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Predicting the need for ventilation in term and near-term neonates

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Objective: To determine whether the need for respiratory support can be predicted by oxygen requirement within the first 72 h in term and near-term infants.

Methods: To mimic the population of infants that would often be delivered outside a tertiary centre we studied a retrospective cohort of infants ≥ 32 weeks requiring oxygen, divided into three groups: cot oxygen only, nasal continuous positive airway pressure (NCPAP) only, or intermittent positive pressure ventilation (IPPV). We recorded each infant's peak fraction of inspired oxygen (FiO_2) – i.e. FiO_2 in the first 72 h in the cot oxygen only group or maximum FiO_2 prior to commencing the highest level of respiratory support. The peak FiO_2 was used as a diagnostic test to predict any respiratory support or IPPV – sensitivity and specificity were calculated and receiver operating characteristic (ROC) curves plotted (FiO_2 0.21–1.00) to identify the best balance point for prediction.

Results: The cohort included 592 infants: 516 cot oxygen only, 46 NCPAP only and 30 IPPV. The proportion ventilated increased with increasing peak FiO_2 – above 0.45 the proportion of infants ventilated exceeded 50%. To predict any respiratory support, the cut-point balancing sensitivity and specificity was a $FiO_2 \geq 0.35$–58/136 required respiratory support (sensitivity = 0.76, specificity = 0.85, positive predictive value (PPV) = 43%, negative predictive value (NPV) = 96%). To predict IPPV the cut-point was a $FiO_2 \geq 0.5$–28/47 treated with IPPV (sensitivity = 0.93, specificity = 0.97, PPV = 60%, NPV = 100%).

Conclusion: The need for respiratory support can be predicted by oxygen requirement within the first 72 h in term and near-term infants with reasonable sensitivity and excellent specificity.

Key words: infant, newborn; oxygen inhalation therapy; prognosis; respiration, artificial; respiratory distress syndrome.

Respiratory distress, most commonly due to hyaline membrane disease (HMD), is still a leading cause of morbidity and mortality in newborn infants.[1] There is a significant body of work in the literature, and ongoing research, into the best approach for management of respiratory problems in the newborn. Most of the research is aimed at the very highest risk group of infants, especially those born less than 28 weeks gestational age (GA) and/or with a birthweight less than 1000 g (extremely low birthweight infants). Comparatively there is relatively little recent data on infants that are more mature – term and near-term infants.

This group of more mature infants however, is not insignificant and is a larger group in number than the more preterm infants. At 32 weeks GA approximately 50% of infants will develop HMD.[2] Other respiratory disorders are also more common in this group including retained fetal lung fluid (RFLF – also known as transient tachypnoea of the newborn or wet lung) and meconium aspiration syndrome (MAS). The majority of these term and near-term infants will only require oxygen treatment, but for a proportion of these infants the disease process will continue to the point where they require intubation and ventilation for the treatment of respiratory failure. It would therefore be helpful to research this larger group of more mature infants for factors associated with the need for respiratory support and if that need can be predicted early. In particular does an infant's oxygen requirement early in the course of respiratory distress adequately predict the likelihood that the infant will need respiratory support and/or ventilation and therefore care in a level 3 nursery? The ability to determine which infants requiring oxygen therapy might need respiratory support would not only be useful in level 3 neonatal units but also in level 1 and 2 neonatal nurseries that frequently care for these more mature infants. It could also be used as a guide to help in the decision making process when considering the need for transferring or retrieving a baby to a level 3 neonatal unit for respiratory support and intensive care.

This information would be particularly useful in Australia and other relatively sparsely populated countries where transferring a baby is a significant undertaking. Our neonatal unit is in Queensland which is the most rural mainland state in Australia.[3] Due to these factors most infants born in this state are delivered in a hospital without a level 3 nursery. High-risk deliveries are preferentially transferred to the closest level 3 nursery prior to confinement, when possible, ensuring that the majority of extremely preterm infants are born at a tertiary centre. Women at later gestations and their infants are often not transferred as they are considered to be low risk and are delivered at the nearest hospital. Depending on the hospital's facilities, 32–34 weeks gestation is used as the guide for the need to be transferred or for continuing care in a regional centre. Subsequently there are a significant number of near-term (32–37 weeks GA) infants that are delivered outside of a tertiary centre.

We aimed to determine if the need for respiratory support in infants ≥ 32 weeks GA could be predicted by the infant's oxygen requirement within the first 72 h of age.

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METHODS

We studied a retrospective cohort of term and near-term infants in an attempt to replicate the population of infants that would usually be delivered outside of a tertiary centre. The cohort consisted of all infants delivered at ≥ 32 weeks to women that were booked to deliver at the Royal Women's Hospital (RWH), Brisbane who subsequently required oxygen therapy. The study included infants born over the 3-year period from 1999 to 2001 inclusive. Infants that were transferred to the RWH *in utero* or *ex utero* were excluded, as these would tend to consist of high risk infants. All infants that had a major congenital abnormality, that were ventilated after requiring intubation for resuscitation or were intubated or received oxygen primarily for or as a result of an operation were also excluded.

Infants who had oxygen therapy at any stage were initially identified using the 'NeoDATA' database system used in the RWH neonatal unit. Their charts were subsequently reviewed to confirm inclusion or exclusion, diagnoses and record their oxygen requirements over the first 72 h of life. For infants that did not require respiratory support the highest fraction of inspired oxygen (FiO_2) required during the first 72 h of life was recorded. If the baby did receive respiratory support the type of support used and time when support was commenced was recorded. For those infants needing nasal continuous positive airway pressure (NCPAP) only, the maximum FiO_2 at any stage prior to commencing NCPAP and whilst on NCPAP was recorded. For infants that required intubation and intermittent positive pressure ventilation (IPPV), their maximum FiO_2 required at any stage prior to being intubated was recorded. Once a baby was intubated or greater than 72 h of age no further data on oxygen requirement was recorded.

For this group of infants we generally aim for an oxygen saturation in the mid to high 90%. Within our unit there is no specific FiO_2 at which all infants receive NCPAP or are intubated. The decision to commence ventilation is made, case by case, using generally accepted principles[4] – i.e. ventilation if there is a deterioration when needing more than 40–60% oxygen, if PaO_2 is < 45 mmHg in the same FiO_2, if $PaCO_2$ is >50–60 mmHg or if there is an ongoing metabolic acidosis.

Data were also collected on other variables including maternal and neonatal factors. These included the use of antenatal steroids, gestational diabetes, delivery method, GA, birthweight, sex of the infant and presence of intrauterine growth retardation (IUGR). IUGR was defined as a birthweight < 10th centile for GA. The infants that were eligible for inclusion were then divided into three groups depending on the form of respiratory support they received. These groups were cot oxygen only, NCPAP only or IPPV. The three groups were compared for differences in demographic data.

The FiO_2 maxima referred to above we have called the peak FiO_2. Therefore the peak FiO_2 = the maximum FiO_2 in the first 72 h if the infant did not get NCPAP or IPPV, or the maximum FiO_2 prior to commencing NCPAP if the infant got NCPAP only, or the maximum FiO_2 prior to intubation if in the IPPV group.

The proportion (and 95% confidence intervals) of infants that required intubation for each peak FiO_2 was calculated by dividing the number of infants with that peak FiO_2 prior to intubation over the total number of infants that had that FiO_2 as their peak FiO_2.

Using the peak FiO_2 as a quasi-diagnostic test to predict the need for respiratory support or intubation, sensitivity and specificity were derived for each FiO_2 between 0.21 and 1.00. Using the need for intubation as a 'true positive', two-by-two tables were made for each FiO_2 between 0.21 and 1.00. Receiver operating characteristic (ROC) curves were made using 1- specificity along the *x*-axis and sensitivity along the *y*-axis. This was then used to identify the oxygen concentration that gave the best balance between sensitivity and specificity. This was done for two scenarios: first to identify the best balance point for the need for any respiratory support using peak FiO_2 required, and second, to identify the need for intubation.

A post-hoc analysis was done to explore the influence of GA on the use of FiO_2 to predict the need for respiratory support (NCPAP and/or IPPV) by repeating the calculation of sensitivities and specificities and plotting the consequent ROC curves for two groups: (i) infants from 32 to 34^{+6} weeks GA; and (ii) infants ≥ 35 weeks GA. A post-hoc analysis by GA was not possible for the prediction of intubation and ventilation due to the small numbers.

Statistics

Data were analysed using Microsoft Excel 97, and GraphPad Prism 3.02. Intergroup variables were analysed statistically using a χ^2 test or ANOVA where applicable.

The sensitivity and specificity of a test change depending on which cut-point is used (e.g. the FiO_2 used to 'diagnose' the need for respiratory support). Therefore, for each cut-point there will be a different sensitivity and specificity. ROC curves are constructed with the *y*-axis representing the sensitivity (the proportion of true-positives) and the *x*-axis representing 1 minus specificity (the proportion of false-positives). The ROC curve is plotted by points that represent the sensitivity and specificity for each cut-point. The more accurate a diagnostic test the more the ROC curve arches up into the top left-hand corner of the graph before moving over to the right. The best cut-point for the balance of sensitivity and specificity is the one nearest to the upper left-hand corner of the graph. The larger the area under the curve of this graph the better the test.

RESULTS

Over the 3-year period, 712 infants ≥ 32 weeks GA were born that subsequently developed an oxygen requirement. Of these, 120 (17%) did not fulfil entry criteria. These are shown in Table 1.

There were 592 infants who fulfilled entry criteria. Of these 516 were managed in humidicrib oxygen only, 46 required NCPAP only and 30 were intubated. There were 66 infants in total that received NCPAP. Of these 66, 20 (30%) were subsequently intubated. Comparisons between the infants that received cot oxygen only, NCPAP only and those that were intubated are shown in Table 2. GA and birthweight

Table 1 Infants excluded from analysis

Exclusion criteria	*n* = 120
Intubated for resuscitation at delivery	55
Congenital heart disease	27
Neonatal surgery	18
Congenital abnormality (other than cardiac)	13
Hyperoxygenation therapy for pneumothorax	3
Chart not available	2
Oxygen commenced after 72 h	1
Intubated for apnoea (phenobarbitone toxicity)	1

Table 2 Characteristics of infants included in study by level of respiratory support required

Characteristics	Cot oxygen $n = 516$	NCPAP only $n = 46$	IPPV $n = 30$	P
Male, n (%)	317 (61)	30 (65)	17 (57)	0.75
Gestational age, weeks, mean (SD)	37.8 (2.7)	34.7 (2.2)	36.0 (3)	< 0.0001
Birthweight, mean (SD)	3110 (743)	2350 (548)	2850 (775)	< 0.0001
IUGR, n (%)	66 (13)	3 (7)	0 (0)	0.06
Complete antenatal steroids, n (%)	38 (7)	12 (26)	7 (23)	< 0.0001
Caesarean delivery, n (%)	252 (49)	18 (39)	21 (70)	0.03
HMD, n (%)	180 (35)	39 (85)	21 (70)	< 0.0001
RFLF, n (%)	141 (27)	6 (13)	1 (3)	0.002
Peak FiO_2†, mean (SD)	29 (7)	37 (9)	65 (17)	< 0.0001
Hours on oxygen, mean (SD)	14 (41)	63 (93)	158 (216)	< 0.0001
Hours of age started respiratory support, mean (SD)	N/A	10.0 (12.2)	16.8 (14.3)	0.0286

†Peak FiO_2 = the maximum FiO_2 in the first 72 h if the infant did not get NCPAP or IPPV, or the maximum FiO_2 prior to commencing NCPAP if the infant got NCPAP only, or the maximum FiO_2 prior to intubation if in the IPPV group.

FiO_2, inspired oxygen fraction; HMD, hyaline membrane disease; IPPV, intermittent positive pressure ventilation; IUGR, intrauterine growth retardation; NCPAP, nasal continuous positive airway pressure; RFLF, retained fetal lung fluid; SD, standard deviation.

were significantly different between groups with those requiring support more likely to have a lower birthweight and be more preterm. IUGR infants tended toward a lower risk of requiring respiratory support. Infants requiring respiratory support were less likely to have retained fetal lung fluid but more likely to have been delivered by Caesarean section, completed a course of antenatal steroids and have hyaline membrane disease; compared with infants having cot oxygen only. Peak FiO_2 and duration of oxygen therapy were significantly different between the groups with those needing respiratory support needing a higher FiO_2 presupport and subsequently needing oxygen for longer. No infant commenced respiratory support beyond 51 h of age.

As expected, the incidence of infants requiring respiratory support increased with increasing peak FiO_2. This is shown in Fig. 1. The proportion of infants requiring support rose when the peak FiO_2 was > 0.4 (40 of 70 infants, 57%). In the group of infants with a peak FiO_2 of > 0.5 there was a high proportion that required intubation (21 of 30 infants, 70%). The proportion of infants requiring intubation and IPPV by peak FiO_2 is shown in Fig. 2. The proportion of infants that require IPPV increases with increasing peak FiO_2. There is a stepwise rise in the proportion of infants being intubated at a peak FiO_2 of 0.4 and similarly at 0.5. Above a peak FiO_2 of 0.45 the proportion of infants ventilated exceeded 50%.

Using peak FiO_2 as a quasi-diagnostic test to predict the need for respiratory support, sensitivity and specificity were derived for peak FiO_2s from 0.21 to 1.00 and ROC curves plotted. This was done for the two scenarios of: (i) the need for any support (NCPAP or IPPV) in all infants (Fig. 3), and (ii) the need for IPPV in all infants (Fig. 4).

For the prediction of the need for any respiratory support, the cut-point for the best balance between sensitivity and specificity is an FiO_2 of ≥ 0.35. There were 136 infants in our cohort with a peak FiO_2 ≥ 0.35 and 58 required respiratory support. Therefore a peak FiO_2 of ≥ 0.35 had a positive predictive value (PPV) of 43% and a negative predictive value (NPV) of 96%, sensitivity = 0.76, specificity = 0.85.

For the prediction of the need for intubation and IPPV in the whole cohort, the cut-point for the best balance between sensitivity and specificity is an FiO_2 of ≥ 0.5. There were 47 infants with a peak FiO_2 ≥ 0.5 and 28 were treated with IPPV. This peak FiO_2 gave a PPV of 60% and a NPV of 100%, sensitivity = 0.93, specificity = 0.97 (Table 3).

The implications of various FiO_2 cut-points for the need for intubation and IPPV, if they are used to determine when to transfer an infant from a level 2 nursery to a level 3 nursery, are shown in Table 4.

Post-hoc analysis by GA

The post-hoc analysis by GA, for the prediction of the need for any respiratory support, showed similar ROC curves in both groups (Figs 5 and 6). There were 475 infants ≥ 35 weeks GA

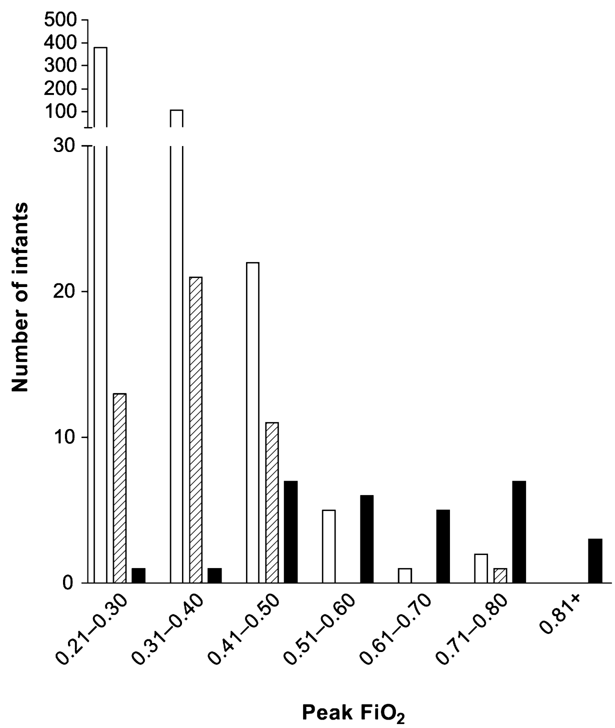

Fig. 1 Number of infants requiring cot oxygen only (□), nasal continuous positive airway pressure (NCPAP) (▨) and intermittent positive pressure ventilation (IPPV) (■) in peak fraction of inspired oxygen (FiO_2) strata from 0.21 to 1.00.

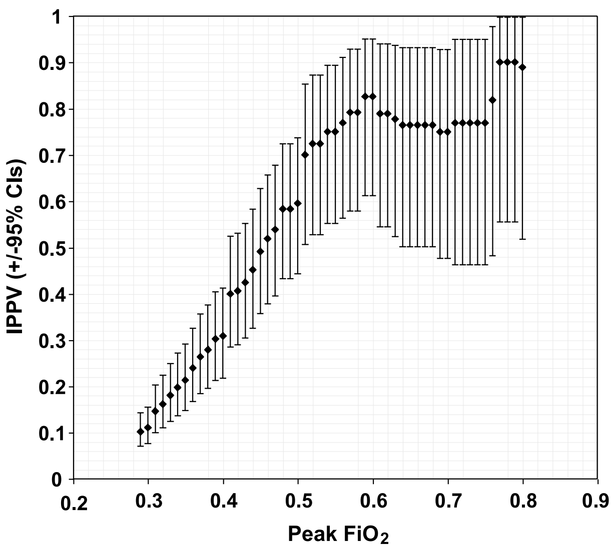

Fig. 2 The proportion (±95% confidence intervals) of infants ventilated for a given peak fraction of inspired oxygen (FiO_2).

and 38 required CPAP and/or IPPV. The cut-point for the best balance between sensitivity and specificity remains at an FiO_2 of ≥ 0.35 (Fig. 5) and the area under the curve is a little bigger. A peak FiO_2 of ≥ 0.35 had a PPV of 30% and an NPV of 98%, sensitivity = 0.84, specificity = 0.83.

There were 117 infants from 32 to 34^{+6} weeks GA and 38 required CPAP or IPPV. The cut-point for the best balance between sensitivity and specificity was lower at an FiO_2 of ≥ 0.30 (Fig. 6) and the area under the curve is a little smaller. A peak FiO_2 of ≥ 0.30 had a PPV of 70% and an NPV of 89%, sensitivity = 0.79, specificity = 0.84.

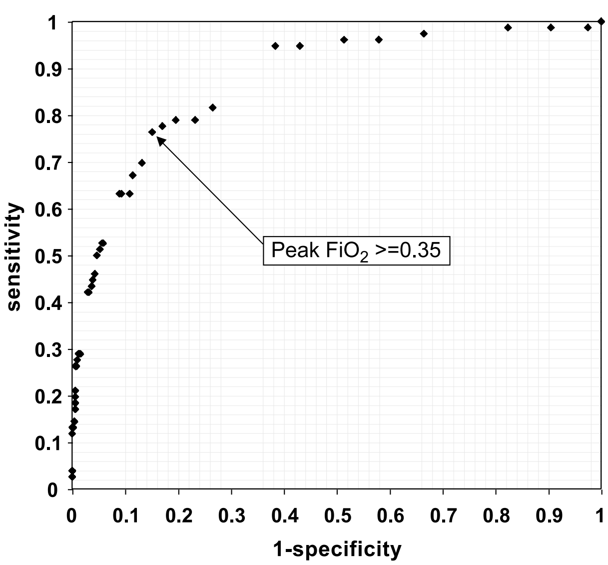

Fig. 3 Receiver operating characteristic curve for the need for any respiratory support (nasal continuous positive airway pressure (NCPAP) or intermittent positive pressure ventilation (IPPV)) based on the peak fraction of inspired oxygen (FiO_2) for all infants ≥32 weeks gestational age. Proportion of area under the curve = 0.87.

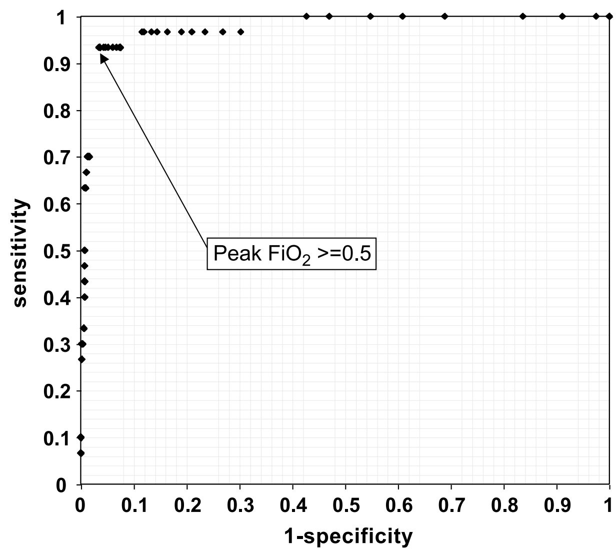

Fig. 4 Receiver operating characteristic curve for the need for intermittent positive pressure ventilation (IPPV) based on the peak fraction of inspired oxygen (FiO_2) for all infants ≥32 weeks gestational age. Proportion of area under the curve = 0.97.

DISCUSSION

We have presented a simple, pragmatic study investigating the likelihood that an infant ≥ 32 weeks GA requiring oxygen will need respiratory support. The cohort of infants in this study would be similar to the group of term and near-term infants born in maternity units with level 1 and 2 nurseries. These results could therefore be used to help in the decision making process when anticipating the likely need for respiratory support and/or mechanical ventilation in infants with respiratory distress in level 1 and 2 nurseries. They could also be useful in deciding which infants need to be transferred to, or retrieved by, level 3 nurseries.

Term and near-term infants with respiratory distress are common and a significant workload in neonatal nurseries. There is however, a sparsity of literature on the prediction of need for respiratory support in this group of infants. Peckman *et al.*[5] used a 'respiratory therapy score' to predict the level of respiratory care needed for neonates with HMD. Their respiratory therapy score was a good predictor of the level of respiratory care that would be required in preterm infants with HMD. Their score utilized a combination of five factors: birthweight, a clinical respiratory distress score, FiO_2, arterial carbon dioxide tension ($PaCO_2$) and pH. The utility of the Peckham *et al.*[5] score is limited as it was done almost three decades ago and only included preterm infants with HMD. They also routinely used respiratory therapy that is now considered deleterious (e.g. endotracheal CPAP).[6] Also blood gas analysis is not readily available in all level 1 and 2 nurseries. In our study we only used FiO_2 to predict the need for support. By doing so we were able to eliminate the need for the ability to perform blood gas analysis. FiO_2 is a common variable that can be easily ascertained and communicated in the vast majority of clinical situations. Hewson *et al.* reported on a small cohort of 22 infants born in a hospital with a level 2 nursery from 31 to 35 weeks GA with significant respiratory distress (i.e. had an FiO_2 of > 0.30 for more than 12 h or were transferred early because of the need for respiratory support).[7] Half of these infants were transferred to a level 3 nursery. They concluded that the need for prolonged CPAP or IPPV was best predicted

Table 3 Prediction of the need for intubation and IPPV at a FiO_2 of ≥0.5

Peak FiO_2	Intubated and IPPV		Totals
	Yes	No	
≥0.5	28	19	47
<0.5	2	543	545
Totals	30	562	592

Sensitivity = 0.9333; specificity = 0.9662; positive predictive value = 0.5957; negative predictive value = 0.9963.

by the presence of an expiratory grunt, a chest X-ray showing HMD and an FiO_2 of > 0.40 at 12 h of age.

The influences on the clinical course of respiratory distress are many.[2,4,8] Therefore a multiple regression analysis may be an appropriate statistical method to use to answer this question. This would involve a degree of complexity that we were trying to avoid. We chose to use only FiO_2 because it is relatively easy to determine. As expected, we found that the numbers of infants needing respiratory support increased with increasing FiO_2. The proportion of infants intubated was clearly related to increasing FiO_2. ROC curves developed confirm this trend and were used to identify the best balance point between the sensitivity and specificity for FiO_2 as a predictor for respiratory support in our cohort. This would suggest that FiO_2 could be used as a reliable indicator for the need for respiratory support. Our post-hoc analysis showed that FiO_2 is still a good predictor of the need for respiratory support for infants in both GA groups. However it did show that the optimum threshold for needing respiratory support for infants from 32 to 34^{+6} weeks GA was a little lower than the whole cohort at an FiO_2 of 0.30.

Our data are influenced by and reflect the practices in our neonatal unit, particularly target oxygen saturations. For this group of infants we generally aim for an oxygen saturation in the mid to high 90%. There is a risk of this result being confounded by set guidelines for the use of NCPAP and intubation for a given FiO_2. However, within our unit there is no specific FiO_2 at which all infants receive NCPAP or are intubated. The decision to commence ventilation is made, case by case, using generally accepted principles[4] – i.e. ventilation if there is a deterioration when needing more than 40–60% oxygen, if PaO_2 is < 45 mmHg in the same FiO_2, if $PaCO_2$ is > 50–60 mmHg or if there is an ongoing metabolic acidosis. There were likely to have been other factors considered by the treating doctors when making the decision to start respiratory support. Our study indicates that male infants, smaller infants and those with HMD were more likely to receive any respiratory support, whereas those that had IUGR or RFLF were less likely to need support. These findings may be confounded by clinicians generally having a lower threshold for respiratory support in the former infants and higher thresholds for the latter group. The numbers of infants receiving respiratory support and IPPV in our unit will reflect our thresholds and our degree of intensive care backup – one would think that thresholds for action should be even lower in level 2 nurseries with less backup.

Receiver operating characteristic curves presented were developed to find the best balance between sensitivity and specificity for different thresholds for respiratory support based on FiO_2 requirement. The ROC curve for the prediction of any respiratory support shows that FiO_2 is a reasonable predictor.

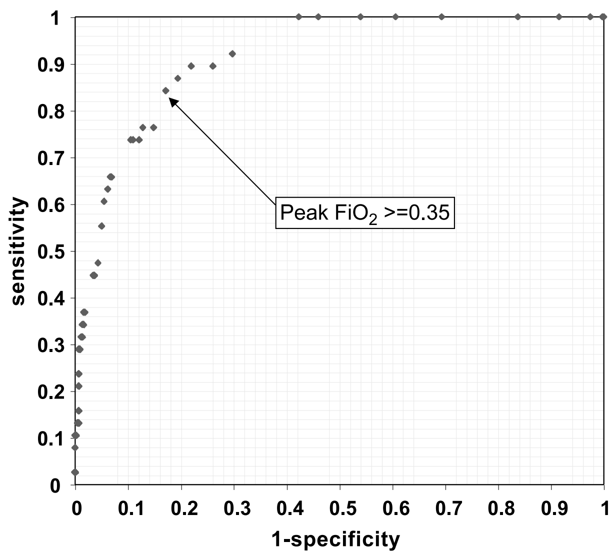

Fig. 5 Receiver operating characteristic curve for the need for any respiratory support (nasal continuous positive airway pressure (NCPAP) or intermittent positive pressure ventilation (IPPV)) based on the peak fraction of inspired oxygen (FiO_2) for infants ≥35 weeks gestational age. Proportion of area under the curve = 0.91.

Table 4 The implications of various FiO_2 cut-points for the need for intubation and ventilation if they are used to determine when to transfer an infant from a level 2 nursery to a level 3 nursery

peak FiO_2 is ≥	sensitivity	1 – sensitivity	specificity	PPV	1 – PPV	NPV
0.30	1.00	0.00	0.57	0.11	0.89	1.00
0.35	0.97	0.03	0.81	0.21	0.79	1.00
0.40	0.97	0.03	0.88	0.31	0.69	1.00
0.45	0.93	0.07	0.95	0.49	0.51	1.00
0.50	0.93	0.07	0.97	0.60	0.40	1.00
0.55	0.70	0.30	0.99	0.75	0.25	0.98
0.60	0.63	0.37	0.99	0.83	0.17	0.98
0.65	0.43	0.57	0.99	0.76	0.24	0.97
0.70	0.40	0.60	0.99	0.75	0.25	0.97
0.75	0.33	0.67	0.99	0.77	0.23	0.97
0.80	0.27	0.73	1.00	0.89	0.11	0.96

PPV, positive predictive value, i.e. the proportion of babies that will be transferred appropriately. 1 – PPV, proportion of babies transferred and not needing ventilation; 1 – sensitivity, proportion of babies that will not be transferred and will need ventilation.

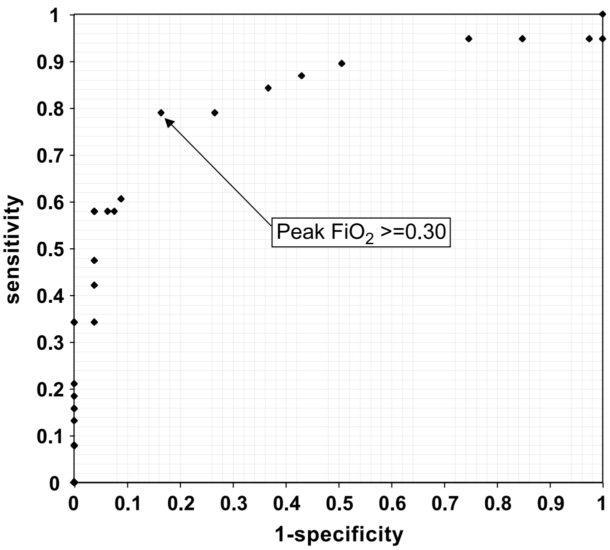

Fig. 6 Receiver operating characteristic curve for the need for any respiratory support (nasal continuous positive airway pressure (NCPAP) or intermittent positive pressure ventilation (IPPV)) based on the peak fraction of inspired oxygen (FiO_2) for infants $32–34^{+6}$ weeks gestational age. Proportion of area under the curve = 0.84.

The ROC curve for predicting the need for intubation had a much steeper gradient, with the inflection point close to the upper left-hand corner, indicating that FiO_2 was a better predictor in this instance.

The need to be able to predict whether an infant with respiratory distress will require transfer to a level 3 nursery is different to the need to predict the need for transfer prior to birth. Patel *et al*. explored this question for pregnancies form 30–36 weeks GA and concluded that the best predictors of the need for respiratory support were GA and an absence of labour.[9] Doyle *et al*. also provide data on the proportion of infants that will require transfer to a level 3 nursery to aid the decision regarding *in utero* transfer at various GAs from 30 to 36 weeks.[10] Unfortunately these data do not help once a baby is delivered and has respiratory distress.

Whether these threshold values of FiO_2 should be used in level 2 nurseries is uncertain. We provide data for a group of infants requiring oxygen that might be generalized to term and near-term infants encountered in level 2 nurseries. Deciding at what point respiratory support and/or ventilation are commenced are based on a number of factors including the clinical status of the infant and the level of support able to be provided in a peripheral level 2 nursery. However, given that most infants will need respiratory support once the FiO_2 is greater than 0.35 and most will require intubation and ventilation when receiving greater than 0.45 (Fig. 2), it would seem prudent to use these data when deciding to move the baby to a nursery able to provide these levels of support. We are not suggesting that clinicians should use the above FiO_2s as absolute indicators for the need for support or intubation. However, once a baby had an FiO_2 requirement of more than 0.4–0.5 there was an associated increased risk of needing intubation and this can be used to instigate timely transfer to, or retrieval by, a unit equipped for intubation and the ongoing needs of a ventilated baby. These data can also be used when counselling parents about the likely need for respiratory support. The predictive values could be further validated by a prospective study that randomly assigns infants to support or no support when the FiO_2s identified in our study are reached.

In conclusion, this study shows that there is a direct relationship between the need for respiratory support and intubation with increasing FiO_2 requirement for those infants born at ≥ 32 weeks GA. The need for respiratory support (NCPAP or IPPV) is best predicted with an FiO_2 requirement of ≥ 0.30 in infants from 32 to 34^{+6} weeks GA, and ≥ 0.35 in more mature babies. The need for intubation and ventilation is best predicted by an oxygen requirement of ≥ 0.5, with the proportion of infants needing ventilation exceeding 50% at an FiO_2 of 0.45. The need for respiratory support can be predicted by oxygen requirement within the first 72 h in term and near-term infants with reasonable sensitivity and excellent specificity.

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