggests seizure)?	<input type="checkbox"/>	<input type="checkbox"/>
Sleep Disordered Breathing		
1. Does your child snore/breathe loudly?	<input type="checkbox"/>	<input type="checkbox"/>
2. Does your child gasp for breath or stop breathing? (if no, child may still have sleep disordered breathing)	<input type="checkbox"/>	<input type="checkbox"/>
3. Does your child have allergies/nasal congestion?	<input type="checkbox"/>	<input type="checkbox"/>
Asthma/Sinusitis		
1. Does your child cough at night?	<input type="checkbox"/>	<input type="checkbox"/>
Pain/Itching/Discomfort		
1. Does your child see a dentist regularly?	<input type="checkbox"/>	<input type="checkbox"/>
2. Could your child have any tooth pain?	<input type="checkbox"/>	<input type="checkbox"/>
3. Does your child have eczema?	<input type="checkbox"/>	<input type="checkbox"/>
4. If your child has eczema, is it currently well controlled? • What medication is used for controlling the eczema: • When is the eczema medication used (i.e. daily, as needed):	<input type="checkbox"/>	<input type="checkbox"/>
5. Do you think that the eczema causes your child to be itchy or have pain?	<input type="checkbox"/>	<input type="checkbox"/>
6. Could your child be hungry at night?	<input type="checkbox"/>	<input type="checkbox"/>
7. Is your child overly sensitive to light, sounds, or textures of clothing?	<input type="checkbox"/>	<input type="checkbox"/>
8. Can you think of anything that may be causing your child pain? • If yes, explain:	<input type="checkbox"/>	<input type="checkbox"/>
Nutrition		
1. Does your child eat at least 1-2 ounces of meat per day?	<input type="checkbox"/>	<input type="checkbox"/>
2. If not, does your child take a multivitamin with iron? • How often:	<input type="checkbox"/>	<input type="checkbox"/>
3. Does your child have restless sleep?	<input type="checkbox"/>	<input type="checkbox"/>
4. Does your child have leg pains/"growing pains"?	<input type="checkbox"/>	<input type="checkbox"/>
Physical Exam		
1. Does child have large tonsils?	<input type="checkbox"/>	<input type="checkbox"/>
2. Is child hypotonic?	<input type="checkbox"/>	<input type="checkbox"/>
3. Does child have nasal congestion or signs of allergic rhinitis?	<input type="checkbox"/>	<input type="checkbox"/>
4. Dental issues	<input type="checkbox"/>	<input type="checkbox"/>
5. Wheezing	<input type="checkbox"/>	<input type="checkbox"/>
6. Significant eczema	<input type="checkbox"/>	<input type="checkbox"/>

contributors that can affect sleep (including neurologic conditions and other sleep disorders that contribute to insomnia).

These contributors should be addressed because their treatment may improve insomnia. Within the ATN, we have developed a list of questions for medical contributors, including gastrointestinal disorders, epilepsy, pain, nutritional issues, and other underlying sleep disorders responsible for insomnia, including sleep-disordered breathing and restless legs symptoms (Table 3) that pediatricians can incorporate within their review of systems. Psychiatric conditions, such as anxiety, depression, and bipolar disorder, should be considered because these may contribute to insomnia. Finally, because many medications contribute to insomnia, a careful review of medications should be performed.

C. Educational/behavioral interventions are the first line of treatment, after excluding medical contributors. However, if an educational (behavioral) approach does not seem feasible, or the intensity of symptoms has reached a crisis point, the use of pharmacologic treatment is considered.

Educational/behavioral approaches to the treatment of insomnia are advocated as a first-line treatment in typically developing children.²¹ In children who have ASD, educational/behavioral approaches are also recommended, especially because these children may not be capable of expressing adverse effects caused by the medications. The core behavioral deficits associated with ASD may impede the establishment of sound bedtime behaviors and routines. These include: (1) difficulty with emotional regulation (eg, ability to calm self); (2) difficulty transitioning from preferred or stimulating activities to sleep; and (3) deficits in communication skills affecting a child's understanding of the expectations of

parents related to going to bed and falling asleep. Conversely, given preferences for sameness and routine, children who have ASD may adapt well to establishment of bedtime routines, especially if visual schedules are implemented.

The ATN has developed an educational toolkit for parents that consists of pamphlets to promote good sleep habits; a survey to assess for habits that may interfere with sleep; sample bedtime routines, including a visual supports library, tip sheets for implementing the bedtime routine, and managing night wakings; and a sleep diary. The toolkit is being tested for feasibility in an ongoing research project funded by the Health Resources and Services Administration of parent sleep education at 4 ATN sites and is also being used in clinical practice throughout the network. As with other educational/behavioral approaches, the success of this toolkit depends on appropriate implementation by parents, with the guidance provided by practitioners an essential element for many families. Families can often be encouraged to implement educational/behavioral strategies when presented with these tools, especially if they receive hands-on instruction in the tools and are provided with an explanation of why a behavioral approach is recommended. However, some families may be in a state of crisis or may not be willing or able to use the behavioral tools. These families may be challenged by difficult daytime behaviors in their child or by financial concerns. These children might require pharmacologic treatment. In addition, practitioners may not be able to provide sufficient instruction in the tools for a family to be successful with their implementation. Therefore, there is the option in the practice pathway (Fig 2, Box 5b) of medication or consultation to a sleep specialist if the family is unwilling or unable to use an educational approach,

depending on the comfort level of the pediatrician.

Behavioral Treatments for Insomnia

The behavioral treatments most commonly used to treat insomnia in children who have ASD include behavioral modification strategies such as extinction (eg, withdrawal of reinforcement for inappropriate bedtime behaviors) and positive reinforcement of adaptive sleep behavior. Sleep hygiene instructions (eg, appropriate sleep schedules and routines) often accompany behavioral modification protocols. Behavioral interventions are effective in the treatment of insomnia in typically developing children.²¹ However, the evidence base for effectiveness of such interventions in children who have ASD is limited. The data from the literature review provide preliminary support for the use of behavioral modification to treat insomnia in children who have ASD. These data were the basis for the development of an educational toolkit used to guide behavioral management of insomnia in the insomnia practice pathway.

Alternative Treatments for Insomnia

The most common alternative therapy with a presence in the literature is massage therapy.^{33,35} However, the results do not demonstrate consistent, statistically significant improvements in sleep.

Pharmacologic Treatments for Insomnia

Although medications and supplements are often used to treat insomnia experienced by children and adolescents who have ASD, the evidence base for pharmacologic treatment is limited. At this time, there are no medications approved by the US Food and Drug Administration for pediatric insomnia. The most evidence exists for the use of melatonin.

D. Clinicians should assure timely follow-up to monitor progress and resolution of insomnia.

Assuring adequate follow-up is crucial when treating children who have ASD and significant insomnia. Follow-up should occur within 2 weeks to 1 month after beginning treatment. The provider and family should expect to see some benefits and improvements within 4 weeks. Follow-up may be conducted by telephone or in person. Timely follow-up allows for fine-tuning of treatment interventions, support of parents, and provision of referrals if needed. In addition to short-term follow-up (eg, 1–2 months), at long-term follow-up (eg, 1-year visit) the steps from the beginning of the practice pathway should be repeated.

As outlined in the practice pathway, treatment of insomnia can be initiated by the general pediatrician, primary care provider, or autism medical specialist. Many children will improve with these initial interventions. Consultation with a sleep specialist is indicated if insomnia is not improving with these initial interventions or when the insomnia is particularly severe, causing significant daytime impairment or placing the child at risk for harm while awake during the night. For those children who have ASD and are taking multiple medications for sleep when initially assessed by the health care provider, consultation with a sleep specialist may be indicated, depending on the comfort level of the provider. Other indications for consultation with a pediatric sleep specialist may include when underlying sleep disorders are responsible for the sleeplessness symptoms (including sleep apnea, restless legs syndrome, periodic limb movements of sleep, and unusual nighttime behaviors [parasomnias] such as sleepwalking or sleep terrors).

Results of the Field Testing

Results of the pilot phase indicated challenges in implementing the practice pathway due to a number of conflicts,

including: (1) competing demands on the pediatric provider in a busy clinical practice; (2) knowledge level of the pediatric provider; and (3) when consultation to the sleep specialist occurs, ensuring communication back to the pediatric provider.

In response to these barriers, we developed the following resources: (1) a short set of screening questions for insomnia as well as a checklist for medical conditions contributing to insomnia (Table 3); and (2) a sleep education toolkit, available in hard copy as well as on the internal ATN Web site (www.autismspeaks.org/atn) that will facilitate parent teaching.

Additional issues were identified related to provider comfort level in the following areas: (1) assessing for medical or sleep contributors themselves rather than referring to a specialist, which led us to modify the practice pathway to allow for both options; (2) providing education to families in use of the toolkit, which affected the length at which follow-up occurred (eg, a second visit with a nurse educator might be needed for toolkit implementation if the provider was too busy to educate families at the time of the initial clinic visit); and (3) treating insomnia with medications on their own versus referring to a sleep specialist. When a child was referred to the sleep specialist, ensuring that the sleep specialist communicated back to the provider regarding recommendations was also an issue related to applying the practice pathway in our field testing, particularly as related to follow-up care.

We modified the flow of the practice pathway in response to feedback during the field testing. Initially, the practice pathway prioritized evaluation and treatment of medical contributors before implementing educational measures, such as the toolkit. However, based on the feedback of clinicians, the

evaluation/treatment of medical contributors and the implementation of educational measures became a parallel process as opposed to a sequential “first–then” approach.

DISCUSSION

We report here on the development of a practice pathway for the evaluation and management of insomnia in children who have ASD. There are several key points of this practice pathway. First, general pediatricians, primary care providers, and autism medical specialists should screen all children who have ASD for insomnia because parents may not volunteer sleep concerns despite these concerns being contributors to medical comorbidities and behavioral issues. Second, the evaluation of insomnia should include attention to medical contributors that can affect sleep, including other medical problems that encompass gastrointestinal disorders, epilepsy, psychiatric comorbidities, medications, and sleep disorders including sleep-disordered breathing, restless legs syndrome (unpleasant sensations in the legs associated with an urge to move), periodic limb movements of sleep (rhythmic leg kicks during sleep), and parasomnias (undesirable movements or behaviors during sleep, such as sleepwalking, sleep terrors, or confusional arousals). In parallel with this screening, the need for therapeutic intervention should be determined. We also determined that educational/behavioral interventions are the first line of treatment, after excluding medical contributors. If an educational (behavioral) approach does not seem feasible, or the intensity of symptoms has reached a crisis point, the use of pharmacologic treatment is considered. Finally, clinicians should assure timely follow-up to monitor progress and resolution of insomnia.

This practice pathway expands the literature that currently exists for typically developing children related to screening and management.^{5,7–9} The rationale for developing a practice pathway that uniquely addresses this population is because children who have ASD, and their families, have unique needs. For example, medical, neurologic, and psychiatric comorbidities are common in children who have ASD, as is the use of medications that influence sleep. In addition, parents of children who have ASD, struggling with the stressors related to their child's disability and the often accompanying behavioral challenges, may not volunteer sleep to be of concern. In turn, pediatric providers may not ask about sleep due to competing medical and behavioral issues. Furthermore, sleep problems are more common in children who have ASD than in children of typical development,^{2,3} and their treatment may impact favorably on daytime behavior and family functioning. Given these factors, we do recognize that children who have other disorders of neurodevelopment could also benefit from this practice pathway, as they share common features with children who have ASD, including

comorbid conditions, parental stressors, and prevalent sleep problems.

The systematic review of the available treatment literature allowed for the recognition that evidence-based standards for the behavioral, pharmacologic, and other treatments of insomnia in ASD are not yet available. Thus, much of these guidelines reflect expert opinion given the absence of data. Additional studies are needed to establish the efficacy and safety of supplemental melatonin, as well as other pharmacologic agents, in large RCTs. Similar studies are needed to address the efficacy of parent-based sleep educational programs to address insomnia, as well as the combination of these educational programs with pharmacologic strategies. Finally, the role of nonpharmacologic methods (apart from educational therapies) warrants study as well. As additional research studies are performed, the clinical pathway will likely require modification. However, it is expected that the overarching approach to insomnia in the child who has ASD will not change. Although the practice pathway was piloted at 4 ATN sites, the next steps involve the wide dissemination of the practice pathway into pediatric

practices. We would also like to develop a practice pathway for nonmedical health professionals who are likely to provide behavioral interventions, including psychologists.

Strengths of the study include the gathering of the following groups: experts in sleep medicine from a variety of disciplines, including neurology, psychiatry, pulmonary medicine, and psychology; engaged pediatricians specializing in ASD; and parents of children who have ASD. Weaknesses include limited evidence-based studies on which to base the practice pathway, making it necessary to rely on expert opinion.

CONCLUSIONS

The practice pathway regarding the identification of insomnia in children who have ASD requires future field testing in clinical settings but represents a starting point to managing insomnia in a growing population of children with the most common neurodevelopmental disability.

ACKNOWLEDGMENT

The valuable assistance of the members of the ATN Sleep Committee in reviewing this document is gratefully acknowledged.

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Goldman, Rebecca Panzer, Daniel L. Coury and Dan G. Glaze
Pediatrics 2012;130;S106
DOI: 10.1542/peds.2012-0900I

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