British Thoracic Society Guideline for diagnosing and monitoring paediatric sleep-disordered breathing

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INTRODUCTION

The following is a summary of the British Thoracic Society (BTS) Guideline for diagnosing and monitoring paediatric sleep-disordered breathing (SDB) and includes a summary of the recommendations and good practice points (GPPs). The full guideline is published as a separate Thorax Supplement[1] and is available from the BTS website.[2] Please refer to the full guideline for full information about each section.[1] All online supplemental appendices are also available via the BTS website.[2]

Background

The aim of the guideline was to provide clarification on the use of diagnostic tools and recordings in the diagnosis and monitoring of children with SDB. The reviewed techniques include sleep questionnaires, pulse oximetry, cardiorespiratory sleep studies (CRSS), sleep video recordings, sleep audio recording and carbon dioxide (CO_2) monitoring. Taking each of these techniques individually, the guideline provides important information on:

1. The basic principles behind the different technologies.
2. The technical and patient considerations.
3. The indications for different types of sleep study.
4. The diagnostic criteria for abnormalities on sleep studies.

Issues around appropriate service provision in the UK are also briefly discussed.

Target audience for the guideline

The guideline will be of interest to clinicians caring for children with SDB including paediatric respiratory physicians, general paediatricians, paediatric respiratory nurses, paediatric physiotherapists, sleep physiologists, paediatric neurologists, otorhinolaryngologists, other allied health professionals and patients and carers.

Areas covered by the guideline

The guideline focuses on how investigative techniques are best used within the National Health Service (NHS) to diagnose and monitor children (0–16 years) with sleep disordered breathing. An overview is provided on the use of sleep studies to investigate SDB and focuses on sleep diagnostics for groups of children with or without comorbidities rather than on specific diseases.

The guideline does not cover specific sleep disorders, such as obstructive sleep apnoea (OSA), as alternative guidance is already available.[3 4]

Recommendations have not been made on techniques that are not widely available within the UK.

METHODOLOGY

BTS guidelines use the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) methodology for guideline development.[5] GRADE is a systematic and transparent process for assessing the quality of the evidence and the full GRADE process involves:

1. Systematic review.
2. Critical appraisal.
3. GRADE analysis.

Full details of the BTS process are available in the BTS guideline production manual (https://www.brit-thoracic.org.uk/quality-improvement/guidelines/).

Clinical questions, patient-centred outcomes and literature search

Clinical questions were defined from the scope of the guideline and formulated into PICO (population, intervention, comparator and outcome) style framework diagnostic accuracy, intervention or prognostic review formats. Patient-centred outcomes were agreed by the group for each question. The clinical questions are listed in Appendix 3 of the full guideline.[1]

The PICO framework formed the basis of the literature search. The initial searches were completed by the University of York, and the latter stages by BTS Head Office. Systematic electronic database searches were conducted to identify all papers that may be relevant to the guideline. For each question, the following databases were searched: Cochrane Database of Systematic Reviews (CDSR), Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and EMBASE. The search strategy is available for review in Online supplement appendix 12 of the full guideline.[1]

Table 1 GRADE score definitions

GRADE		Definition
High	⨁⨁⨁⨁	High confidence that the true effect is close to the estimated effect
Moderate	⨁⨁⨁◯	Moderate confidence that the true effect is close to the estimated effect
Low	⨁⨁◯◯	Low confidence that the true effect is close to the estimated effect
Very low	⨁◯◯◯	Very low confidence that the true effect is close to the estimated effect
Ungraded		GRADE analysis not possible, but evidence deemed important

GRADE, Grading of Recommendations, Assessment, Development and Evaluation.

Critical appraisal and GRADE analysis of the evidence

After an initial screening to determine relevance to the clinical questions, each paper was assessed to determine if it addressed:

1. The clinical question population.
2. The index test and reference standard (for diagnostic accuracy questions), the intervention and comparator (for intervention questions) or the exposure and referent (for prognostic questions).
3. The study type(s) defined in the clinical question protocol.
4. The clinical question outcome(s).

Each full paper fulfilling the above criteria was 'accepted' for inclusion. In circumstances where there was little, or no supporting evidence that fulfilled the above criteria, the full paper inclusion strategy was widened to include evidence that partially addressed the clinical question.

Following data extraction from the 'accepted' papers, evidence profiles were generated for each of the clinical questions and the quality of the evidence was assessed using the GRADE principles.[5] Where GRADE analysis was not possible, but the evidence was deemed important enough to be included in the guideline, the evidence has been listed as (Ungraded), denoting that inclusion was reached by consensus of the Guideline Development Group (GDG). A definition of the GRADE scores is shown in table 1.

The direction and strength of the recommendations are then based on the quality of the evidence, the balance of desirable and undesirable outcomes and the values and preferences of patients/carers. GRADE specifies two categories of strength for a recommendation as shown in table 2.

From the outset, it was acknowledged that there would be little high-quality evidence for some of the clinical questions identified. In this instance, low-grade evidence was considered, along with the expert opinion of the GDG via informal consensus at the meetings.

GPPs were also developed by informal consensus in areas where there was no quality evidence but the GDG felt that some guidance, based on the clinical experience of the GDG, might be helpful to the reader. These are indicated as shown below.

✓ Advised best practice based on the clinical experience of the GDG.

In some instances where evidence was limited, but GDG members felt that it was important to include a recommendation rather than a GPP, recommendations were agreed by informal consensus and categorised as (Conditional—by consensus), based on the same criteria detailed in table 1.

Full information on the consensus method used is available at https://www.brit-thoracic.org.uk/quality-improvement/guidelines/sleep-disordered-breathing-in-children/.

Declarations of interests

All members of the GDG made declarations of interest in line with BTS policy and further details can be obtained on request from BTS Head Office. GDG members are listed in Appendix 3 to the full guideline.

Stakeholders

Stakeholders were identified at the start of the process. All stakeholder organisations were notified when the guideline was available for public consultation and a list of all stakeholders is listed in Appendix 4 to the full guideline.[1]

SUMMARY OF RECOMMENDATIONS AND GPPS

Please note that sleep-disordered breathing (SDB) in children without comorbidities is related to snoring and upper airway obstruction and commonly referred to as obstructive sleep apnoea (OSA).

Diagnosing SDB in children with suspected SDB

Sleep questionnaires, combined sleep questionnaires and 'protocol-driven' clinical assessments, sleep video recordings and sleep audio recordings

Children without comorbidities

Recommendations

- The Sleep-Related Breathing Disorder scale of the Paediatric Sleep Questionnaire (SRBD-PSQ), with a cut-off of ≥0.33, or Obstructive Sleep Apnoea-18 item questionnaire (OSA-18), with a cut-off of ≥0.60, can be considered for diagnosing moderate-to-severe SDB in children of at least 2 years of age with no comorbidities. If a test questionnaire is inconsistent with clinical features or if a higher degree of diagnostic certainty is required, further tests, such as pulse oximetry, a cardiorespiratory sleep study (CRSS) or polysomnography (PSG), are recommended. (Conditional)
- Sleep questionnaires combined with a 'protocol-driven' clinical assessment can be considered for diagnosing SDB in children, but it should be noted that the sleep clinical record (SCR) is labour-intensive, taking approximately 30 min to complete. If a test questionnaire is inconsistent with clinical features, or if a higher degree of diagnostic certainty is required, further tests such as pulse oximetry, CRSS or PSG are recommended. (Conditional)

Table 2 Explanation of the terminology used in BTS recommendations

Strength	Benefits and risks	Implications
Strong Recommended, so 'offer'	Benefits appear to outweigh the risks (or vice versa) for the majority of the target group	Most service users would want to, or should receive this intervention
Conditional Suggested, so 'consider'	Risks and benefits are more closely balanced, or there is more uncertainty in likely service users' values and preferences	Service users should be supported to arrive at a decision based on their values and preferences

BTS, British Thoracic Society.

Good practice points

- ✓ Clinical questionnaires, combined with clinical examination, can identify moderate or severe SDB with a moderate-to-high sensitivity and low-to-moderate specificity. This may be considered adequate, for example, in relation to deciding whether, or not to pursue surgery to improve the airway (eg, tonsillectomy).
- ✓ The Clinical Assessment Score-15 (CAS-15) combined sleep questionnaire and 'protocol-driven' clinical assessment can be considered for diagnosing SDB in children. In contrast to the SCR, the CAS-15 takes 10 min to complete but has a reduced sensitivity of moderate.
- ✓ Sleep questionnaires should not be considered for diagnosing SDB in children under 2 years of age, or if mild SDB is suspected.

Children with comorbidities

Good practice point

- ✓ Sleep questionnaires should not be considered for diagnosing SDB in children with comorbidities.

Pulse oximetry and CRSS

Children without comorbidities

Recommendation

- ► For children with suspected SDB, pulse oximetry can be considered as a first-line diagnostic test for SDB. If a test result does not fit the clinical picture, a higher level of investigation, such as a CRSS, may be required (see also the GPPs section below). (Conditional)

Good practice points

- ✓ If pulse oximetry is normal, but there is suspicion of SDB, a CRSS may be useful to identify mild OSA. Sleep video recording may also be considered to give a clearer picture.
- ✓ If pulse oximetry is abnormal, CRSS are more specific and can discriminate between central and obstructive events.
- ✓ When analysing and interpreting paediatric pulse oximetry traces, a 4% Oxygen Desaturation Index (ODI4) cut-off of >4/hour and/or a 3% Oxygen Desaturation Index (ODI3) cut-off of >7/hour are suggestive of an abnormality in children over 2 years of age. Baseline mean oxygen saturations (SpO_2) of <95%, desaturations to <90% and clustering and depth of desaturation events should also be considered in pulse oximetry interpretation.[6 7] If one pulse oximetry parameter is considered abnormal when the other parameters are considered normal, a CRSS should be considered.
- ✓ While pulse oximetry is non-discriminatory at all ages, particular caution is required in using oximetry to diagnose OSA in children under 2 years of age as children in this age group are predisposed to central sleep apnoea (as a result of developmental immaturity) and oxygen desaturations cannot discriminate between obstructive and central events.
- ✓ If a child is unable to tolerate CRSS equipment, for example children with autistic spectrum disorder, consideration should be given to using play therapy techniques to facilitate data acquisition. Consideration should also be given to undertaking CRSS in the home (see the 'Home monitoring (pulse oximetry or CRSS)' recommendations and GPPs section).
- ✓ If a CRSS test result does not fit the clinical picture, PSG should be considered. An exception to this is when CRSS rules out a diagnosis of SDB and a diagnostic pathway for narcolepsy should be considered.
- ✓ Clinicians are cautioned from using Apnoea Hypopnoea Index (AHI) alone to guide decision making.
- ✓ If hypoventilation is suspected, please refer to the 'Pulse oximetry and CO_2 monitoring' recommendations and GPPs below.

Children with comorbidities

Recommendation

- ► For children with neuromuscular disorders or Down syndrome predisposing to SDB, CRSS can be considered for diagnosing SDB. (Conditional)

Good practice points

- ✓ Although CRSS can only be recommended as a diagnostic tool for SDB in children with neuromuscular disorders or Down syndrome, CRSS can be considered as a first line diagnostic tool for children with other comorbidities.
- ✓ If a CRSS is abnormal, the significance of the findings should be carefully considered and the range of potential management options discussed with the child and their family/carer.
- ✓ If CRSS findings are inconsistent with the clinical picture the clinical history should be reviewed giving specific consideration to non-respiratory causes of sleep disorders. Referral to a neurology sleep service for assessment should also be considered.
- ✓ If a CRSS is not available, pulse oximetry can be considered as an initial diagnostic test for SDB in children with comorbid disorders, but if a test result is abnormal caution must be taken in interpreting the results as desaturations may have varying causes. Referral for more complex studies may be required to assess for hypoventilation and determine the cause and mechanisms of desaturation.
- ✓ If a pulse oximetry test is normal, this does not exclude SDB and clinical review should consider repeat/additional testing.
- ✓ Clinicians are cautioned from using AHI alone to guide decision making.
- ✓ If hypoventilation is suspected, please refer to the 'Pulse oximetry and carbon dioxide (CO_2) monitoring' recommendations and GPPs below.

Pulse oximetry and CO_2 monitoring

Children without comorbidities

Recommendation

- ► The addition of CO_2 monitoring to pulse oximetry is not recommended for diagnosing SDB in children without comorbidities. (Conditional—by consensus)

Children with comorbidities

Recommendation

- ► The addition of CO_2 monitoring to pulse oximetry should be considered for children with comorbidities and suspected SDB where hypoventilation is suspected, such as patients with neuromuscular disease or patients suspected of central hypoventilation (eg, congenital central hypoventilation syndrome). (Conditional—by consensus)

Good practice points

- ✓ If CO_2 measurements are not consistent with the clinical picture, this should be confirmed using a blood gas measurement. If using a transcutaneous CO_2 monitor, this should be recalibrated first. If the problem is not resolved, consideration should be given to checking and changing the sensor head membrane.

- ✓ Pulse oximetry with CO_2 monitoring can be considered as a screening tool to identify hypoventilation in children with comorbidities, or to assess response to adjustments to ventilatory settings in the home setting.
- ✓ The American Academy of Sleep Medicine (AASM) recommends scoring hypoventilation during sleep when >25% of the total sleep time, as measured by either the arterial PCO_2 or surrogate (transcutaneous or end tidal which is more relevant in paediatrics), is spent with a PCO_2 >50 mm Hg/6.7 kPa.[8]

Home monitoring (pulse oximetry or CRSS)

Recommendation

- ► Home CRSS can be considered for diagnosing SDB in children without comorbidities where the patients and/or carers are deemed appropriate for implementing a home sleep study. If a test result is inconsistent with the clinical picture, or data are incomplete, a repeat study should be offered and consideration should be given as to whether this should be undertaken as an inpatient. (Conditional—by consensus)

Good practice points

- ✓ Home CRSS can be considered for children with comorbidities and pulse oximetry can be considered for children with, or without comorbidities if the patient and carer are deemed appropriate for home sleep studies.
- ✓ Care should be taken in defining 'total sleep time' during home sleep studies as it may differ between centres, for example, some may use total recording time, while some may base it on sleep time documented in the overnight sleep diary.
- ✓ If the data acquired during a home study are fragmented with frequent interruptions due to poor signal quality, consideration should be given to repeating the study as an inpatient.
- ✓ Parents who choose home monitoring should be supported with training in order to optimise data acquisition of sleep studies in the home environment. This training might involve patient leaflets, patient videos or videoconferencing calls with health professionals skilled in setting up sleep studies.

Pulse oximetry/CRSS optimal monitoring time and process

Pulse oximetry motion artefact removal and averaging time

Recommendation

- ► Pulse oximetry should be undertaken using an oximeter with a software algorithm to minimise the influence of motion artefact. (Conditional—by consensus)

Good practice point

- ✓ Based on the Australasian Sleep Association's 'Overnight oximetry for evaluating paediatric OSA: Technical specifications and interpretation guidelines',[9] a short pulse oximetry averaging time of 2–3 s should be used when diagnosing SDB in children.

Pulse oximetry/CRSS optimal monitoring time

Good practice point

- ✓ Sleep studies, using pulse oximetry or a CRSS, with 4–6 hours of continuous sleep duration should be adequate for diagnosing moderate-to-severe SDB in children. The sleep duration is defined as continuous to allow adequate opportunity for all sleep stages to occur. Combining short episodes of sleep interspersed with wake to create 4–6 hours of sleep recording may miss parts of the sleep cycle and is not advised. This includes children under the age of 2 years, where rapid eye movement (REM) cycles are more evenly dispersed through the night. If a child is older than 2 years of age (when REM sleep is greater in the latter half of the night), or if mild disease is to be excluded, a period of longer than 6 hours is advised.

Pulse oximetry/CRSS optimal number of monitoring nights

Recommendation

- ► A single night of pulse oximetry monitoring, ideally consisting of 6 hours of continuous sleep duration, can be considered adequate for identifying SDB in children without comorbidities. (Conditional—by consensus)

Good practice points

- ✓ A single night of CRSS monitoring should also be considered adequate for identifying SDB in children without comorbidities.
- ✓ If it is anticipated that a child will poorly tolerate a pulse oximetry probe, consider providing a pulse oximeter for more than one night to acquire at least one night of technically adequate data. Alongside the sleep log data, information on how typical the period of sleep was for the child should also be collected.
- ✓ If pulse oximetry or CRSS is being considered for diagnosing SDB in children with comorbidities, more than one night of monitoring should be considered, particularly if a parent/carer reports that an initial period of monitoring is not representative of the child's sleep.
- ✓ If a CRSS is normal but symptoms are ongoing, a repeat CRSS should be performed.

CO_2 monitoring and pulse oximetry for monitoring home ventilation

Good practice points

- ✓ If children are receiving continuous positive airway pressure (CPAP) therapy or bilevel positive airway (BiPAP) pressure therapy, regular monitoring should be provided with a minimum of pulse oximetry and CO_2 monitoring.
- ✓ When deciding on which type of sleep study to perform, the relative risks and benefits of each should be discussed with the patient and/or carer.
- ✓ Data download from a CPAP device or ventilator can help complement results from a sleep study, but operators should note that many ventilator algorithms, such as AHI, have not been validated in children.

Narcolepsy

Recommendations

- ► If SDB is excluded, or effectively treated, and excessive daytime sleepiness (EDS) persists, other diagnoses including narcolepsy, with possible coexistent cataplexy, sleep paralysis, hypnagogic and hypnopompic hallucinations and circadian rhythm disorders should be considered. (Conditional—by consensus)
- ► As cataplexy may be subtle, both child and parents/carers should be asked about head nods, neck/shoulder posturing and eyelid/facial droop. These are typically associated with laughter but may also be associated with anger or frustration. (Conditional—by consensus)
- ► Both child and parents/carers should be asked about sleep paralysis, hypnagogic and hypnopompic hallucinations. (Conditional—by consensus)

► Both child and parents/carers should be asked about sleep onset and wake up times to elicit total sleep time and sleep latency to exclude a circadian rhythm disorder that can be associated with EDS. (Conditional—by consensus)

Good practice points

✓ An awareness of rare conditions in children, which may primarily present with EDS, should always be maintained.
✓ As the associated symptoms of narcolepsy may be subtle or may not be volunteered, directed questions in the clinical history should be used to elicit a possible diagnosis of narcolepsy in children and initiate referral to a specialist paediatric sleep service for specialist assessment and investigation. The current standard of diagnostic investigation is a 1-week period (minimum, preferably 2 weeks) of actigraphy with PSG and multiple sleep latency testing (MSLT). These investigations should be performed in line with AASM/European Sleep Research Society (ESRS) guidance.[10 11]
✓ Children with narcolepsy should be under the care of a clinician with special expertise in the management of narcolepsy. This may be a paediatric neurologist or a sleep physician, depending on local service arrangements.

Sleep assessments for children undergoing tonsillectomy

Recommendations

► Routine preoperative sleep monitoring as a basis for surgical decision making is not recommended in children without comorbidities who are over the age of 2 years, and in whom severe OSA is not suspected. (Conditional—by consensus)
► Preoperative sleep monitoring before tonsillectomy (with or without adenoidectomy) should be considered for children who are less than 2 years of age to allow preoperative planning. (Conditional—by consensus)

Good practice points

✓ Preoperative sleep monitoring before tonsillectomy (with or without adenoidectomy) may be considered for children of all ages with comorbidities (eg, obesity, Down syndrome, cerebral palsy, neuromuscular disease) and suspected SDB to confirm a diagnosis of SDB and allow preoperative planning.
✓ A preoperative pulse oximetry sleep study before tonsillectomy (with or without adenoidectomy) may be considered for children without comorbidities with suspected severe OSA.
✓ Sleep monitoring following tonsillectomy (with or without adenoidectomy) may also be considered for children with severe OSA, with or without comorbidities, if there is a clinical need (eg, less than 2 years of age, Down syndrome, obesity, cerebral palsy, neuromuscular disease).

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Disclaimer Healthcare providers need to use clinical judgement, knowledge and expertise when deciding whether it is appropriate to apply recommendations for the management of patients. The recommendations cited here are a guide and may not be appropriate for use in all situations. The guidance provided does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and/or their guardian or carer.

Competing interests None declared. BTS Declarations of Interest forms have been completed by all members for each year they were part of the GDG. Details of these forms can be obtained from BTS Head Office. 'Declarations of Interest' was a standing item at each GDG meeting.

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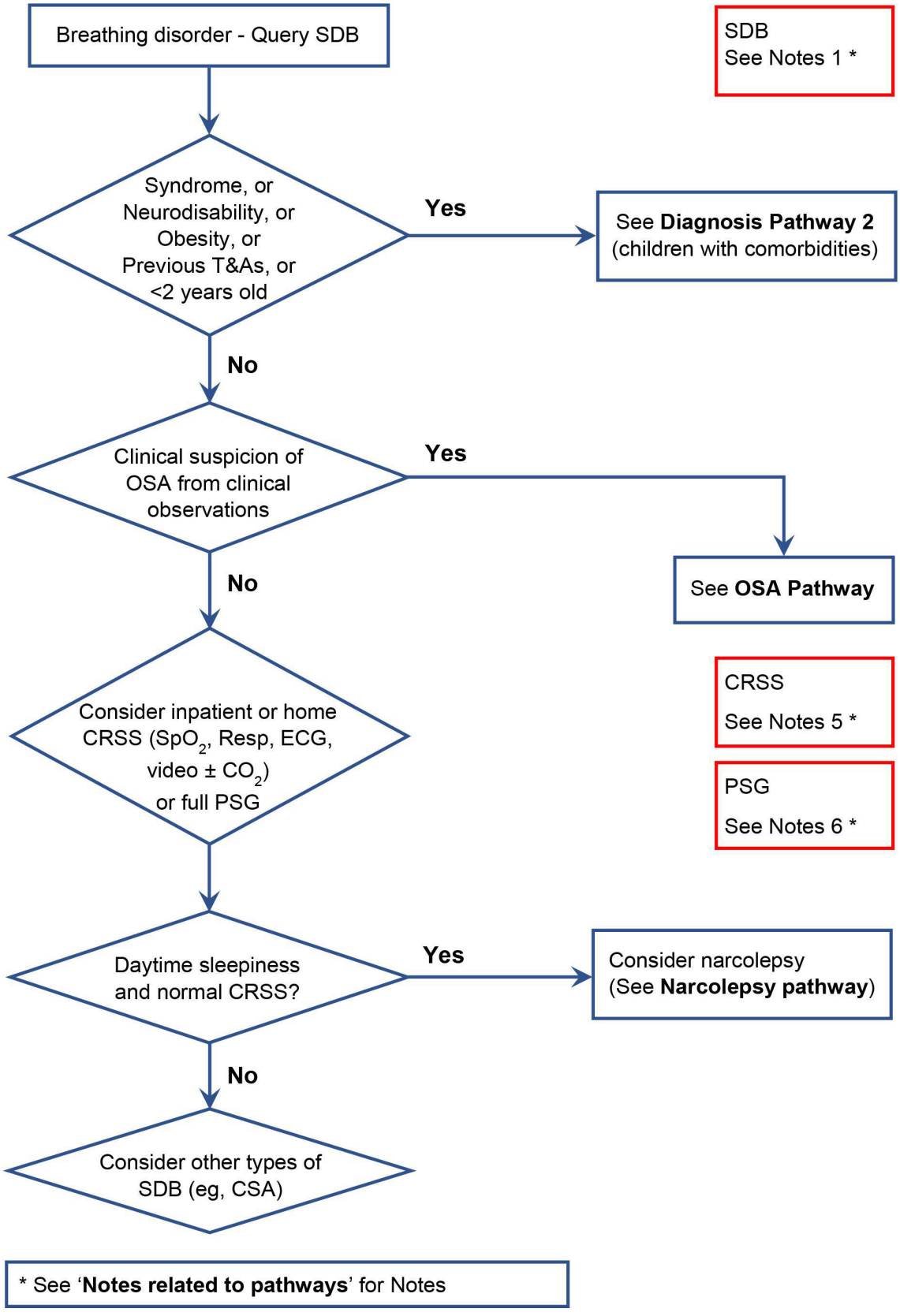
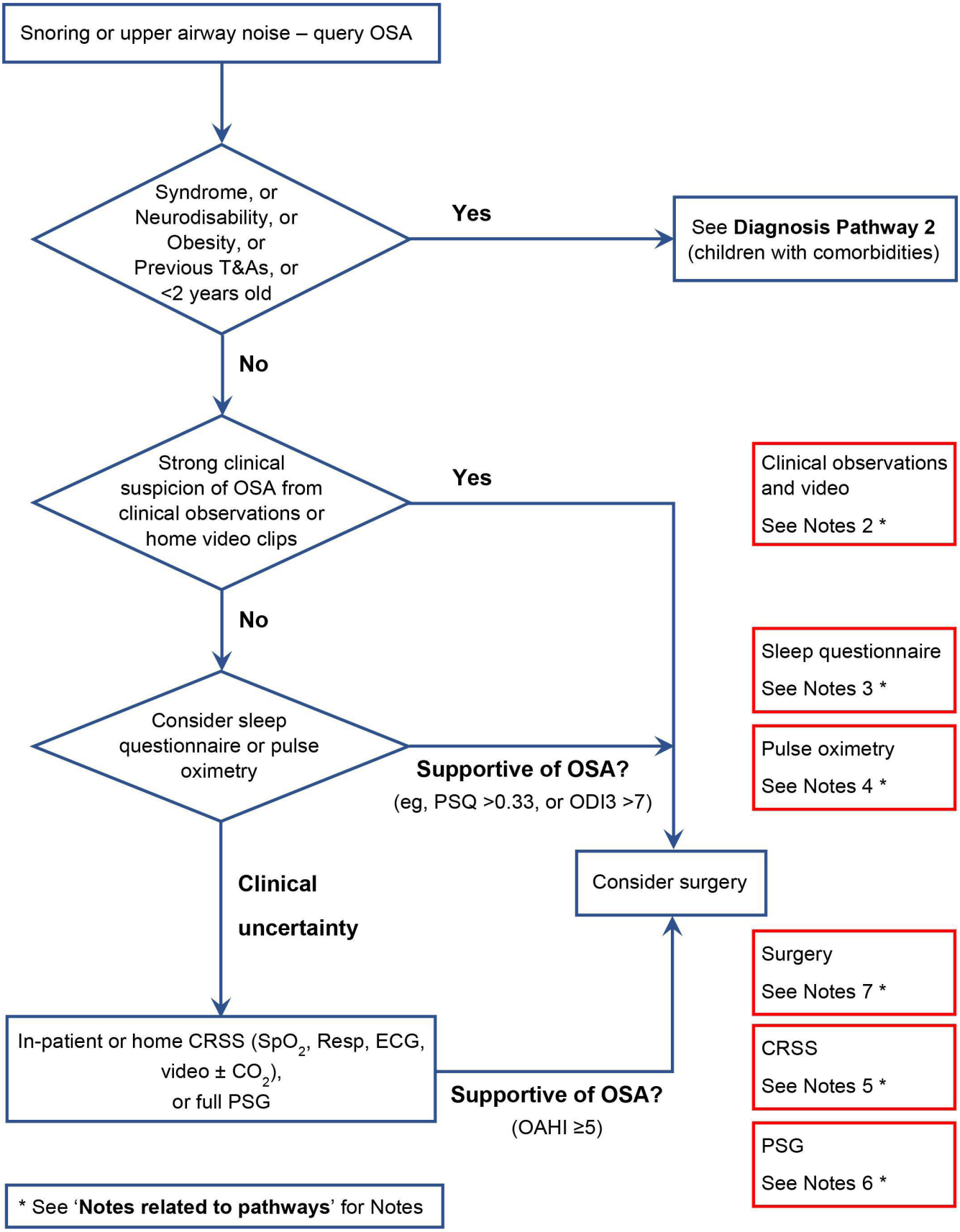
APPENDIX 1 – CLINICAL PATHWAYS/OPTIMAL PROCESS INFORMATION

Diagnosis Pathway 1 (Children without comorbidities).



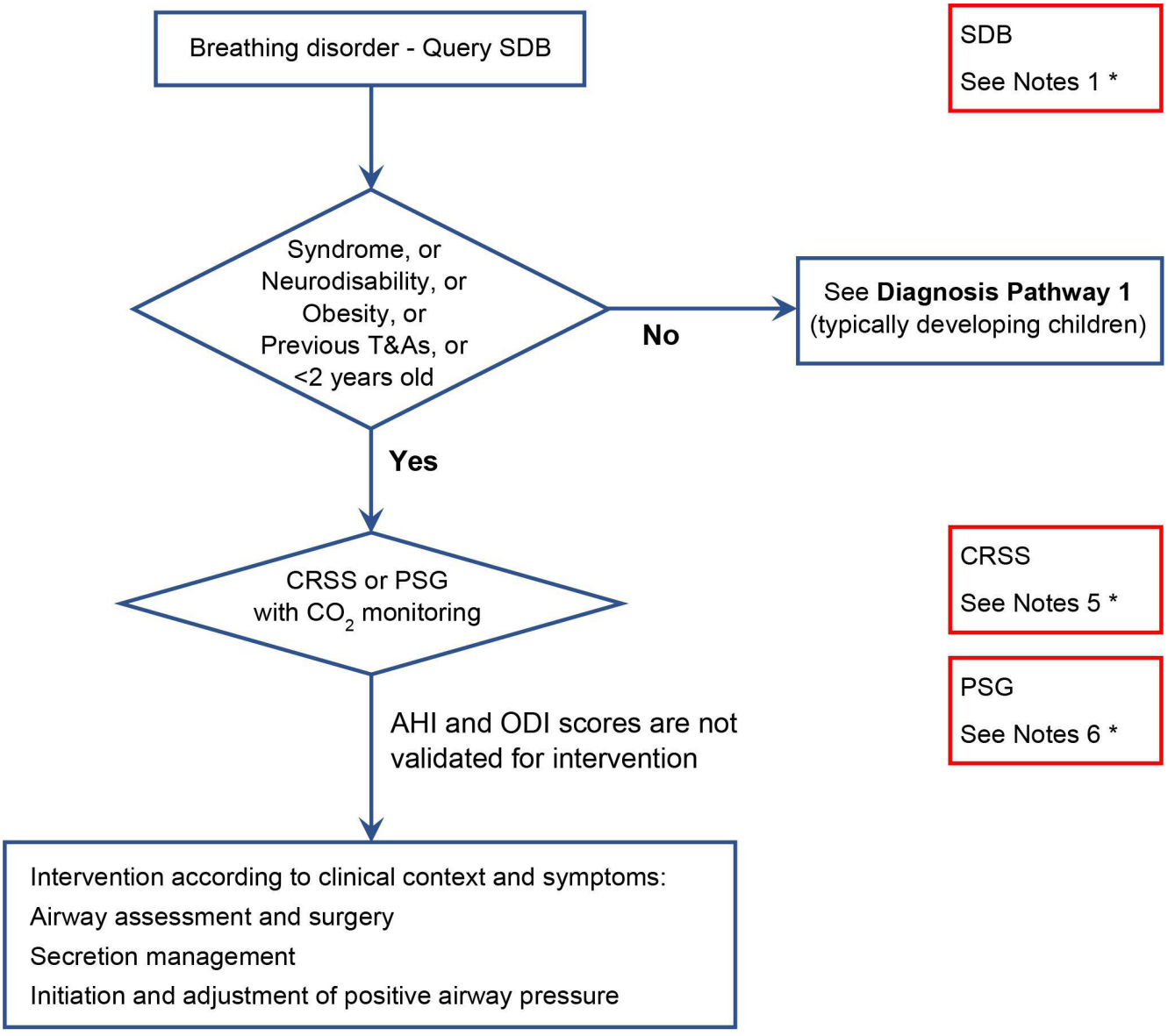
CRSS, cardiorespiratory sleep study; CSA, central sleep apnoea; OSA, obstructive sleep apnoea; PSG, polysomnography; SDB, sleep-disordered breathing; SpO_2, oxygen saturation; T&As – tonsillectomy and adenoidectomy.

Obstructive sleep apnoea pathway



CRSS, cardiorespiratory sleep study; OAHI, obstructive apnoea hypopnoea index; ODI3, oxygen desaturation index; OSA, obstructive sleep apnoea; PSG, polysomnography; PSQ, paediatric sleep questionnaires; SDB, sleep-disordered breathing; SpO_2, oxygen saturation; T&As – tonsillectomy and adenoidectomy.

Diagnosis Pathway 2 (Children with comorbidities)



* See '**Notes related to pathways**' for Notes
† Spirometry can also be considered, but has not been included in the evidence review

CRSS, cardiorespiratory sleep study; AHI, apnoea hypopnoea index; ODI, oxygen desaturation index; PSG, polysomnography; SDB, sleep-disordered breathing; SpO_2, oxygen saturation; T&As – tonsillectomy and adenoidectomy.

Pulse oximetry optimal monitoring time/process

Optimal pulse oximetry settings for monitoring SDB in children

Oximetry variable	Optimal setting(s)
Motion artefact removal	Motion artefact removal should be used.
Averaging time	2–3 s
Monitoring time (hours)	4–6 hours continuous sleep duration if moderate-to-severe SDB is suspected.
	>6 hours continuous sleep duration if mild SDB is suspected.
Monitoring time (nights)	1 night for children without comorbidities.
	Consider >1 night for children with comorbidities.
	Consider >1 night if initial period of monitoring not representative of child's sleep.

Pulse oximetry measurements suggestive of an abnormality in children >2 years of age

Oximetry variable	Abnormal measurement
ODI4	A cut-off of >4/hr
ODI3	A cut-off of >7/hr
Mean SpO_2	<95%
Clustering and depth of desaturation events should also be considered (eg, mean >4% desaturation nadir <90%, or 3 episodes of desaturation <80%)	

Precautions when analysing home pulse oximetry

Care should be taken when defining 'total sleep time' as different centres can use different definitions (eg, total recording time or sleep time documented in an overnight sleep diary)

Oximetry cannot discriminate between obstructive or non-obstructive events or determine hypoventilation.

CRSS optimal monitoring time/process

Optimal CRSS monitoring times for diagnosing SDB in children

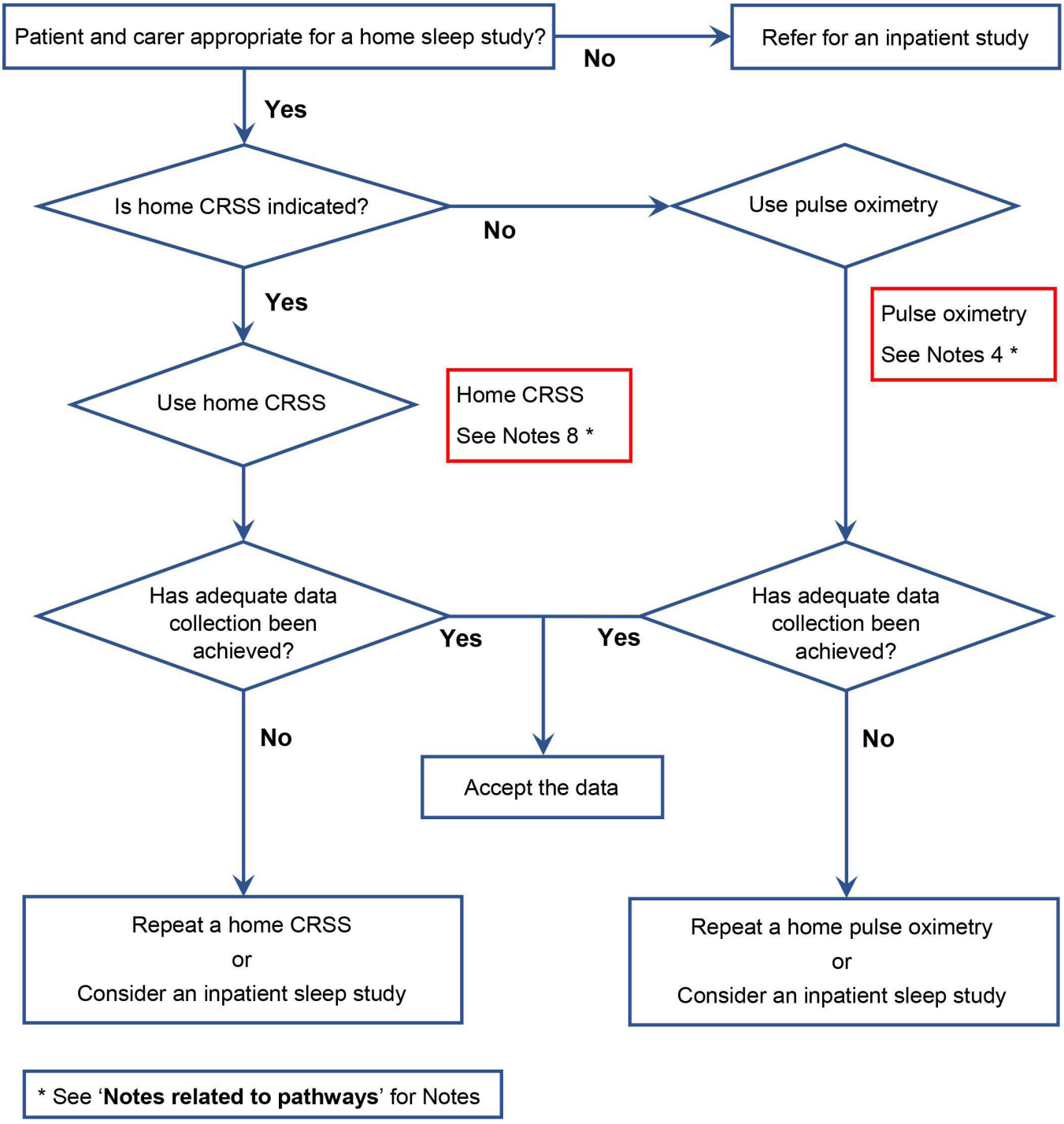
CRSS variable	Optimum
Monitoring time (hours)	4–6 hours continuous sleep duration if moderate-to-severe SDB is suspected.
	>6 hours continuous sleep duration if mild SDB is suspected.
Monitoring time (nights)	1 night for children with/without comorbidities.
	>1 night if initial period of monitoring not representative of child's sleep.

Considerations if a CRSS is normal

If a cardiorespiratory sleep study is normal but symptoms are ongoing, a repeat cardiorespiratory sleep study should be performed.

If a child has a normal CRSS, but has daytime sleepiness, narcolepsy can be considered (see the Narcolepsy pathway).

Home monitoring pathway



CRSS, cardiorespiratory sleep study.

Home ventilation

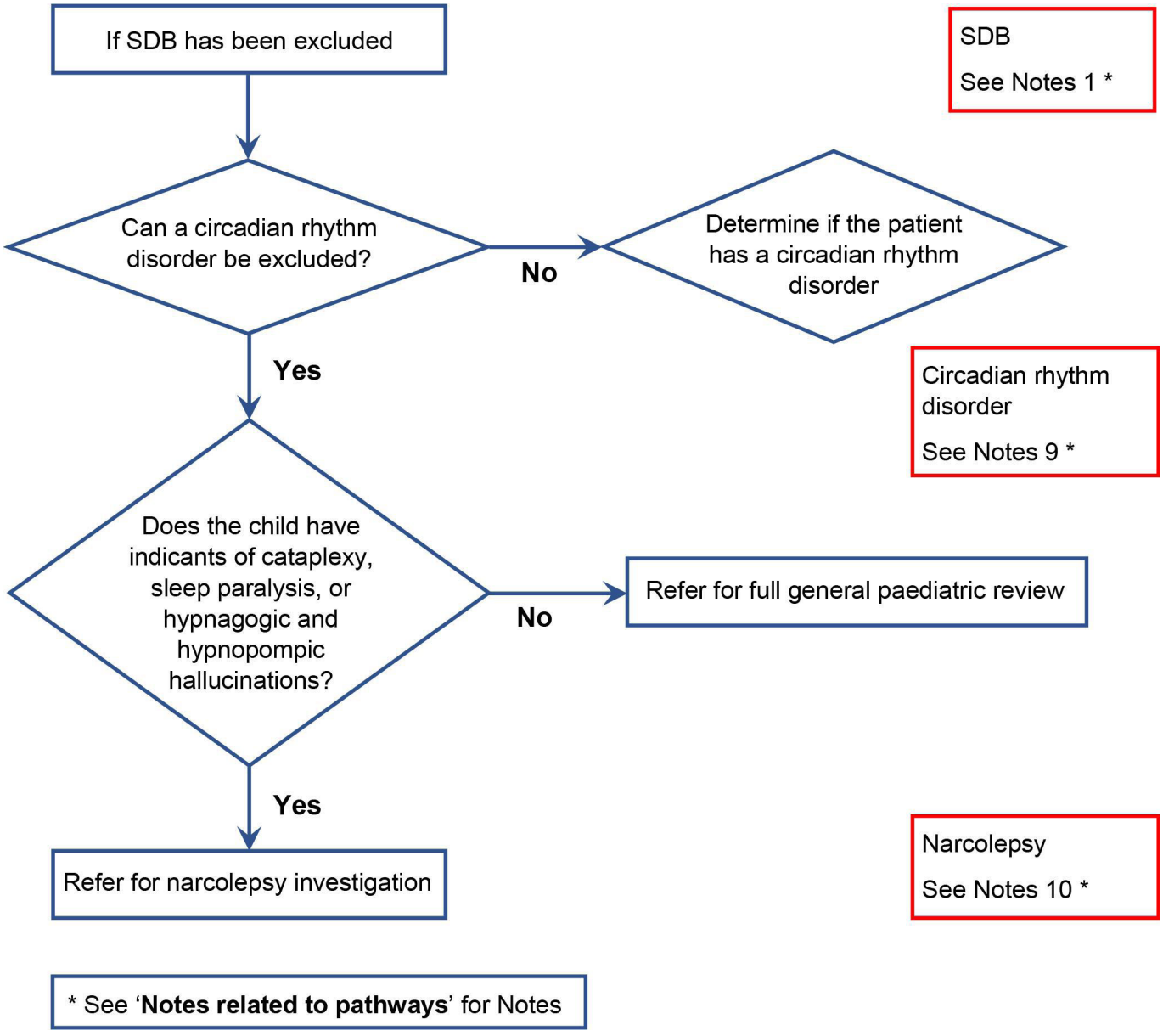
Pulse oximetry and CO_2 monitoring

CPAP or BiPAP treatment

For children receiving continuous positive airway pressure therapy (CPAP) or bi-level positive airway pressure (BiPAP), regular monitoring should be provided with a minimum of pulse oximetry and carbon dioxide monitoring.

When downloading from a CPAP device or ventilator, it should be noted that many ventilator algorithms, such as apnoea hypopnoea index (AHI), have not been validated in children.

Narcolepsy pathway



SDB, sleep-disordered breathing.

Notes related to pathways

Notes 1	Sleep disordered breathing (SDB) An awareness of rare conditions in children, which may primarily present with excessive daytime sleepiness, should always be maintained.
Notes 2	Clinical observations & video recordings There is currently insufficient evidence to make recommendations for use of sleep video or audio recordings to diagnose SDB. Video and audio recordings do not have validated scoring systems. Clinicians use these in a similar way to clinical observation to support intervention to treat SDB, but there is no method for scoring overall severity in sleep.
Notes 3	Sleep questionnaires SRBD-PSQ ≥0.33 and OSA-18 ≥0.60 questionnaires are recommended for diagnosing moderate-to-severe obstructive sleep apnoea (OSA) (AHI ≥5) in children without comorbidities. Questionnaires are not validated in children <2 years of age. Due to a lack of evidence, the use of sleep questionnaires for diagnosing SDB in children with comorbidities is not supported at this time. Sleep questionnaires will not detect mild SDB. If higher diagnostic certainty is needed, further monitoring with pulse oximetry, CRSS or PSG are advised.
Notes 4	Pulse oximetry Pulse oximetry can be considered as a first-line diagnostic test for SDB in children, but a normal study does not exclude the presence of mild to moderate SDB. Pulse oximetry ODI4 >4/hour or ODI3 >7/hour is supportive of a diagnosis of SDB. Pulse oximetry does not discriminate between obstructive and non-obstructive events, and for this reason should be used with caution in children under 2 years and for children with comorbidities for diagnosing OSA. A normal pulse oximetry study does not exclude the possibility of hypoventilation. The addition of carbon dioxide monitoring (CO_2) to pulse oximetry does not increase the diagnostic yield in children without comorbidities. The addition of CO_2 monitoring to pulse oximetry can be considered for children with comorbidities and suspected SDB where hypoventilation is suspected.
Notes 5	Cardiorespiratory sleep studies (CRSS) CRSS can be considered as a first line diagnostic tool for children with, or without comorbidities. The addition of CO_2 monitoring to CRSS probably does not increase the diagnostic yield in children without comorbidities. The addition of CO_2 monitoring to CRSS can be considered for children with comorbidities and suspected SDB where hypoventilation is suspected.
Notes 6	Polysomnography (PSG) PSG provides information on sleep architecture, as well as arousals related and unrelated to respiratory events. PSG is mostly performed with supervision and as an inpatient; unsupervised diagnostic PSG can be done in the home setting with good effectiveness. PSG is done to diagnose sleep behaviour disorders, eg, parasomnias, and to exclude SDB, for example, in narcolepsy. PSG needs to be done in conjunction with multiple sleep latency testing to diagnose narcolepsy.
Notes 7	Surgery Adenotonsillectomy is an effective treatment for OSA, especially in typically developing children (ie, those without comorbidities). OSA might not necessitate surgery, especially if mild when a 'wait and see' approach or medical therapy may be appropriate. Surgery should be agreed between clinicians and patients and/or parents/carers. Surgery may require local health board agreements.
Notes 8	Home CRSS Home CRSS can be considered for children with, or without comorbidities if the patient and carer are deemed appropriate for home sleep studies.
Notes 9	Circadian rhythm disorder Sleep onset and wake up times should be discussed with the patient and/or carer to elicit sleep time and sleep latency.
Notes 10	Narcolepsy As the pathognomonic symptoms of narcolepsy may be subtle, or may not be volunteered, directed questions in the clinical history should be used to elicit, or exclude a diagnosis of narcolepsy in children. As cataplexy may be subtle, both child and parents/carers should be asked about head nods, neck/shoulder posturing and eyelid/facial droop. These are typically associated with laughter but may also be associated with anger or frustration. Both child and carer(s) should be asked about sleep paralysis and hypnagogic and hypnopompic hallucinations.

AHI, Apnoea–Hypopnoea Index; CRSS, Cardiorespiratory Sleep Studies; ODI3, 3% Oxygen Desaturation Index; ODI4, 4% Oxygen Desaturation Index; OSA, obstructive sleep apnoea; PSG, polysomnography; SRBD-PSQ, Sleep-Related Breathing Disorder scale of the Paediatric Sleep Questionnaire.