Clinical question.

For neonates requiring resuscitation (P), is any adjunct measure (e.g., CO2 detection, pulse oximeter) as effective as the usual clinical findings (e.g., heart rate, chest movement) effective to improve outcome (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention/therapy

State if this is a proposed new topic or revision of existing worksheet: New topic

Conflict of interest specific to this question: Two articles included in worksheet that I co-authored.

Search strategy (including electronic databases searched).

**MEDLINE** (OVID search)
Run June 23, 2009
Hits: 105
Retrieved for further review: 2

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1950 to Present>

Search Strategy:

1. *Infant, Newborn/ (27414)
2. *resuscitation/ or cardiopulmonary resuscitation/ or heart massage/ or respiration, artificial/ (50367)
3. 1 and 2 (418)
4. Carbon Dioxide/ (64211)
5. oximetry/ or blood gas monitoring, transcutaneous/ (9551)
6. Electrocardiography/ (145329)
7. 6 or 4 or 5 (216842)
8. 3 and 7 (25)
9. Heart Rate/ (122092)
10. Respiration/ (63905)
11. "Work of Breathing"/ (1647)
12. Respiratory Sounds/ (5150)
13. Cyanosis/ (3577)
14. Apgar Score/ (5692)
15. 11 or 13 or 10 or 9 or 12 or 14 (191014)
16. exp "Outcome and Process Assessment (Health Care)"/ or exp "Outcome Assessment (Health Care)"/ or exp Treatment Outcome/ (443568)
17. prognosis/ or treatment outcome/ or treatment failure/ or "outcome assessment (health care)"/ (671966)
18. exp Perinatal Mortality/ or exp Child Mortality/ or exp Infant Mortality/ or exp Hospital Mortality/ or exp Mortality/ (207740)
19. death/ or asphyxia/ or brain death/ (19188)
20. longitudinal studies/ or follow-up studies/ or cohort studies/ (510517)
21. 18 or 19 or 16 or 17 or 20 (1221035)
22. 21 or 7 or 15 (1565007)
23. 22 and 3 (105)

**EMBASE** (OVID search)
Run June 23, 2009
Hits: 39
Retrieved for further review: 4

Database: EMBASE <1980 to 2009 Week 25>

Search Strategy:

1. *Infant, Newborn/ (6846)
2. *resuscitation/ or cardiopulmonary resuscitation/ or heart massage/ or respiration, artificial/ (60098)
3. 1 and 2 (131)
4. Carbon Dioxide/ (27835)
5. oximetry/ or blood gas monitoring, transcutaneous/ (3716)
6. Electrocardiography/ (30503)
7. 6 or 4 or 5 (61797)
8. 3 and 7 (4)
9. Heart Rate/ (72834)
10. Respiration/ (16123)
11. "Work of Breathing"/ (14119)
12. Respiratory Sounds/ (752)
13 Cyanosis/ (4031)
14 Apgar Score/ (5250)
15 11 or 13 or 10 or 9 or 12 or 14 (110775)
16 exp "Outcome and Process Assessment (Health Care)"/ or exp "Outcome Assessment (Health Care)"/ or exp Treatment Outcome/ (486830)
17 prognosis/ or treatment outcome/ or treatment failure/ or "outcome assessment (health care)"/ (590029)
18 exp Perinatal Mortality/ or exp Child Mortality/ or exp Infant Mortality/ or exp Hospital Mortality/ or exp Mortality/ (246031)
19 death/ or asphyxia/ or brain death/ (43483)
20 longitudinal studies/ or follow-up studies/ or cohort studies/ (343743)
21 18 or 19 or 16 or 17 or 20 (1064144)
22 21 or 7 or 15 (1212300)
23 22 and 3 (39)

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (OVID Search)
Run June 23, 2009
Hits: 0
Search Strategy:
--------------------------------------------------------------------------------
1 *Infant, Newborn/ (211)
2 *resuscitation/ or cardiopulmonary resuscitation/ or heart massage/ or respiration, artificial/ (2100)
3 1 and 2 (2)
4 Carbon Dioxide/ (2083)
5 oximetry/ or blood gas monitoring, transcutaneous/ (563)
6 Electrocardiography/ (5302)
7 6 or 4 or 5 (7821)
8 3 and 7 (1)
9 Heart Rate/ (13242)
10 Respiration/ (2799)
11 "Work of Breathing"/ (149)
12 Respiratory Sounds/ (223)
13 Cyanosis/ (33)
14 Apgar Score/ (484)
15 11 or 13 or 10 or 9 or 12 or 14 (16070)
16 exp "Outcome and Process Assessment (Health Care)"/ or exp "Outcome Assessment (Health Care)"/ or exp Treatment Outcome/ (53836)
17 prognosis/ or treatment outcome/ or treatment failure/ or "outcome assessment (health care)"/ (57808)
18 exp Perinatal Mortality/ or exp Child Mortality/ or exp Infant Mortality/ or exp Hospital Mortality/ or exp Mortality/ (6720)
19 death/ or asphyxia/ or brain death/ (66)
20 longitudinal studies/ or follow-up studies/ or cohort studies/ (33515)
21 18 or 19 or 16 or 17 or 20 (82120)
22 21 or 7 or 15 (100767)
23 22 and 3 (2)

COCHRANE DATABASE OF Abstracts of Reviews of Effects – DARE (OVID search)
Run June 23, 2009
Hits: 0
Search Strategy:
--------------------------------------------------------------------------------
1 *Infant, Newborn/ (211)
2 *resuscitation/ or cardiopulmonary resuscitation/ or heart massage/ or respiration, artificial/ (2100)
3 1 and 2 (2)
4 Carbon Dioxide/ (2083)
5 oximetry/ or blood gas monitoring, transcutaneous/ (563)
6 Electrocardiography/ (5302)
7 6 or 4 or 5 (7821)
8 3 and 7 (1)
9 Heart Rate/ (13242)
10 Respiration/ (2799)
11 "Work of Breathing"/ (149)
12 Respiratory Sounds/ (223)
13 Cyanosis/ (33)
14 Apgar Score/ (484)
15 11 or 13 or 10 or 9 or 12 or 14 (16070)
16 exp "Outcome and Process Assessment (Health Care)"/ or exp "Outcome Assessment (Health Care)"/ or exp Treatment Outcome/ (53836)
17 prognosis/ or treatment outcome/ or treatment failure/ or "outcome assessment (health care)"/ (57808)
18  exp Perinatal Mortality/ or exp Child Mortality/ or exp Infant Mortality/ or exp Hospital Mortality/ or exp Mortality/ (6720)
19  death/ or asphyxia/ or brain death/ (66)
20  longitudinal studies/ or follow-up studies/ or cohort studies/ (33515)
21  18 or 19 or 16 or 17 or 20 (82120)
22  21 or 7 or 15 (100767)
23  22 and 3 (2)

Cochrane Central Register of Controlled Trials (CENTRAL) (OVID search)
Run June 23, 2009
Hits: 2
Retrieved for further review: 0

Database: EBM Reviews - Cochrane Central Register of Controlled Trials <2nd Quarter 2009>
Search Strategy:
--------------------------------------------------------------------------------
1  *Infant, Newborn/ (211)
2  *resuscitation/ or cardiopulmonary resuscitation/ or heart massage/ or respiration, artificial/ (2100)
3  1 and 2 (2)
4  Carbon Dioxide/ (2083)
5  oximetry/ or blood gas monitoring, transcutaneous/ (563)
6  Electrocardiography/ (5302)
7  6 or 4 or 5 (7821)
8  3 and 7 (1)
9  Heart Rate/ (13242)
10  Respiration/ (2799)
11  "Work of Breathing"/ (149)
12  Respiratory Sounds/ (223)
13  Cyanosis/ (33)
14  Apgar Score/ (484)
15  11 or 13 or 10 or 9 or 12 or 14 (16070)
16  exp "Outcome and Process Assessment (Health Care)"/ or exp "Outcome Assessment (Health Care)"/ or exp Treatment Outcome/ (53836)
17  prognosis/ or treatment outcome/ or treatment failure/ or "outcome assessment (health care)"/ (57808)
18  exp Perinatal Mortality/ or exp Child Mortality/ or exp Infant Mortality/ or exp Hospital Mortality/ or exp Mortality/ (6720)
19  death/ or asphyxia/ or brain death/ (66)
20  longitudinal studies/ or follow-up studies/ or cohort studies/ (33515)
21  18 or 19 or 16 or 17 or 20 (82120)
22  21 or 7 or 15 (100767)
23  22 and 3 (2)

Web of Science/ISI Web of Knowledge - 1900 – 2009 June 20
Search run on June 23, 2009
Hits: 167
Retrieved for further review: 18

# 12  167
#11 AND #10 AND #2 AND #1
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 11  >100,000
#6 OR #5 OR #4 OR #3
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 10  >100,000
#9 OR #8 OR #7
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 9  >100,000
TS=(longitudinal studies) OR TS=(follow-up studies) OR TS=(cohort studies)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 8  >100,000
TS=(perinatal mortality) OR TS=(child mortality) OR TS=(infant mortality) OR TS=(hospital mortality) OR TS=(mortality) OR TS=(death) OR TS=(asphyxia) OR TS=(brain death)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 7  >100,000
TS=(treatment outcome) OR TS=(treatment failure) OR TS=(prognosis) OR TS=("outcome assessment")
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 6  >100,000
TS=(heart rate) OR TS=(respiration) OR TS=("work of breathing") OR TS=(respiratory sounds) OR TS=(cyanosis) OR TS=(Apgar score)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 5  8,097
TS=(electrocardiography)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 4  5,888
TS=(oximetry) OR TS=(blood gas monitoring, transcutaneous)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 3  90,559
TS=(carbon dioxide)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 2  29,902
TS=(resuscitat*) OR TS=(delivery room) OR TS=(cardiopulmonary resuscitation) OR TS=(heart massage) OR TS=(respiration, artificial)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

# 1  >100,000
TS=(newborn) OR TS=(neonat*) OR TS=(infant)
Databases=SCI-EXPANDED, SSCI, A&HCI Timespan=All Years

SCOPUS
Run June 23, 2009
1960 to present
Hits: 2
Retrieved for further review: 0

SCOPUS – Adjunct Measures
(newborn OR infant OR neonat* OR delivery room) AND (resuscitat* OR cardiopulmonary resuscitation OR heart massage OR artificial respiration) AND (carbon dioxide OR oximetry OR pulse oximeter OR transcutaneous blood gas monitor* OR heart rate OR respiration OR work of breathing OR respiratory sounds OR cyanosis OR apgar score OR electrocardiography) AND (treatment outcome OR treatment failure OR prognosis OR outcome assessment OR perinatal mortality OR child mortality OR infant mortality OR hospital mortality OR mortality OR death OR asphyxia OR brain death OR longitudinal studies OR follow-up studies OR cohort studies)

Manual Search of Reference Lists from Retrieved Articles
Performed August 15, 2009
18 articles identified for further review

• State inclusion and exclusion criteria

The following studies were included:
Studies of newborns.
Studies of cardiopulmonary resuscitation addressing pulse oximetry, carbon dioxide measurement, heart rate determination, adequacy of respiration.
Studies assessing outcomes.

• Number of articles/sources meeting criteria for further review:
46 studies were reviewed. 23 studies met the criteria for inclusion in this worksheet. 0 studies are LOE 1, 3 studies LOE 2, 1 study is LOE 3, 14 studies are LOE 4, 5 studies are LOE 5.
# Summary of evidence

## Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>E1 = Accurate heart rate measurement using pulse oximetry in improving outcomes</th>
<th>E2 = Accurate heart rate determination using palpation in improving outcomes</th>
<th>E3 = Accurate transcutaneous oxygen saturation measurement using pulse oximetry in improving outcomes</th>
<th>E4 = Transcutaneous oxygen saturation measurement using pulse oximetry in reducing admission to the neonatal intensive care unit</th>
<th>E5 = Detection of cyanosis using transcutaneous oxygen saturation measurement resulting in improved outcomes</th>
<th>E6 = Accurate heart rate measurement using a vacuum stethoscope in improving outcomes</th>
<th>E7 = Accurate heart rate measurement using a timing device in improving outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Kopotic (2002) E4</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Poor</td>
<td>Maxwel (1987) E3</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## Evidence Neutral to Clinical question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>E1 = Accurate heart rate measurement using pulse oximetry in improving outcomes</th>
<th>E2 = Accurate heart rate determination using palpation in improving outcomes</th>
<th>E3 = Accurate transcutaneous oxygen saturation measurement using pulse oximetry in improving outcomes</th>
<th>E4 = Transcutaneous oxygen saturation measurement using pulse oximetry in reducing admission to the neonatal intensive care unit</th>
<th>E5 = Detection of cyanosis using transcutaneous oxygen saturation measurement resulting in improved outcomes</th>
<th>E6 = Accurate heart rate measurement using a vacuum stethoscope in improving outcomes</th>
<th>E7 = Accurate heart rate measurement using a timing device in improving outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Stola (2009) E1, E3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>Ginott (1980) E6</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>E1 = Accurate heart rate measurement using pulse oximetry in improving outcomes</th>
<th>E2 = Accurate heart rate determination using palpation in improving outcomes</th>
<th>E3 = Accurate transcutaneous oxygen saturation measurement using pulse oximetry in improving outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
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</tr>
</tbody>
</table>
There are several adjunct measures relevant to newborn resuscitation. In the literature, these focus on alternate methods of measuring the physiologic variables of heart rate and oxygenation. However, there is a paucity of literature addressing the impact of adjunct measures on clinical outcomes. Most studies focus on the accuracy and/or feasibility of such methods. With the mounting indirect evidence and expert opinions supporting adjunct measures such as pulse oximetry to determine heart rate and oxygen saturation, there is a need for guidelines evaluating their use. In this worksheet, 46 relevant articles were identified for further review and 23 articles met the criteria for inclusion in the worksheet. However, only 2 articles addressed meaningful clinical outcomes. Kopotic et al (2002) showed a statistically and clinically significant reduction in NICU admissions when pulse oximetry was used during resuscitation of infants at risk of respiratory failure. Maxwell et al (1984) published a case series of 4 preterm infants where pulse oximetry was used in the delivery room. They report that, in one infant, pulse oximetry aided in the identification of endotracheal tube misplacement that was not detected by auscultation or observation of the infant’s chest wall.

Pulse oximeters display heart rate in addition to transcutaneous oxygen saturation values. A pulse oximeter determines heart rate by recording pulsations in the capillary bed. Hence it is subject to error resulting from poor perfusion, patient motion and ambient light. The feasibility of using pulse oximetry to measure heart rate has been supported by several studies. Overall, they have shown that pulse oximetry can measure heart rate in the delivery room with reasonable accuracy. Pulse oximetry measurements of heart rate can be obtained within a few minutes of birth and provide a continuous heart rate reading. However, clinical assessment of heart rate is still required until the pulse oximeter provides stable readings. Studies supporting the feasibility of pulse oximetry for heart rate measurement in the delivery room have been published by House et al (1987), Hay et al (2002), Finer et al (2004), Kamlin et al (2008), Singh et al (2008), Escrig et al (2008), Wang et al (2008), Vento et al (2008), Stola et al (2009) and Dawson et al (2009). None of these studies addressed the impact of pulse oximetry measurement of heart rates during newborn resuscitation in improving outcomes.

Two studies examined the accuracy of palpation in determining heart rate during newborn resuscitation. Owen et al (2004) reported that palpation was less accurate than auscultation. In a study by Kamlin et al (2006b), ECG determination of heart rate was more accurate than either auscultation or palpation (p=0.003). However, the difference between the 3 methods was small and likely not clinically significant.


It is generally accepted that visual detection of cyanosis is inaccurate. One study (O’Donnell et al, 2007) assessed the accuracy of visual detection of cyanosis by videotaping newborn resuscitations and showing them to healthcare providers. Pulse oximetry measurements of transcutaneous oxygen saturation were made during the resuscitation. The authors concluded that visual detection of cyanosis was unreliable. The main limitation of this study was that pulse oximetry was used, instead of the gold standard of co-oximetry, to determine the accuracy of the visual assessment of cyanosis. The study did not address clinical outcomes.

A study by Ginott et al (1986) examined the use of a vacuum stethoscope connected to a speaker in determining heart rate during newborn resuscitation. The authors described various resuscitation scenarios in which the vacuum stethoscope appeared to provide a more accurate assessment of heart rate compared to manual heart rate measurement. However, the statistical significance is not clear as inferential statistics were not performed.

The literature review did not find any studies addressing the use of carbon dioxide detection which met the inclusion criteria for this worksheet.

The NRP recommendation for determining heart rate is to measure the heart rate manually for 6 seconds and then multiply the result by 10. A study by Theophilopoulos et al (1998) examined the use of a novel electronic timing device...
which alerted the clinician at the end of the 6 second measurement period. The study was performed using mannequins. The authors report that use of the electronic timer resulted in more accurate heart rate determination than traditional manual methods.

Acknowledgements:

Citation List

References Meeting Criteria for Further Review

   
   **Level of Evidence:** 4  
   **Quality of Study:** Fair  
   **Supportive/Neutral/Opposing Clinical Question:** Neutral  
   **Reviewer's Comments:** Observational study. Infants >36 weeks gestation had continuous preductal pulse oximetry performed in the delivery room (n=200). The authors report that they were successfully able to record transcutaneous oxygen saturations by 1 minute of age. The study was not designed to assess outcomes related to pulse oximetry use. The authors do not mention whether the resuscitation team was blinded to the pulse oximeter's readings. There is no information regarding the time to first reading. There is no comparison to a gold standard. However, study does demonstrate feasibility of pulse oximetry measurement in the delivery and therefore, is included in the worksheet.

   
   **Level of Evidence:** Not included in worksheet  
   **Quality of Study:** Not included in worksheet  
   **Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
   **Reviewer's Comments:** This review article discusses limitations of the Apgar score. It cautions against inappropriate use of the Apgar score to predict outcomes. The study does not address the question we are asking and hence is not included in the worksheet.

   
   **Level of Evidence:** 4  
   **Quality of Study:** Fair  
   **Supportive/Neutral/Opposing Clinical Question:** Neutral  
   **Reviewer's Comments:** Prospective observational study of PRETERM infants <30 weeks gestation. Compared resuscitation with room air and 100% oxygen. Infants were switched 100% oxygen if SpO2 <70% at 5 minutes of age. In 100% oxygen group, SpO2 was 78% at 2 minutes and 90% at 5 minutes. By 8 minutes, 50% had SpO2=95%. In room air group, SpO2 was 25% at 2 minutes and 65% at 5 minutes. Data is available for oxygen saturations by 1 minute of age. Heart rate measurements were made using the pulse oximeter. 97/105 (92%) infants in the air group required supplementary oxygen at a median of 5.05 minutes (IQR 4-5.5). By design, the participants were not blinded to the pulse oximeter's readings. There was no comparison of heart rate or pulse oximetry readings to gold standards. The study was not
designed to assess outcomes directly related to pulse oximetry use. The study is included in the worksheet because it shows the feasibility of pulse oximeter use in the delivery room for measuring oxygen saturations and heart rate.


**Level of Evidence:** 4  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** Prospective randomized control trial of infants less than or equal to 28 weeks gestation. Infants were randomized to initiation of resuscitation with either 30% oxygen or 90% oxygen. The aim was to reach a target SpO2 of 85% at 10 minutes. Adjustments of oxygen were made according to heart rate. Treatment failure was defined as a heart rate <60 bpm for >30 seconds and prompted an increase to 100% oxygen. Continuous pulse oximetry measurements of oxygen saturation were made. The pulse oximeter was used to measure heart rate once a stable reading was obtained - auscultation was used prior to this. At every time point, babies in the 30% oxygen group received >21% oxygen. By 5 minutes, both groups were in ~55% oxygen and remained similar for the rest of resuscitation. By the end of resuscitation, both groups were maintained in 32-34% oxygen. The investigators report that the time to reliable SpO2 readings was 85.6 +/-28.4 seconds in the low oxygen group and 88.2 +/-30.5 seconds in the high oxygen group. By design, the resuscitation team was not blinded to the pulse oximeter. There is no comparison of pulse oximetry readings of heart rate or oxygen saturation to the gold standards. The study does show, indirectly, the feasibility of using pulse oximetry to measure oxygen saturations and heart rates during resuscitation of preterm infants. Therefore, it is included in the worksheet.


**Level of Evidence:** Not applicable - Expert opinion  
**Quality of Study:** Not applicable - Expert opinion  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is a review article. The authors support the use of pulse oximeters in the delivery room for continuous heart rate monitoring and oxygen saturation measurements. The authors' opinion is that the heart rate should be continuously measured using clinical methods (eg, palpation, auscultation) until the pulse oximeter starts delivering valid readings, typically beyond 1 minute of age. This article provides expert opinion and will be included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a review article. It does not address the question and hence is not included in the worksheet.


**Level of Evidence:** 2  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is a descriptive, observational study. No inferential or descriptive statistics are presented. A vacuum stethoscope was applied to the chest of 37 infants. The stethoscope was connected to a tape recorder and a loudspeaker, allowing the resuscitation team to continuously hear the infants heart rate. The authors state that the stethoscope can be applied within 10 to 15 seconds of birth. The attending physician determined the heart rate manually. It is not clearly stated if the physician could also hear the heart rate from the vacuum stethoscope. The study had 3 groups. Group 1 (n=9) had fetal
distress and bradycardia at birth. There was reportedly a poor correlation (no value given) in 3 of the babies between the heart rate at 1 minute as measured manually versus using the vacuum stethoscope. Group 2 (n=11) had a normal heart rate initially followed by bradycardia following nasopharyngeal suctioning. Two of the infants were evaluated as having adequate heart rates while the vacuum stethoscope indicated bradycardia. Group 3 (n=17) had infants with tachycardia. It is important to note that the study does not comment on whether the vacuum stethoscope aided heart rate determination DURING the resuscitation. It is likely that the recording was reviewed AFTER the resuscitation for heart rate determination. Therefore, this method would have limited utility during active resuscitation. The authors state that ECG recording has the following limitations: application takes up to 1 minute, sensitive to movement artefact. They state that the vacuum stethoscope has the advantages of being noninvasive, inexpensive and simply to apply. This study will be included in the worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: Important study but not relevant to question. This study was not included in the worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: Very nice review of physiologic reflexes relevant to resuscitation. The study does not address the question and hence is not included in the worksheet.


Level of Evidence: 5
Quality of Study: Fair
Supportive/Neutral/Opposing Clinical Question: Neutral
Reviewer's Comments: This study compares the performance of 2 pulse oximeters in 26 nonsedated NICU infants. Weights ranged from 900 g to 2710 g. One of the outcomes was the accuracy of the pulse oximeters to measure the heart rate as compared to an ECG recording. Assessors were blinded to which pulse oximeter was being evaluated. The Masimo SET pulse oximeter detected 86% of bradycardic episodes compared to the Nellcor pulse oximeter which detected 14% of the bradycardic episodes. This was not a study of delivery room interventions. It is quite likely that the pulse oximeter's ability to accurately measure heart rate would be lower in the delivery room due to motion and poor perfusion. However, this study does directly assess the ability of the pulse oximeter to detect bradycardia using the gold standard of an ECG. Because the patient population, NICU patients, is different from the population addressed in the worksheet, it is coded as LOE 5. It is included in the worksheet.


Level of Evidence: 4
Quality of Study: Fair
Supportive/Neutral/Opposing Clinical Question: Neutral
Reviewer's Comments: This study evaluated the utility of pulse oximetry in the delivery room. This is an observational study, n=100. The resuscitation team was blinded to the pulse oximeters' measurements except for cases where the SpO2 was extremely low and hence posed a danger to the infant. The authors
report they were able to obtain meaningful SpO2 data within 1 minute in 43/100 infants, within 2 minutes in 81/100 infants, within 3 minutes in 95/100 infants. The study was not designed to assess the impact on outcomes of using the pulse oximeter. However, it provides useful data regarding the ability to obtain SpO2 values as early as 1 minute after delivery. This study is included in the worksheet.


**Level of Evidence:** 4  
**Quality of Study:** Good  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is an observational study of SpO2 in newborns. n=175. The mean gestational age was 37.5 weeks (SD 3.0). 54 infants were <37 weeks (mean GA 33.5 wks, SD 1.8), and 121 were term (mean gestational age 39.3, SD 1.3). The mean time to apply the sensor was 58 seconds (SD 21) and the mean time to acquisition of SpO2 data after birth was 74 seconds (SD 22). The authors state that they were not able to obtain data from 12/175 infants. This study does not compare the SpO2 data collected to a gold standard. The study is included in the worksheet. Coded as Kamlin (2006a).


**Level of Evidence:** 4  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** Study comparing palpation, auscultation versus ECG for determination of heart rate in the delivery room. Patients were low-risk term births who did not require active resuscitation. Two care providers were allocated by a coin toss to either assessing heart rate by palpation of the umbilical cord or by auscultation of the precordium. The heart rate was counted for 6 seconds and then multiplied by 10 as per the NRP method. Participants were blinded to the ECG recording. Twenty three assessors assessed 26 infants. The mean GA was 38 weeks and the mean BW was 3191 grams. The authors report that cord pulsations were not detectable in 5/26 infants. The mean time to application of the ECG leads was 1.9 minutes. The mean difference in heart rate between ECG and auscultation was -14 (SD 21). The mean difference in heart rate between ECG and palpation was -21 (SD 21). Both auscultation (p<0.003) and palpation (p=0.001) underestimated the heart rate. The clinical significance of the differences observed are questionable as the mean heart rate by ECG was 167 compared to auscultation (154 bpm) and palpation (147 bpm). One limitation of the study is the absence of infants with a heart rate <100 bpm which is the threshold for intervention as per NRP. The authors state that, although ECG is the gold standard for heart rate measurement, the utility of the ECG in the delivery room is limited due to costs, access to equipment and time to data aquisition. This study is included in the worksheet. Coded as Kamlin (2006b).


**Level of Evidence:** 4  
**Quality of Study:** Good  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is an observational study examining the accuracy of pulse oximetry measurements of heart rate as compared to the gold standard of ECG. 3 ECG leads were used. The resuscitation team was able to see both the pulse oximeter and ECG displays. The heart rate recorded by the pulse oximeter and the perfusion index from a video recording of pulse oximeter display recorded during the resuscitation. This investigator could not see the ECG. Another investigators measured the heart rate from a video recording of the ECG during the resuscitation. This investigator could not see the pulse oximeter display. 92 deliveries were attended but the authors could not make recordings in 37 of them (12 of these were due to problems with the pulse oximeter and 20 were due to problems with the ECG). The study included data for 55 infants. The mean gestational age was 35 weeks (SD=3.7 weeks). The median times to
acquire heart rate measurements with the pulse oximeter and ECG were 68 seconds (IQR 60 to 118 seconds) and 80 seconds (IQR 64 to 104 seconds), respectively. The mean heart rate via pulse oximetry was 2 bpm lower than the mean heart rate via ECG (SD=13). For infants requiring advanced resuscitation, (n=7), the median difference was <1 bpm. For detection of a HR<100 bpm, the pulse oximetry had a sensitivity of 89%, specificity of 99%, PPV 83%, NPV 99%. The authors advise caution of using pulse oximetry in the delivery room because of the problems associated with motion artefact. The authors recommend using pulse oximetry as an adjunct to clinical surveillance. This study is included in the worksheet.


Level of Evidence: 2
Quality of Study: Fair
Supportive/Neutral/Opposing Clinical Question: Supportive
Reviewer's Comments: This is the only study identified that assesses the impact on outcomes of using pulse oximetry in the delivery room. The study had 2 parts. STUDY A: Prospective observational study comparing newborn infants resuscitated with a pulse oximeter in place with the concurrent control group consisting of newborn infants resuscitated without a pulse oximeter in place. The outcomes of interest were admission rates to the Special Care Nursery (clinically unwell) versus admission rates to the Normal Newborn Nursery (clinically well) and Apgar scores in the 2 groups. Infants pre-identified as being at high risk for respiratory failure were included in the study. There were 25 infants in the experimental group (mean gestational age 32 weeks) and 25 infants in the control group (mean 31 weeks). There were no complications of pulse oximetry. Apgar scores were similar in the 2 groups. Infants in the experimental group were significantly less likely to be admitted to the Special Care Nursery (32% vs 52%, p=0.04). STUDY B: Prospective observational study assessing the ability of the pulse oximeters to measure transcutaneous oxygen saturations in extremely preterm, very low birth weight infants in the delivery room. 15 infants were included in this study. The median gestational age was 26.4 weeks (minimum 24.3 weeks, maximum 29.0 weeks). A reliable signal was obtained in 100% of the infants. The median time from birth to detection of the pulse rate signal was 2.3 minutes. This study is relevant to the study question and is included in the worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: Study is not relevant to question. Not included in worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: The study does not investigate the impact of ancillary methods of physiologic measurement. It is not relevant to the question and therefore is not included in the worksheet.


Abstract: No abstract.
Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: This is a letter to the editor of the journal Indian Pediatrics. It is not included in the worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: This is a Spanish language paper. The paper was retrieved. However, review of the abstract indicated that the study was not relevant to the question. The study was not included in the worksheet.


Level of Evidence: 4
Quality of Study: Good
Supportive/Neutral/Opposing Clinical Question: Neutral
Reviewer's Comments: Observational study measuring pre and postductal SpO2 simultaneously in 110 healthy newborn infants. The person responsible for the airway and for oxygen administration was unaware of the pulse oximeters' readings. The median (IQR) time till accurate measurements were achieved was 3 minutes (2.4-4.1). Out of 110 infants, accurate measurements of SpO2 were recorded at 2, 3, 4, 5, 10 and 15 minutes in 20, 62, 92, 106, 109 and 110 minutes. The study center delays cord clamping for 1 minute. It is not clear if the pulse oximeters' sensors were applied during or after cord clamping, hence the time to accurate readings may actually be 1, 2, 3, 4, 9 and 14 minutes though this is not clear in the article. The authors state that it was "difficult to place the sensors and have accurate readings for the first 2 to 3 minutes". This study addressed the feasibility of pulse oximetry in the delivery room but does not report on outcomes. It is included in the worksheet.


Level of Evidence: 4
Quality of Study: Poor
Supportive/Neutral/Opposing Clinical Question: Supportive
Reviewer's Comments: This is a case series examining pulse oximetry use during newborn resuscitation in the delivery room. The cases include 4 preterm infants (2 27 weeks infants, a 31 week infant and a 34 week infant). Transcutaneous oxygen saturation measurements were successfully made in all infants. In 3 of the cases, problems with endotracheal tube positioning were detected by auscultation. However, in Case 1, use of the pulse oximeter allowed detected of malposition of the endotracheal tube. The authors state that, in Case 1, auscultation and observation of the chest failed to detect that the endotracheal tube had been advanced too far. This study includes one case showing potentially improved outcomes resulting from the use of pulse oximetry. This study is included in the worksheet.


Level of Evidence: Not included in worksheet
Quality of Study: Not included in worksheet
Supportive/Neutral/Opposing Clinical Question: Not included in worksheet
Reviewer's Comments: This study does not address the question. It was not included in the worksheet.


**Reviewer’s Comments:** This study is not relevant to the question. It was not included in the worksheet.


**Level of Evidence:** 4

**Quality of Study:** Good

**Supportive/Neutral/Opposing Clinical Question:** Neutral

**Reviewer’s Comments:** Observational study assessing ability of health care personnel to detect cyanosis visually. Twenty newborn resuscitations were videotaped along with simultaneous pulse oximetry measurements. The median GA was 31 weeks and the median BW was 1552 grams. 27 study participants were shown videos of the resuscitations and asked to assess if the infants were pink at the start of resuscitation, at which point a baby became pink or wether an infant was cyanotic for the entire resuscitation. The results showed large variability in the oxygen saturations at which participants detected cyanosis or the absence of cyanosis. The authors state that the results suggest that the “clinical assessment of the newborn infant’s colour is unreliable” The study does not address outcomes. However, it does contribute information related to the clinical detection of cyanosis and hence is included in the worksheet.


**Level of Evidence:** 2

**Quality of Study:** Fair

**Supportive/Neutral/Opposing Clinical Question:** Neutral

**Reviewer’s Comments:** Prospective ‘randomized’ study comparing 3 methods of heart rate determination (palpation of the umbilical artery, brachial artery and femoral artery) in the delivery room. The only exclusion criterion was the need for resuscitation beyond 5 minutes of age. The authors state that the study was randomized, however, the method of randomization is not stated. If the pulse was not detected after 30 seconds it was coded as not palpable. The heart rate was palpated by one member of the resuscitation team while one of the study investigators auscultated the heart rate over the precordium. Therefore, the auscultated heart rate was taken as the gold standard. The person palpating the heart rate coded it into one of the following categories: <60, 60-100, or > 100 bpm. Sixty babies were enrolled with 20 babies in each group. Results: Femoral artery correctly identified as >100 bpm in 9/20, femoral artery incorrectly identified hr<100 in 9/20 and femoral pulse not palpable in 7/20. Brachial artery correctly identified as >100 bpm in 5/20, incorrectly identified hr<100 in 3/20 and was not detectable in 12/20. Umbilical cord correctly identified hr as >100 bpm in 11/20, incorrectly identified hr<100 bpm in 4/20 and was not palpable in 4/20. The authors conclude that palpation of pulses for hr determination is not sufficiently accurate and may result in inappropriate interventions. This study compares different accepted methods of determining heart rate. This study does not directly address outcomes. It is included in the worksheet.


**Level of Evidence:** Not included in worksheet
**Quality of Study:** Not included in worksheet

**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet

**Reviewer's Comments:** This study is not relevant to the question. The median postnatal age of enrolled infants was 3 days (range 1-14 days). This study is not included in the worksheet.


**Level of Evidence:** Not included in worksheet

**Quality of Study:** Not included in worksheet

**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet

**Reviewer's Comments:** This study did not address the question. It is not included in the worksheet.


**Level of Evidence:** Not included in worksheet

**Quality of Study:** Not included in worksheet

**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet

**Reviewer's Comments:** This communication is not relevant to the study question. It is not included in the worksheet.


**Level of Evidence:** Not included in worksheet

**Quality of Study:** Not included in worksheet

**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet

**Reviewer's Comments:** This is a review article. It is not relevant to the question. It is not included in the worksheet.


**Level of Evidence:** 4

**Quality of Study:** Good

**Supportive/Neutral/Opposing Clinical Question:** Neutral

**Reviewer's Comments:** This is an observational study of pulse oximetry measurements of healthy newborns in the delivery room. The study includes 115 newborns, all of whom are greater than or equal to 35 weeks gestation. Stable SpO2 data was collected at a median of 82 seconds (IQR 30-140 seconds) after birth. This study used prespecified criteria for exclusion of poor quality SpO2 data. The authors report that 14% of data was excluded, the majority of which were collected immediately after birth. The authors state that pulse oximetry may play a role beyond 2 minutes of life given the time to meaningful data acquisition. No comparison of the recorded SpO2 data is made to a gold standard (e.g., arterial blood gas value). The study is included in the worksheet.


**Level of Evidence:** 4

**Quality of Study:** Fair

**Supportive/Neutral/Opposing Clinical Question:** Neutral

**Reviewer's Comments:** This is a prospective observational study of 70 newborns that received supplemental oxygen at birth compared to a cohort of 115 healthy newborns. Continuous SpO2 measurements were made by pulse oximetry. Babies receiving 100% oxygen by free flow had a slower increase in oxygen saturation compared with healthy infants transitioned in room air. Babies resuscitated with 100% oxygen by assisted ventilation had a similar increase in oxygen saturation compared with healthy infants transitioned...
in room air. The SpO2 of preterm infants resuscitated with supplemental oxygen did not exceed values observed in healthy infants transitioned in room air. Oxygen saturation readings were available by 1 to 2 minutes. The resuscitation team was blinded to the pulse oximeter. There is no comparison of the pulse oximeter readings to the gold standard. The study was not designed to assess outcomes resulting from use of pulse oximetry. Because the study demonstrates that pulse oximetry use is feasible in the delivery room, it is included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/ Neutral/ Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is an observational study of pulse oximetry use during resuscitation of asphyxiated newborns. The study mentions heart rate measurements but does not comment on how the heart rate was measured (eg, clinically, pulse oximetry, ECG). The study does not present information on the accuracy of the signal or the time to data acquisition. It is not included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/ Neutral/ Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a wonderful review of relevant physiology during newborn resuscitation. However, it does not address the question. Hence, it is not included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/ Neutral/ Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a case report of the use of a carbon dioxide detector used in an adult patient. It is not relevant to the question. It is not included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/ Neutral/ Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a retrospective study examining infants from the Resair 2 trial for variables associated with a positive response to resuscitation. There is no discussion about the method of determining physiologic variables (eg, heart rate). It is not relevant to the question. The study is not included in the worksheet.


**Level of Evidence:** 5  
**Quality of Study:** Fair  
**Supportive/ Neutral/ Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is an observational study examining the accuracy of pulse oximetry in determining heart rates. Stable preterm infants admitted to the NICU had simultaneous measurements of heart rate using an ECG and via pulse oximetry. n=30. The mean gestational age was (29 weeks (SD=4). The mean difference in heart rate as determined by pulse oximetry and ECG was -0.4 bpm (SD=6). Although
this is a study of NICU infants, it is designed well and compares pulse oximetry heart rate measurements to the gold standard of ECG. Note that the patient population of stable infants in the NICU likely resulted in more accurate heart rate measurements by pulse oximetry as there is less motion and better perfusion than immediately after birth. Because this study examines infants in the NICU, it is not directly relevant to the current worksheet which examines resuscitation in the delivery room. Hence, it is coded as LOE 5. It is included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This study is not relevant to the question. It is not included in the worksheet.


**Level of Evidence:** 3  
**Quality of Study:** Good  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** Prospective study with retrospective cohort. This study examined the introduction of a practice plan in 2006 for resuscitation of infants <1500 g. Prior to this, infants were resuscitated with 100% oxygen. Following institution of practice plan, the resuscitation team was allowed to choose the starting FiO2 and to titrate it to achieve an SpO2 of 85-95%. Retrospective analysis of 47 infants. Prospectively analyzed 53 infants. Starting FiO2 ranged from 0.21 to 0.50. 55% reached target, 45% exceeded target but 1/3 of these were always in room air. 81% of infants needed supplemental oxygen on admission to NICU. The practice plan was associated with a reduction in SpO2 on admission to NICU from 99% to 95% (p=0.0001), and a PaO2 <80 mm Hg from 44% to 70%. Of note, there was a reduction in the concentration of supplemental oxygen at 24 hours from 40% to 25% (p=0.0005). Note that in half of the cases, the FiO2 had to be increased to reach the target SpO2. Pulse oximetry was not routinely used prior to introduction of the practice plan. After introduction of the practice plan, pulse oximetry was used to measure oxygen saturation and heart rate in the delivery room. Heart rate was detected within 1 minute. The study, by design, did not blind the resuscitation team to the pulse oximeter's reading. The study was not designed to directly assess the impact of pulse oximetry use on outcomes. This study demonstrates the feasibility of pulse oximetry for measuring oxygen saturation and heart rate in preterm infants in the delivery room. It is included in the worksheet.


**Level of Evidence:** 5  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This study has high relevance to the question. Three methods of assessing 4 different heart rates were assessed: NRP 6 second count by auscultation, clinician's own method, novel electronic timing device which was preset to alert the clinician 6 seconds after it was activated. The study used a model in which an electronic metronome was placed in the mannequin's chest. The study was not randomized as each clinician was assessed for each of the 3 methods for each of the 4 heart rates. The electronic timer was associated with the highest accuracy in heart rate determination. The author's state that use of the electronic timer reduced the error rate in heart rate determination from 22% to 4% as compared to the NRP 6 second method. The author's acknowledge the methodologic limitations of the study. Most significantly, the metronome was loud enough that it could be heard without a stethoscope and the metronome sounded at a constant interval. The metronome tone is not representative of the nature of the heart rate in a transitioning infant where the heart rate is much quieter and variable in rate and tone. Because the study was performed using a mannequin, and not in newborn infants, it is coded as LOE 5. The study is included in the worksheet.

**Level of Evidence:** 4  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** Prospective observational study of healthy term newborn infants in the delivery room (*n*=50). Two pulse oximetry probes placed immediately after birth to continuously record pre and post ductal oxygen saturations. It is not clear if the heart rate data was obtained from the pulse oximeter's measurements. Oxygen saturation measurements were possible at 2 minutes of age. The authors do not mention if the resuscitation team was blinded to the pulse oximeter. The study was not designed to assess outcomes resulting from the use of pulse oximetry. There is no comparison of pulse oximetry measurements of oxygen saturation to the gold standard. This study does show that oxygen saturation measurement using pulse oximetry is feasible at the time of birth. It is included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a Finnish-language article. The abstract was reviewed and this paper does not address newborn resuscitation in the delivery room. It is not included in the worksheet.


**Level of Evidence:** Expert opinion  
**Quality of Study:** Expert opinion  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** This is a review article. Many of the recommendations are based on expert opinion. The authors state that it is important to have equipment necessary for avoiding hyperoxemia during newborn resuscitation in the delivery room. This includes an oxygen blender, oxygen, compressed air and a pulse oximeter. They also argue that heart rate determination is critical as it is an early indicator of successful transition. It is suggested that the use of an ECG monitor or pulse oximeter during resuscitation have the benefits of providing an accurate heart rate and of freeing up a member of the team who otherwise would have been responsible for measuring heart rate via auscultation. The authors recommend that referral centers should have the ability to monitor heart rate, oxygen saturation and temperature in the delivery room. It is included in the worksheet.


**Level of Evidence:** 4  
**Quality of Study:** Fair  
**Supportive/Neutral/Opposing Clinical Question:** Neutral  
**Reviewer's Comments:** Prospective randomized control trial of preterm infants (GA 23-31 weeks) who were resuscitation with room air or 100% oxygen. In the 100% oxygen group, the FiO2 at 5 minutes was weaned if SpO2 >95%. Treatment failure was described as the presence of one of the following: chest compressions, resuscitation medications, heart rate <100 bpm at 2 minutes, heart rate <60 bpm for >30 seconds. For treatment failure, the FiO2 was increased to 100%. Every baby in the RA group met the rescue criteria at or before 3 minutes with 6/18 patients directly switched to 100% oxygen for bradycardia by 2 minutes. 12/18 patients had an incremental increase in FiO2 for failing to achieve an SpO2 of 70% by 3 minutes. The resuscitation team was not blinded to the pulse oximeter. Comparisons of the SpO2 and heart rate measurements from the pulse oximeter were not compared to the corresponding gold standards were not made. The study was not designed to assess outcomes directly related to the use of pulse oximetry. SpO2 data was available from 1 minute of age. This study demonstrated, indirectly, that pulse
oximetry can be used to measure oxygen saturation and heart rate in the delivery room. Hence, it is included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This is a commentary on an article that was assessed for inclusion in this worksheet. It is not relevant and is not included in the worksheet.


**Level of Evidence:** Not included in worksheet  
**Quality of Study:** Not included in worksheet  
**Supportive/Neutral/Opposing Clinical Question:** Not included in worksheet  
**Reviewer's Comments:** This study is not relevant to the question. It is not included in the worksheet.