Survey of the practices of neonatologists in managing neonates believed to be at high risk of sleep disordered breathing

Bhavesh Mehta, Karen Waters, Dominic Fitzgerald, Nadia Badawi

ABSTRACT

Objective To determine the practices of neonatologists in managing high-risk neonates believed to be at risk of sleep disordered breathing (SDB).

Design An electronic web-based questionnaire assessing awareness of and current practices for managing neonates predisposed to SDB with conditions like craniofacial anomalies, neuromuscular disorders or airway problems was emailed to 232 neonatologists and neonatal fellows working in Australia and New Zealand (NZ). Additionally, neonatologists were approached directly during the annual Australia and NZ perinatal conference in 2019.

Results 93 neonatologists (40%) responded to the survey. The majority (85%) of the respondents stated that there were no written protocols/criteria for sleep consultation in their unit. We found considerable variations in the threshold for performing tests including oximetry or referring for polysomnography. Most respondents would perform oximetry before referring for a sleep consultation. However, the duration of oximetry varied from 6 to 24 hours and there was no consensus about what is considered abnormal on an oximetry study.

Conclusion Management of SDB is gaining importance in neonatal care because of prolonged length of hospital stay and possible long-term effects of SDB. Responses received suggest a lack of clarity regarding thresholds for referral for treatment of SDB. Likely contributory factors are concerns regarding a lack of long-term outcome data from treatment perceived to be onerous for the family, and delay in some infants and delaying hospital discharge. To overcome inconsistencies in practice, standardised guidelines for assessing and managing SDB in neonates are needed.

BACKGROUND

Sleep disordered breathing (SDB) is increasingly recognised as a cause of morbidity and prolonged hospital stay in neonates and young infants. SDB involves a spectrum of problems in neonates; the most severe form is obstructive sleep apnoea (OSA), which causes obstructive events and associated arousals leading to impaired sleep quality and disturbances in both oxygen saturation and carbon dioxide (CO₂).

Neonates with OSA often suffer recurrent oxygen desaturation and CO₂ retention (type II respiratory failure). Previous studies have demonstrated an association between episodes of hypoxia and poor growth and long-term neurodevelopmental delay. SDB has been linked to several long-term adverse effects in children including hypertension, behavioural problems and impairment of cognition, attention and executive functions. Therefore, early identification of high-risk infants is important so that treatment can improve quality of life and neurocognitive function. There is a gap in literature regarding SDB in neonates and its long-term outcomes. Piteo et al reported that infants who snored had lower cognitive scores compared with controls. In a study of 33 infants with cleft lip/palate, Smith et al reported that infants with more obstructive episodes had lower global behaviour scores at 3 years of age. However, a couple of recent studies showed negative links between SDB in neonates and neurodevelopmental outcomes.

Neonates are more vulnerable to OSA due to number of reasons including anatomical considerations (small mid-face), obligate nasal breathing, immature respiratory control and predominance of rapid eye movement sleep state, which may exacerbate obstruction due to loss of muscle tone. In young children,
adenotonsillar hypertrophy is the principal cause of OSA. However, in infants, anatomical anomalies are the predominant cause like laryngomalacia, macroglossia, craniofacial disorders such as craniosynostosis (Crouzon’s disease, Apert syndrome and Pfeiffer syndrome), cleft palate and Pierre-Robin sequence, infants with mid-face hypoplasia (eg, Treacher Collins and Gold-enhar syndromes) and with choanal atresia (CHARGE association). Low muscle tone is also an important predisposing factor, for example, in infants with Down syndrome, Prader-Willi syndrome or neuromuscular disorders.

Polysomnography (PSG) remains the gold standard test to diagnose and quantify the severity of SDB. It uses a combination of measurements including electroencephalogram, electro-oculogram for eye movements and submental electromyogram for muscle tone to characterise the sleep architecture. Respiratory function is assessed by nasal air flow, chest and abdomen movements, oximetry and transcutaneous CO₂ level. In addition to that, heart rate, limb movements, audio sounds to detect snoring and video recordings are also monitored.

However, PSGs in infants can only be performed at specialised paediatric centre in consultation with a paediatric sleep physician. There is usually a prolonged wait time for admission in the accepting centre due to a combination of bed constraints and availability of sleep technicians to perform polysomnograms in the neonatal intensive care unit (NICU) which leads to longer hospital stay.

Overnight oximetry study has been used as a screening tool in children and adults; however, there are limited data in young infants. An oximetry study includes monitoring of heart rate, respiratory rate and oxygen saturation. However, its sensitivity depends on the severity of SDB and the presence of more significant oxygen desaturation. Normal oximetry does not rule out SDB and therefore does not replace PSG. A high prevalence of movement artefacts also makes data interpretation challenging. A recent study showed good correlation between the desaturation index obtained from an overnight oximetry study to the Apnoea–Hypopnoea Index (AHI) obtained from PSG in young infants (<6 months) at risk of SDB.

The exact prevalence of SDB in neonates is unknown. However, its recognition seems to be increasing. Currently, in the absence of clinical guidelines, our experience in the largest surgical neonatal unit in New South Wales is that the approach to assessing a newborn with suspected SDB in both regional and tertiary settings varies significantly and in effect is largely driven by the experience of individual clinician.

Consequently, the aim of our study was to assess the knowledge and awareness of SDB in neonatologists and neonatal fellows working across Australia and New Zealand (NZ), and to determine their practices and referral criteria for sleep consultation.

METHODS

A questionnaire (online supplemental appendix 1) was devised in consultation with paediatric sleep physicians, with questions tailored to suit the clinical picture of neonates seen in our practice. A pilot survey was first sent for feedback to four neonatologists, experienced in managing neonates with SDB who were excluded from the final survey. The final questionnaire had 17 multiple choice questions and respondents could pick one or more answers as necessary (free text was available for additional comments).

In the survey, we asked a series of questions to explore knowledge and practices of neonatologists regarding the management of neonates predisposed to SDB in various conditions including craniofacial anomalies, syndromes like Down and Beckwith-Wiedemann syndromes, neuromuscular disorders, functional anomalies of airway and in preterm infants with moderate–severe chronic lung disease. Symptoms were arranged in a Likert-type scale and respondents were asked to choose a level/symptom at which they would recommend oximetry or initiate referral for PSG. By asking about timing for referral for PSG, we were trying to ascertain timing for sleep consultations as the PSG needs to be conducted and interpreted in specialised centres by the sleep physicians.

RESULTS

Seventy-three responses were received from the online survey, with a further 20 more responses in phase 2, making a total of 93 responses (40% response rate). The majority of responses (80%) were from neonatologists working in a major NICU (centres providing care for...
Table 1  Neonatologists’ practices about SDB in neonates

<table>
<thead>
<tr>
<th>Responses</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many neonates have you referred for sleep consultation in the last 12 months?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 0</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>b. 1–3</td>
<td>38</td>
<td>41</td>
</tr>
<tr>
<td>c. 4–6</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>d. &gt;6</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>2. Clinical features suggestive of significant SDB in a term newborn (multiple options could be selected):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Bradycardia in the absence of apnoea or desaturation</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>b. Apnoea and desaturations</td>
<td>64</td>
<td>69</td>
</tr>
<tr>
<td>c. Multiple desaturations on overnight oximetry</td>
<td>62</td>
<td>67</td>
</tr>
<tr>
<td>d. Desaturation during feeding</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>e. All of the above</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>

SDB, sleep disordered breathing.

DISCUSSION

In this survey of practices related to management of neonates at high risk for and/or with symptoms of SDB, we found considerable variations in screening, including the performance and interpretation of oximetry, and referral for PSG. In general, there was a shift towards PSG in infants with more severe symptoms. We suggest that there is high need for a standardised approach to the management of high-risk newborns with complex and critical conditions and providing state-wide specialist services) and majority of them were working in a perinatal unit (67%).

A decision to refer for sleep consultation was taken by the neonatal consultant in almost all cases (96%), however the majority (86%) said that there is no protocol or guideline in the unit, hence this decision is based on an individual consultant’s opinion. The majority of respondents (60%) said that they had referred <4 patients for sleep consultation in the last 12 months. Respondents were asked to identify clinical features that concerned them most about the possibility of SDB in a term newborn—obvious apnoea and desaturations after term gestation or multiple episodes of desaturation on overnight oximetry were the most common symptoms determining the referral (table 1).

Responses to the questions regarding management of different groups of high-risk neonates indicated that current practices are very variable. Results are described in figure 1. Practices for the use of oximetry studies also varied, from their use as a screening tool before referring for sleep consultation to how they are performed, and how the result is interpreted (table 2). The most common brand of oximeter used was Masimo. A significant proportion (36%) of the respondents either did not know or did not reply to the question about the type of oximeter used in their unit.
management of infants with conditions associated with a high risk for and/or symptoms of SDB.

Apnoea and desaturations in a term baby were reported as the most common reasons for referral to a sleep physi-
cian. These events could be related to central apnoea
due to immaturity of the central nervous system and
occur commonly in healthy infants in all sleep stages.21
The frequency of central apnoea decreases with age, and
prolonged or significant central apnoea is rare after 1
month of age.22 We included this question in our study
as SDB in neonates is a spectrum of disorders which
includes central apnoea.1 Our aim was to identify the
referral pattern/threshold for referral to a sleep physi-
cian who can then decide about the need and timing
for further investigation and management of apnoea
whether central, obstructive or mixed.

Most respondents would perform oximetry before
referring for sleep consultation. A large proportion
(35%–40%) of neonatologists suggested that they
would order an oximetry screening study even in an asym-
ptomatic high-risk neonate. This indicates that extended
oximetry recordings are more commonly used in clinical
practice to assess infants’ respiratory status. However,
the duration of oximetry study varied from 6 to 24 hours
and there was no consensus about what is considered
abnormal on an oximetry study which is consistent with
previous studies.23 24

Factors contributing to variations in clinical practice
An oximetry study can be used as a surrogate measure of
airway obstruction.25 However, there are limited studies
so far comparing oximetry profiles with PSG parameters
in neonates.18 In addition to this, one paediatric study
showed that there was variation in clinical interpretation
leading to different management plans when the same
study report was shown to different paediatricians.26 We
conclude that in addition to the differences in oxime-
ters and analysis software available for use in neonatal
units, a major problem with oximetry studies is the lack
of consensus guidelines for interpreting neonatal/infant
oximetry reports. We think oximetry can play an impor-
tant role in screening for moderate to severe OSA in
high-risk infants and guide referral to a specialist centre
for further evaluation. This will also help sleep physician
and receiving hospital to prioritise their admission.

The levels for cut-off in various parameters in PSG to indi-
cate pathologically significant OSA in neonates are also
still being defined and little is known about the long-term

Table 2  Neonatologists’ practices about use of oximetry study in neonates

<table>
<thead>
<tr>
<th>Responses</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How often do you use an oxygen download study in your unit before referral to a sleep physician?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Always</td>
<td>42</td>
<td>45</td>
</tr>
<tr>
<td>b. Usually</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>c. Sometimes</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>d. Never</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>e. Did not answer</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>2. What is the duration of an oxygen download study in your unit?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 6 hours</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>b. 8 hours</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>c. 12 hours</td>
<td>33</td>
<td>35</td>
</tr>
<tr>
<td>d. 24 hours</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>e. Did not answer</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>3. What device do you use to record oximetry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Masimo</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>b. Nellcor</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>c. Not sure</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>d. Did not answer</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>4. What is considered abnormal oxygen download study in your unit (what features in oximetry would prompt you to refer for sleep study):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Saturation &lt;90% for more than 5% of download</td>
<td>47</td>
<td>74</td>
</tr>
<tr>
<td>b. Saturation &lt;85% for more than 2% of download</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>c. Saturation &lt;80% for more than 1% of download</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>d. Frequent bradycardia and/or desaturation</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>e. Clusters of desaturations</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>
outcome of the condition. A standardised scoring guideline with criteria for analysis of PSG in young infants (<6 months old) is available from the American Academy of Sleep Medicine (AASM).27–29 However, diagnosing SDB based on neonatal PSG remains challenging as normative data are not well established. Most of the previous studies of PSG involving infants have excluded neonates and/or used different criteria to define SDB such as, Respiratory Disturbance Index >5/hours of sleep30; Mixed Obstructive AHI >2/hours of sleep31; and OSA defined as AHI >2 unless >25% of events were central.32 With many studies performed prior to the publication of AASM guidelines/criteria, the generalisability of their results to the neonatal age group is restricted.33 Nonetheless, together these studies30–32 report a much higher incidence of respiratory disturbances in young infants compared with older children. A recent study21 based on AASM criteria showed that healthy newborns have a wider range of both obstructive and central events and much higher AHI than older infants and children. Thus, applying current AASM paediatric thresholds would likely result in overtreatment of sleep apnoea in neonates. This creates significant clinical dilemmas for neonatologists regarding when intervention is necessary which is further compounded by the uncertainty regarding any causal linkage between SDB and abnormal neurodevelopmental outcomes.11 12

LIMITATIONS

The main limitation of this study was low response rate. Despite efforts to improve engagement, the response rate for our survey was only 40% which could indicate selection bias. However, as responses were obtained from individuals rather than a unit-based protocol survey, we believe the result to be reasonably representative of the entire region, especially because responses include representation from across Australia and NZ. We chose to target neonatologists individually as we believed that practices by different neonatologists within a single centre may be different.

Limited feedback suggested that several respondents found this topic too difficult, making them reluctant to complete the questionnaire. Non-respondent neonatologists potentially represent people who chose not to do it due to lack of knowledge or awareness about the condition. Based on the above and considering 80% of the neonatologists who responded were working in a major NICU, we suspected selection bias meaning participation from major centres and experienced neonatologists. Therefore, the results may represent the opinions of a group of neonatologists with a higher level of knowledge than would have been present in the broader community.

Multiple participants from limited number of centres may also bias the survey results. A significant proportion of respondents were from major teaching hospitals and tertiary care centres. Therefore, the survey results may not accurately reflect the practice in neonatal centres where care is provided for low birth weight or high-risk infants.

Figure 2  Suggested referral pathway for neonates suspected to have SDB. PSG, polysomnography; SDB, sleep disordered breathing.
(15%–25%) of respondents were either not sure or did not reply to the questions related to the timing of doing oximetry or referring for PSG in different clinical scenarios. Use of structured questions and answers can limit the ability of respondents to express their opinion. Providing more choices to respondents by giving them a free note option with each question can help in addressing this issue in future work. This could be achieved with a qualitative study of neonatologists’ opinions on the assessment of SDB in the NICU.

In the present survey, we categorised the clinical features of SDB from being asymptomatic to having severe symptoms. The questions were designed to give the opportunity for clear answers. In reality, patients can present with combination of symptoms and signs such as oxygen desaturations with increased work of breathing which might make decision-making for the need for intervention easier for treating neonatologists.

We did not ask about the oximetry settings in this study. While this information would have been important, it was not a primary aim of the survey to specifically ask about oximetry practices. Furthermore, one-third of neonatologists could not even describe the type of oximeter used in their unit. Asking them about averaging times for data acquisition would have been even more challenging and likely raised further concerns about knowledge in this area.

CONCLUSION
This study has demonstrated a need to develop consensus guideline for screening and referring neonates with high risk for and/or symptoms of SDB. There is a need for a simple guide (figure 2) that would ensure a consistent way these high-risk neonates are managed in neonatal units throughout Australasia in an effort to decrease long-term morbidity and improve neurodevelopmental outcomes. Guidelines also need to take into account the specific condition considering the complexities and inter-related comorbidities of vulnerable infants in the NICU.

Future researchers should focus on:

- Developing a consensus guideline for the practice of neonatal oximetry studies for SDB including appropriate choice of device, settings and reporting format which are critical for interpretation.
- Identifying the prevalence of OSA in extremely low birthweight infants as they approach discharge and whether this is associated with prolonged need for supplemental oxygen.
- Identifying the consequences of SDB by correlating neonatal oximetry profiles and PSG with neurodevelopmental outcomes through early childhood and into the school-aged population.

Contributors BM participated in the development of the survey and design of the study, conducted the survey, performed data analysis and drafted the initial manuscript. KW, DF and NB participated in the conceptualisation and design of the study, reviewed and revised the manuscript, and approved the final manuscript as submitted.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethics approval was granted by Sydney Children’s Hospital Network’s Human Research and Ethics Committee—LNR/15/SDHN/470.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. We agree to share deidentified participant data (including data dictionaries).

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REFERENCES


Appendix I: Survey questionnaire

Referral Practices for Neonates Suspected to Have Sleep Disordered Breathing (SDB)

1. What level is your neonatal unit classified as?
   a) Level 3
   b) Level 4
   c) Level 5
   d) Level 6

2. Is your nursery in a
   a) Children’s hospital
   b) Perinatal centre or maternity hospital

3. How does referral for sleep consultation occur in your unit?
   a. There is a written protocol/criteria for sleep consultation like apnoea/desaturation after term corrected gestational age
   b. No written protocol or instruction – it is based on individual consultant’s decision
   c. Other ______________________

4. Who is responsible for initiating a referral for sleep consultation?
   a. Neonatologist
   b. Fellow
   c. Nurse Practitioner
   d. Others __________________________

5. How many neonates have you sent for sleep consultation in the last 12 months?
   a. 0
   b. 1-3
   c. 4-6
   d. >6

6. Clinical features suggestive of significant apnoea (requiring sleep study) in a term newborn.
   You can select multiple:
   a. Bradycardia in the absence of apnoea or desaturation
   b. Apnoea and desaturations
   c. Multiple desaturations on overnight oximetry
   d. Desaturation during feeding
   e. All of the above
7. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a neonate with "CRANIOFACIAL ANOMALIES" like craniosynostosis, cleft palate, Pierre Robin sequence

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic</th>
<th>Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑ work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oximetry Study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refer for Polysomnography (PSG)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

8. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a neonate with "SYNDROMES likely to affect breathing" like Down, Beckwith-Wiedemann or Prader-Willi syndrome

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic</th>
<th>Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑ work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oximetry Study</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refer for Polysomnography (PSG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

9. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a neonate with "NEUROMUSCULAR DISORDERS" like SMA, congenital muscular dystrophy
<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic</th>
<th>Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oximetry Study</td>
<td>Refer for Polysomnography (PSG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a neonate with "FUNCTIONAL PROBLEM of AIRWAY" e.g. vocal cord paralysis, laryngomalacia

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic</th>
<th>Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oximetry Study</td>
<td>Refer for Polysomnography (PSG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a preterm neonate with "Moderate CHRONIC LUNG DISEASE" [needing <30% O2 after 36 weeks postmenstrual age or at discharge]

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic</th>
<th>Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
</table>
12. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a preterm neonate with "Severe CHRONIC LUNG DISEASE" [needing >30% O2 and/or positive pressure after 36 weeks postmenstrual age or at discharge]

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
</table>

Oximetry Study

Refer for Polysomnography (PSG)

13. Enter the level at which you would order oximetry and/or polysomnography (PSG) in a neonate who is "Going Home on oxygen for Other Reason" [e.g. cardiac]

<table>
<thead>
<tr>
<th>Management</th>
<th>Asymptomatic Occasional desaturations or bradycardia noted on monitor</th>
<th>Repeated desaturations noted on nursery monitoring</th>
<th>Symptomatic obstruction on sleep only (e.g. ↑work of breathing)</th>
<th>Symptomatic obstruction when awake</th>
<th>Not applicable/Not sure</th>
</tr>
</thead>
</table>

Oximetry Study

Refer for Polysomnography (PSG)
14. How often do you use an oxygen download study in your unit before referral to a sleep physician?
   a. Always
   b. Usually
   c. Sometimes
   d. Never

15. What is the duration of an oxygen download study in your unit?
   a. 6 hours
   b. 8 hours
   c. 12 hours
   d. 24 hours

16. What device do you use to record oximetry? ______________________

17. What is considered abnormal oxygen download study in your unit (what features in oximetry would prompt you to refer for sleep study):
   a. Saturation <90% for more than 5% of download
   b. Saturation <85% for more than 2% of download
   c. Saturation <80% for more than 1% of download
   d. Frequent bradycardia and/or desaturation
   e. Clusters of desaturations
   f. We do not use oxygen download studies in our unit

18. Any other comments
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Thank you for completing the survey.