**Review**

Respiratory function monitoring during neonatal resuscitation: A systematic review

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**Abstract**

**Aim:** Positive pressure ventilation via a facemask is critical in neonatal resuscitation, but frequently results in mask leak, obstruction, and inadequate respiratory support. This systematic review aimed to determine whether the display of respiratory function monitoring improved resuscitation or clinical outcomes.

**Methods:** Randomized controlled trials comparing outcomes when respiratory function monitoring was displayed versus not displayed for newborns requiring positive pressure ventilation at birth were selected and from databases (last search August 2022), and assessed for risk of bias using Cochrane Risk of Bias Tools for randomized control trials. The study was registered in the Prospective Register of Systematic Reviews. Grading of Recommendations, Assessment, Development and Evaluations was used to assess the certainty of evidence. Treatment recommendations were approved by the Neonatal Life Support Task Force of the International Liaison Committee on Resuscitation. Results reported primary and secondary outcomes and included resuscitation and clinical outcomes.

**Results:** Of 2294 unique articles assessed for eligibility, three randomized controlled trials were included (observational studies excluded) (n = 443 patients). For predefined resuscitation and clinical outcomes, these studies either did not report the primary outcome (time to heart rate ≥ 100 bpm from birth), had differing reporting methods (achieving desired tidal volumes, significant mask leak) or did not find significant differences (intubation rate, air leaks, death before hospital discharge, severe intraventricular hemorrhage, chronic lung disease). Limitations included limited sample size for critical outcomes, inconsistent definitions amongst studies and unreported long-term outcomes.

**Conclusion:** Although respiratory function monitoring has been utilized in clinical care, there is currently insufficient evidence to suggest its benefit for newborn infants receiving respiratory support for resuscitation at birth.

**Registration:** PROSPERO CRD42021278169 (registered November 27, 2021).

**Funding:** The International Liaison Committee on Resuscitation provided support that included access to software platforms and teleconferencing.

**Keywords:** Neonatal resuscitation, Respiratory function monitoring, Grading of Recommendations, Assessment, Development and Evaluations (GRADE), Positive pressure ventilation (PPV), International Liaison Committee on Resuscitation (ILCOR), Neonatal Life Support Task Force (NLS TF), Preferred Reporting Items for Systematic Reviews and meta-analyses (PRISMA)

**Introduction**

At birth, newborn infants undergo multiple physiologic changes, including lung aeration, airway liquid clearance, and the initiation of pulmonary gas exchange. Approximately 5% of term newborns need respiratory support to successfully complete this transition, whereas advanced resuscitation interventions are needed in less than 1%. Providing rapid and effective positive pressure ventilation via a face mask is considered to be a critical component of neonatal resuscitation. However, this is a challenging skill to master and maintain. Frequent problems when providing mask ventilation

**Abbreviations:** GRADE, Grading of Recommendations, Assessment, Development and Evaluations, R F M, Respiratory Function Monitoring, RCTs, randomized controlled trials, NICU, neonatal intensive care unit, ILCOR, International Liaison Committee on Resuscitation, NLS TF, Neonatal Life Support Task Force, PRISMA, Preferred Reporting Items for Systematic Reviews and meta-analyses, ECG, electrocardiogram, CINAHL, Cumulative Index to Nursing and Allied Health Literature, RoB, risk of bias

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are: a widely variable mask leak (median range) of 29% (0%–100%)
and mask obstruction; which may lead to an inadequate
tidal volume being delivered. Respiratory function monitoring may help clinicians improve resuscitation performance by providing feedback on mask leak and delivered tidal volumes, among other parameters. In randomized controlled trials (RCTs) the use of respiratory function monitoring reduces face mask leak. Studies with respiratory function monitoring have demonstrated that changes in tidal volume occur during transition at birth, a positive relationship between tidal volume delivered and increase of heart rate during this transition, the contribution of spontaneous breathing to the tidal volume in newborn infants being provided positive pressure ventilation and tidal volume changes during cardiac compressions. Clinically, respiratory function monitoring via mechanical ventilators is commonly used in the neonatal intensive care unit (NICU) as a feedback tool. However, it is not routinely used to monitor ventilation during neonatal resuscitation. Instead, the assessment of adequate ventilation in the delivery room relies on observing adequate chest rise, and heart rate improvement. T-piece resuscitator devices deliver a known peak inflation pressure and positive end expiratory pressure. However, peak inflation pressure may not correlate with delivered tidal volume, which will vary depending on face mask leak and obstruction, lung aeration, as well as lung compliance and airway resistance. Respiratory function monitoring helps identify mask leak and obstruction, and measures the expired tidal volume. Most clinicians underestimate face-mask leak, and thereby, their estimation of delivered tidal volume is poor. Respiratory function monitoring has potential to replace inaccurate and imprecise visual estimation of tidal volume by providing a more accurate data display. The International Liaison Committee on Resuscitation (ILCOR) Neonatal Life Support Task Force (NLS TF) identified respiratory function monitoring as a high priority topic and had reviewed this topic in 2015. Literature surveillance identified new trials that justified a review update. This systematic review aimed to determine whether the display of respiratory function monitoring improved resuscitation or clinical outcomes.

Methods

Protocol
This study was conducted in accordance with Cochrane Handbook for Systematic Reviews of Interventions. Reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for meta-analyses in healthcare protocols. The study was registered in the Prospective Register of Systematic Reviews (PROSPERO) (CRD42021278169, registered November 27, 2021) before beginning data extraction. This review included studies in newborn infants receiving respiratory support at birth to determine if the display of respiratory function monitoring versus no display of respiratory function monitoring improves resuscitation and/or improve clinical outcomes.

Respiratory function monitoring was defined as a device(s) that measures the following parameters during neonatal resuscitation: 1. Calculated or measured by flow meter: mask leak, inspired and expired tidal volume, flow rate, respiratory rate. 2. Measured by manometry: peak inflation pressure, positive end expiratory pressure. 3. Measured by capnography: end-tidal carbon dioxide concentration excluding colorimetric detectors (optional). As defined for this review, respiratory function monitoring does not include untrated stand-alone electrocardiogram (ECG), pulse oximetry or an analog display of manometry.

PROSPERO was updated following discussions with the NLS TF and our ILCOR representatives to reflect the following changes. The primary outcome of death before discharge was initially selected, but it was determined prior to the search that HR > 100 bpm was a more appropriate primary outcome, given its importance as a marker of successful resuscitation and its influence on the decisions of the healthcare team; and European Union trials were inadvertently left out of the registry, but the search was in fact performed and PROSPERO was amended.

Outcomes
Published evidence and discussion with the ILCOR NLS TF was utilized for the ranking of patient-oriented outcomes. Outcomes of interest were broadly categorized into ‘resuscitation outcomes’ (time to heart rate ≥ 100 bpm from birth (primary outcome), achieving desired tidal volume, maximum mask leak, rate of intubation] and ‘clinical outcomes’ (death before hospital discharge, severe intraventricular hemorrhage (grades 3 or 4), bronchopulmonary dysplasia or chronic lung disease, duration of respiratory support, air leaks) reported either individually or as a composite outcome.

Search strategy
A search was conducted by an information specialist in close consultation with the review team in the following databases, from their date of inception until September 20, 2021 without language restrictions: Ovid Medline, Embase, Cochrane Controlled Register of Trials, Cumulative Index to Nursing and Allied Health Literature (CINAHL), US National Library of Medicine (clinicaltrials.gov), International Standard Randomized Controlled Trial Number registry (isrctn.com) and the European Union Clinical Trials Register (clinicaltrialsregister.eu). The search was repeated on August 25, 2022. The search strategy for all databases is included in Supplement A.

Study selection and data extraction
Covidence (Veritas Health Innovation, Melbourne, Australia) was used for study selection and data extraction. Titles and abstracts were screened by two independent reviewers (JF, YR). Disagreement during abstract screening was resolved by full text review. In the event initial consensus could not be reached, a third reviewer (MT) completed full text review with final decisions determined by team consensus.

RCTs and non-randomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), manikin-based studies, and animal-based studies were eligible for inclusion. Although the search strategy was designed to find animal and manikin studies, an early decision was made that because there were sufficient human infant trials to provide direct evidence, animal and manikin studies were set aside for inclusion in a future review that will include training and teamwork outcomes. Unpublished studies (e.g. conference abstracts, trial protocols) were excluded. As three randomized control trials were eligible for inclusion in this review, we did not include observational studies in the formal analysis.

Data Collection, risk of bias and certainty of evidence Assessment
Authors independently extracted details of study methodology and prespecified outcomes. Authors reached consensus for any dis-
agreements through discussion. The pair of authors assessed risk of bias (RoB) using the Cochrane Risk of Bias Tool for RCTs (version 2). Certainty of evidence for each outcome was assessed by pairs of authors utilizing the GRADE framework.20 The entire team reviewed the RoB and GRADE evaluations to achieve consensus.

Data analysis
Data analysis was conducted using Review Manager software (version 5.3, Nordic Cochrane Centre, Copenhagen, Denmark). Evidence to decision assessments utilized GRADEpro GDT software (GRADEpro Guideline Development Tool. McMaster University and Evidence Prime, 2021).

All prespecified outcomes were reported in this review, no extra data provided by study authors was requested. A meta-analysis using Revman Forest plots was performed if at least 2 studies were included for the relevant outcome. Where meta-analysis was not appropriate, but prespecified outcome was important (e.g. achieving desired tidal volume, significant mask leak), studies were included in a narrative description. Heterogeneity was quantified using the I^2 statistic. Given our expectation for small sample sizes, we employed a random effects model. We calculated unadjusted risk ratios using the Mantel-Haenszel method for dichotomous variables. Prespecified subgroup analyses were conducted for all outcomes where data was available and included: i. gestational age at birth: ≥37 weeks, 32–36 weeks, <32 weeks, ii. timing of cord clamping: <30 seconds (immediate), ≥30 seconds (deferred).

Results
Our search identified 2807 studies (513 duplicates, 2259 deemed irrelevant) with 35 full-text studies assessed for eligibility; of these, three RCTs30–32 were included in the final analysis and 32 observational studies were ultimately excluded, but will be included in a future systematic review examining human performance. Cohen’s kappa was 0.72 (substantial agreement) at the abstract screening stage and 1.0 (full agreement) at the full-text screening stage. Refer to the Covidence PRISMA flow diagram (Fig. 1) and the GRADE Assessment of Evidence table (Table 1).

Study characteristics
Three RCTs30–32 were identified, including 443 newborn infants. One newborn infant died in the delivery room in the van Zanten et al. study, resulting in a total of 442 newborn infants available for

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Fig. 1 – PRISMA Flow Diagram 32 Studies were excluded because they were categorized as observational studies on humans or simulated patients that will be included in a future systematic review examining team performance. From: Page et al.27
The studies were conducted in Australia, Europe and North America and were published between 2012 and 2021. Patients were recruited from 2008-2019. Two studies were conducted at a single center and the third study was multi-centered. The studies ranged in size from 49 to 288 infants. The three RCTs enrolled infants < 37 weeks postmenstrual age who required positive pres-

| Outcomes                                    | % of participants | Certainty of the evidence | Relative effect | Anticipated absolute effects* (95% CI) |
|----------------------------------------------|-------------------|---------------------------|-----------------|---------------------------------------|
| Intubation in delivery room                  | 443               | Very low                   | RR 0.90         | Study population                      |
| Achieving targeted TVs (4–8 mL/kg)           | 337               | Low                       | RR 0.96         | Study population                      |
| BPD                                          | 393               | Low                       | RR 0.85         | Study population                      |
| IVH (Grade 3 or 4)                           | 287               | Low,e                     | RR 0.96         | Study population                      |
| Death prior to hospital discharge            | 442               | Low                       | RR 1.00         | Study population                      |
| Pneumothorax                                 | 393               | Low                       | RR 0.54         | Study population                      |
| IVH (all grades)                             | 393               | Low,low                   | RR 0.69         | Study population                      |

1 Zeballos Sarrato G, Sánchez Luna M, Zeballos Sarrato S, Pérez Pérez A, Pescador Chamorro I, Bellón Cano JM. New Strategies of Pulmonary Protection of Preterm Infants in the Delivery Room with the Respiratory Function Monitoring. Am J Perinatol; 2019.
2 van Zanten HA, Kuypers KLAM, van Zwet EW, van Vonderen JJ, Kamlin COF, Springer L, Lista G, Cavigioli F, Vento M, Núñez-Ramiro A, Oberthuer A, Kribs A, Kuester H, Horn S, Weinberg DD, Foglia EE, Morley CJ, Davis PG, Te Pas AB. A multi-centre randomised controlled trial of respiratory function monitoring during stabilisation of very preterm infants at birth. Resuscitation; 2021.

Table 2 – Risk of Bias for the three RCTs evaluated.

| Manuscript               | Random sequence generation | Allocation Concealment | Blinding of participants and personnel | Blinding of outcome assessment | Incomplete outcome data | Selective reporting | Overall Risk of Bias |
|--------------------------|-----------------------------|------------------------|----------------------------------------|-------------------------------|------------------------|-------------------|---------------------|
| Schmözer et al., 2012    | Low                         | Low                    | Some Concerns                          | Low                           | Low                    | Some concern      | High                |
| Zeballos Sarrato et al., 2018 | Low                         | Low                    | Some Concerns                          | Low                           | Low                    | Some concern      | High                |
| Van Zanten et al., 2021  | Low                         | Low                    | Some Concerns                          | Low                           | Low                    | Some concern      | Some Concerns      |
sure ventilation in the delivery room and infants were randomized to an respiratory function monitoring displayed or respiratory function monitoring not displayed group (Table 4).

Assessment of sources of bias
All three studies had potential bias regarding blinding of personnel (Table 2). Although all had concealment of the allocation sequence, there may have been team’s performance bias because the intervention itself (respiratory function monitoring displayed vs not displayed) could not be blinded due to nature of the studies’ design. One study (Zeballos Sarrato et al.) did not specify if outcome assessors were blinded.\(^{31}\) Furthermore, in this study, tidal volume was specified as the primary outcome in the clinical trial registry (USClinicalTrials.gov PRS, ID: NCT02748720), whereas the primary outcome reported in the published study was need for surfactant (selective reporting bias). Likewise, Schmolzer et al. listed several secondary outcomes

Respiratory Function Monitor Visible vs Respiratory Function Monitor Not Visible, outcome: Achieving targeted tidal volumes (4-8 mL/kg).

Respiratory Function Monitor Visible vs Respiratory Function Monitor Not Visible, outcome: Intraventricular hemorrhage (IVH) - Grade 3 or 4.

Respiratory Function Monitor Visible vs Respiratory Function Monitor Not Visible, outcome: Intraventricular hemorrhage - all grades.

Respiratory Function Monitor Visible vs Respiratory Function Monitor Not Visible, outcome: Death before discharge

Respiratory Function Monitor Visible vs Respiratory Function Monitor Not Visible, outcome: Pneumothorax

Fig. 2 – Forest Plots: Selected data represented here while the remaining Forest Plots are listed in Supplement C.
in the clinical registry (ACTRN12608000357358) that were not ultimately reported (changes in heart rate and SpO2 during the first 10 minutes, days of ventilation, Q2 at 36 weeks’ postmenstrual age). As a result, overall risk of bias was assessed as ‘high’ for Zeballos et al. and Schmölzer et al. and ‘some concerns’ for van Zanten et al.

**Primary outcomes**

For the important outcome of time to heart rate > 100 bpm in the delivery room, no data were reported in the included studies.

**Secondary Outcomes:**

Forest plots are displayed in Fig. 2.

**Resuscitation outcomes**

Pre-specified resuscitation outcomes for this review included: time to heart rate > 100 bpm, achieving desired tidal volume, maximum mask leak and rate of intubation. Other outcomes were considered post-hoc analyses.

For the important outcome of intubation in the delivery room, evidence of very low certainty (downgraded for risk of bias, inconsistency and imprecision) (RR 0.90, 95% CI 0.55 – 1.48; p = 0.69; I2 = 61%) could not exclude benefit or harm from displaying respiratory function monitoring compared to not displaying respiratory function monitoring.

For the important outcomes of achieving desired tidal volumes in the delivery room30–32 (RR 0.96, 95% confidence interval (CI) 0.69 – 1.34; p = 0.8; I2 = 0%) and, pneumothorax31–32 (RR 0.54, 95% CI 0.26 – 1.13; p = 0.10; I2 = 0%), evidence of low certainty (downgraded for risk of bias and imprecision) could not exclude clinical benefit or harm from displaying respiratory function monitoring compared to not displaying respiratory function monitoring.

For the important outcome of face mask leak, the three RCTs could not be meta-analyzed as the measurement of leak was reported differently in each study. One trial reported median (IQR) percentage of leak > 60% per infant also in the first 10 minutes and found less leak when respiratory function monitoring was displayed (p = 0.01). Another trial reported percentage of leak > 75% in the first 10 minutes and found less leak when respiratory function monitoring was displayed (p = 0.001).31 The third and largest trial reported median (IQR) percentage of leak > 60% per infant also in the first 10 min and found no significant difference in leak (p = 0.13) between when respiratory function monitoring was displayed and not displayed.

All three studies reported percentage of infants with tidal volume > 8 mL/kg, and two showed a lower proportion of infants with "excessive tidal volume" when respiratory function monitoring was displayed compared to when it was not displayed.30–31 Schmölzer et al. found a difference of 31% vs 36% of infants, (RR 0.81, 95% CI 0.67–0.98). In a post-hoc analysis, Zeballos Sarrato et al. reported a difference of 14.8 vs 36.5%, p < 0.001. However, van Zanten et al. did not find significant differences in the percentage tidal volume > 8 mL/kg per infant (p = 0.93) nor the duration of tidal volume > 8 mL/kg in seconds per infant (p = 0.14).

In regard to prespecified subgroup analyses for the systematic review, Zeballos Sarrato et al. found there was a lower proportion of infants with tidal volumes > 8 mL/kg (28–29 weeks’ gestation – 25 vs 78%, p < 0.001 (n = 21), <28 weeks’ gestation – 15 vs 44%, p < 0.001 (n = 51)). However, this was a post-hoc analysis with relatively few patients and where the duration of tidal volume > 8 mL/kg was not specified, hence, it did not influence our conclusions.

Two RCTs reported on positive pressure ventilation duration using medians (IQR). Neither found a significant difference. Zeballos Sarrato et al. reported a median (IQR) positive pressure ventilation duration of 100 (63–131) seconds when respiratory function monitoring was visible and 80 seconds (45–146) when it was masked, p = 0.44. van Zanten et al. reported a median (IQR) positive pressure ventilation duration of 184 seconds (101–331) when respiratory function monitoring was visible and 170 seconds (82–292) when it was masked, p = 0.24.

**Clinical outcomes**

For the critical outcome of death before hospital discharge, evidence of low certainty (downgraded for risk of bias and imprecision) from 3 RCTs30–32 involving 442 patients could not exclude clinical benefit or harm from displaying respiratory function monitoring compared to not displaying respiratory function monitoring (RR 1.00 95% CI 0.66 – 1.52; p = 0.99; I2 = 0%).

For the important outcome of bronchopulmonary dysplasia / chronic lung disease (any), evidence of low certainty (downgraded for risk of bias and imprecision) from 2 RCTs31–32 involving 393 patients could not exclude clinical benefit or harm from displaying respiratory function monitoring compared to not displaying respiratory function monitoring (RR 0.85 95% CI 0.7 – 1.04; p = 0.12; I2 = 0%).

For the critical outcome of severe intraventricular hemorrhage (grades 3 or 4), evidence of low certainty (downgraded for risk of bias and imprecision) from 1 RCT32 involving 287 patients could not exclude clinical benefit or harm from displaying respiratory function monitoring compared to not displaying respiratory function monitoring (RR 0.96 95% CI 0.38 – 2.42; p = 0.93). Statistical heterogeneity could not be calculated because events occurred in only one trial.

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**Table 3 – Examples of Future Research Priorities.**

| Question                                                                 | Reference |
|--------------------------------------------------------------------------|-----------|
| Does the use of a RFM vs no RFM during neonatal resuscitation in the delivery room result in a difference in the percentage of time spent delivering a target TV? |           |
| What is the definition of clinically significant mask leak (in terms of % leak and % of time spent with that degree of leak)? |           |
| Does the use of a RFM vs no RFM during neonatal resuscitation in the delivery room result in a faster time to a heart rate > 60 bpm (and > 100 bpm)? |           |
| What is the optimal manner to display RFM data and alarms to achieve the most accurate and timely acquisition, interpretation and translation to actionable information? |           |
| What are the training requirements to achieve and maintain competency in the acquisition and accurate interpretation of data derived from RFM during neonatal resuscitation? |           |
| What is the cost effectiveness for the use of RFM (vs no RFM) during neonatal resuscitation? |           |
### Table 4 – Characteristics of included RCTs – Data largely represented as mean (SD); VTe = expired tidal volume.

| Location | Schmölder et al\(^{30}\) | Zeballos Sarrato et al\(^{31}\) | van Zanten et al\(^{32}\) |
|----------|--------------------------|-------------------------------|--------------------------|
| Study enrollment | November 2008 – January 2010 | October 2014 – April 2016 | October 2013 – May 2019 |
| Hospital Location | Delivery room | Delivery room | Delivery room |

| Sample Size | n = 54 | n = 46 | n = 54 | n = 52 | n = 138 | n = 150 |
|-------------|--------|--------|--------|--------|--------|--------|
| Gestational Age | 28 (2) | 27 (2) | 28.2 (2.7) | 28.4 (2.9) | 26 +2 (25+2 –27+1) | 26 + 2 (25+4 –27+1) |
| Birth Weight (grams) | 1006 (326) | 919 (324) | 1133 (514) | 1078 (419) | 822 (187) | 823 (195) |
| Primary outcome | Mask leak | TV during PPV | Percentage of inflations during PPV within a target range (TV 4–8 mL/kg) |

| Length of analysis | First 40 breaths | First 10 minutes | First 10 minutes |
|--------------------|------------------|------------------|------------------|
| Number of inflations analyzed | 1,040 | 3,329 | 25,432 |

| Target TV | 4–8 mL/kg | 4–6 mL/kg | 4–8 mL/kg |
|-----------|-----------|-----------|-----------|

| Reported expired TV | Delivered expired TV per infant mL/kg | Delivered VTe per infant mL/kg | Delivered Duration of expired TV > 8 mL/kg expired TV per infant mL/kg |
|---------------------|--------------------------------------|---------------------------------|-------------------------------------------------|
| \[TV < 4\ mL/kg, TV 4–8 mL/kg, TV > 8 mL/kg\] | | | |

| Reported face mask leak | % of leak per infant | % of leak > 75 % over all inflations | Duration of leak > 60 % per infant during PPV, AND % of leak per infant |
|-------------------------|----------------------|-------------------------------------|---------------------------------------------------------------------|
| Type of RFM used | Florian Respiratory Function Monitor | NMS, Respiratory Profile Monitor | ALD Resuscitation Monitor |
| RFM Displayed | RFM Not Displayed (control) | RFM Displayed | RFM Not Displayed (control) | RFM Displayed | RFM Not Displayed (control) |
| 1,040 | 920 | 3,329 | 3,934 | 25,432 | 25,920 |
Post-Hoc analyses
For the outcome of intraventricular hemorrhage (all grades), evidence of low certainty (downgraded for risk of bias and imprecision) from 2 RCTs involving 393 patients suggests possible clinical benefit from displaying a respiratory function monitor compared to not displaying a respiratory function monitoring (RR 0.69 95% CI 0.49–0.96; p = 0.03; I² = 0%). Intraventricular hemorrhage (all grades) was not a pre-specified outcome for this review and should be considered a post-hoc analysis. Intraventricular hemorrhage (all grades), but not severe intraventricular hemorrhage, was significantly decreased in the respiratory function monitoring visible group (low certainty). The composite outcome of intraventricular hemorrhage (all grades) and periventricular leukomalacia was not considered for this review as the composite outcome was a post-hoc analysis and the results driven by the increased incidence of intraventricular hemorrhage (all grades), not periventricular leukomalacia which was found in only a small proportion of infants.

Discussion
This systematic review of the use of respiratory function monitoring for the outcome of intraventricular hemorrhage (all grades), evidence of low certainty (downgraded for risk of bias and imprecision) from 2 RCTs involving 393 patients suggests possible clinical benefit from displaying a respiratory function monitor compared to not displaying a respiratory function monitoring. Intraventricular hemorrhage (all grades), but not severe intraventricular hemorrhage, was significantly decreased in the respiratory function monitoring visible group (low certainty). The composite outcome of intraventricular hemorrhage (all grades) and periventricular leukomalacia was not considered for this review as the composite outcome was a post-hoc analysis and the results driven by the increased incidence of intraventricular hemorrhage (all grades), not periventricular leukomalacia which was found in only a small proportion of infants.

Conclusion
Although respiratory function monitoring has been utilized in many sites, there is currently insufficient evidence to suggest (high RoB, very low or low certainty evidence) that it would be beneficial for all newborn infants receiving respiratory support at birth. Some outcomes were meta-analyzed, but heterogeneity in the definitions of some key outcomes across studies precluded pooling results.
analysis, data interpretation or manuscript preparation. She was excluded from bias assessment of this study. One author (YR) holds patents for pulse oximeter technology to guide oxygen titration in the delivery room. Georg Schmözer and Peter Davis are the authors of one study. Neither was involved in selection of articles for inclusion, data extraction or analysis but both acknowledged their potential intellectual conflicts of interest and participated in the Task Force discussions.

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Article Summary:

JF and YR conducted the literature search and article screening, MT completed full-text review to resolve any disagreements. JF, YR, LH completed bias assessment and GRADE analysis. All authors contributed to and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2022.100327.

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