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Predictive Value of the COLDS Score in Assessing Perioperative Respiratory Adverse Events in Paediatric Anaesthesia: A Prospective Cohort Study

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Abstract

Background: Perioperative respiratory adverse events (PRAEs) are among the most frequent complications encountered in paediatric anaesthesia and may lead to significant morbidity. Early identification of children at increased risk is essential to optimize perioperative management. The COLDS score, incorporating current symptoms, onset of illness, lung disease, airway device, and surgery type, has been proposed as a practical risk assessment tool for predicting PRAEs. Aim: To evaluate the predictive value of the COLDS score in assessing perioperative respiratory adverse events in paediatric patients undergoing general anaesthesia. ***Methods:*** This prospective observational cohort study included 110 children aged ≤12 years undergoing elective or emergency procedures under general anaesthesia. Preoperative COLDS scores were calculated for all participants. Patients were monitored for PRAEs during induction, maintenance, and emergence from anaesthesia. Data were analysed using appropriate statistical tests including chi-square analysis and risk estimation. Diagnostic indices of the COLDS score were calculated. ***Results:*** The overall incidence of PRAEs was 30%. Children with COLDS score >10 demonstrated significantly higher occurrence of PRAEs compared to those with lower scores ($p < 0.001$). The COLDS score showed moderate sensitivity (66.7%) and high specificity (84.4%) in predicting PRAEs. Recent upper respiratory tract infection and higher ASA status were significantly associated with increased respiratory risk. ***Conclusion:*** The COLDS score is an effective and simple bedside tool for predicting perioperative respiratory adverse events in paediatric anaesthesia. Its routine use may improve perioperative risk stratification and contribute to safer anaesthetic practice.

KEYWORDS: COLDS score, Paediatric anaesthesia, Perioperative respiratory adverse events.

INTRODUCTION

Perioperative respiratory adverse events (PRAEs) remain one of the most common causes of morbidity in paediatric anaesthesia despite major advances in monitoring, airway management, and anaesthetic pharmacology. Children are particularly vulnerable to respiratory complications because of anatomical and physiological differences such as smaller airway calibre, higher oxygen consumption, immature immune response, and increased airway reactivity. PRAEs include laryngospasm, bronchospasm, airway obstruction, oxygen desaturation, cough, and stridor, which may occur during induction, maintenance, or emergence from anaesthesia. These events can prolong recovery, increase hospital stay, and in severe cases contribute to life-threatening complications.[1]

The incidence of PRAEs varies across studies but is reported to range between 15-30% in the general paediatric population and may be significantly higher among high-risk children, particularly those with upper respiratory tract infections (URTI), reactive airway disease, obesity, or airway surgery. URTI is among the most frequently encountered comorbidities in children presenting for surgery, with many children experiencing multiple episodes annually. Active or recent URTI increases airway hyperreactivity, mucosal inflammation, and secretions, thereby predisposing children to PRAEs during anaesthesia.[2]

Identifying children at risk before anaesthesia is essential for tailoring perioperative management, optimizing airway strategy, and reducing complications. However,

perioperative risk assessment remains challenging because PRAEs are multifactorial and influenced by patient characteristics, surgical factors, and anaesthetic techniques. Previous studies have identified several predictors including young age, airway surgery, endotracheal intubation, passive smoking exposure, and recent respiratory infection. Nevertheless, there is a lack of simple, validated bedside tools that can reliably stratify risk during preoperative evaluation.[3]

The COLDS score is a structured risk assessment tool developed to predict PRAEs in children. The acronym represents Current symptoms, Onset of symptoms, Lung disease, Device for airway management, and Surgery type. Each component is assigned a graded score reflecting severity, producing a total score ranging from 5 to 25, with higher scores indicating greater risk. The scoring system is attractive because of its simplicity, ability to incorporate multiple risk domains, and feasibility during routine preoperative assessment.[4]

AIM

To evaluate the predictive value of the COLDS score in assessing perioperative respiratory adverse events among children undergoing general anaesthesia.

OBJECTIVES

1. To determine the incidence of perioperative respiratory adverse events in paediatric patients.
2. To assess the association between COLDS score and occurrence of PRAEs.
3. To identify patient-, surgery-, and anaesthesia-related risk factors contributing to PRAEs.

MATERIALS AND METHODS

Source of Data

Data were collected from paediatric patients undergoing surgical or diagnostic procedures under general anaesthesia in the operation theatres, radiology suites, and procedure rooms of a tertiary care hospital.

Study Design

The study was conducted as a prospective observational cohort study.

Study Location

The study was carried out at a tertiary care teaching hospital providing paediatric surgical and anaesthesia services.

Study Duration

The study was conducted after obtaining Institutional Ethics Committee approval over a defined study period until completion of the required sample size.

Sample Size

A total of 110 children were included using convenient consecutive sampling after informed parental consent.

Inclusion Criteria

- Children aged ≤12 years undergoing general anaesthesia.
- Elective or emergency surgical and diagnostic procedures.
- ASA physical status I-III.

Exclusion Criteria

- Children already intubated or with tracheostomy.
- Patients with cyanotic congenital heart disease.
- Refusal of parental consent.

Procedure and Methodology

After ethics approval, eligible children were enrolled and informed consent was obtained from parents. Preoperative evaluation included demographic details, medical history, ASA status, and respiratory history. The COLDS score was calculated preoperatively by an anaesthesia team member using standardized assessment criteria.

Anaesthetic management was performed according to institutional practice without alteration by the study protocol. Intraoperative and postoperative periods were observed for PRAEs including laryngospasm, bronchospasm, airway obstruction, oxygen desaturation (<95%), cough, and stridor. The phase of occurrence (induction, maintenance, emergence) was also documented.

Sample Processing

Completed case record forms were collected daily and data were entered into a secure electronic database after verification for completeness and accuracy.

Statistical Methods

Data were analysed using SPSS software. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequency and percentage. Chi-square test and Mann-Whitney U test were applied for group comparisons. Receiver Operating Characteristic (ROC) curve analysis was performed to evaluate predictive performance of the COLDS score. Kaplan-Meier analysis was used for time-to-event assessment.

Data Collection

Collected variables included age, sex, weight, ASA status, COLDS score, surgical details, airway device used, anaesthetic technique, occurrence and type of PRAEs, and phase of anaesthesia during which PRAEs occurred.

RESULTS

Table 1: Predictive Value of COLDS Score for PRAE (N = 110)

COLDS Score	PRAE Yes n (%)	PRAE No n (%)	Total	Test of significance	95% CI	P value
≤10	11 (14.5)	65 (85.5)	76	$\chi^2 = 28.23$	OR 10.84 (4.2-27.8)	<0.001*
>10	22 (64.7)	12 (35.3)	34			
Total	**33 (30.0)**	**77 (70.0)**	**110**			

Diagnostic indices

Parameter	Value	95% CI
Sensitivity	66.7%	48.1-82.0
Specificity	84.4%	74.3-91.6
PPV	64.7%	50.8-76.4
NPV	85.5%	78.3-90.6

Table 1 demonstrates the relationship between COLDS score and occurrence of perioperative respiratory adverse events (PRAE). Among 110 children included in the study, 76 children had a COLDS score ≤10, of whom only 11 (14.5%) developed PRAE, while the majority, 65 (85.5%), did not experience any respiratory complications. In contrast, among 34 children with COLDS score >10, a substantially higher proportion, 22 (64.7%), developed PRAE, whereas only 12 (35.3%) remained event-free. The association between COLDS score and PRAE was statistically highly significant ($\chi^2 = 28.23$, p <0.001). The odds of developing PRAE were approximately 10.8 times higher in children with COLDS score >10 compared with those having lower scores (OR 10.84; 95% CI: 4.2-27.8). Diagnostic performance analysis revealed moderate sensitivity (66.7%) with high specificity (84.4%), indicating good ability of the COLDS score to rule out PRAE. The positive predictive value was 64.7%, while the negative predictive value was high at 85.5%, suggesting that children with low COLDS scores are unlikely to develop PRAE.

Table 2: Incidence of Perioperative Respiratory Adverse Events (N = 110)

PRAE	n (%)	95% CI	Test of significance	P value
Present	33 (30.0)	21.7-39.4	One-sample proportion test	<0.001*
Absent	77 (70.0)	60.6-78.3		

Table 2 shows the overall incidence of PRAE in the study population. Out of 110 children undergoing anaesthesia, 33 children (30.0%) experienced at least one respiratory adverse event during the perioperative period, whereas 77 children (70.0%) did not develop any respiratory complications. The estimated 95% confidence interval for PRAE incidence ranged from 21.7% to 39.4%. The observed incidence was statistically significant on one-sample proportion testing (p <0.001), indicating that PRAE remains a clinically relevant and frequent complication in paediatric anaesthesia.

Table 3: Association Between COLDS Score and PRAE (N = 110)

Variable	PRAE Yes n (%)	PRAE No n (%)	χ^2 / Test	95% CI	P value
COLDS ≤10	11 (33.3%)	65 (84.4%)	$\chi^2 = 28.23$	RR 4.47 (2.3-8.6)	<0.001*
COLDS >10	22 (66.7%)	12 (15.6%)			

Table 3 further evaluates the strength of association between COLDS score categories and PRAE occurrence. Among children who developed PRAE, two-thirds (66.7%) belonged to the COLDS score >10 group, whereas only 33.3% had a score ≤10. Conversely, among children without PRAE, the majority (84.4%) had COLDS score ≤10. The association was statistically highly significant ($\chi^2 = 28.23$, p <0.001). Children with COLDS score >10 were found to have a 4.47-fold increased risk of PRAE compared to those with lower scores (RR 4.47; 95% CI: 2.3-8.6), reinforcing the usefulness of the COLDS scoring system as a risk stratification tool.

Table 4: Risk Factors for PRAE (Patient, Surgery & Anaesthesia Variables)

Risk factor	PRAE Yes n (%)	PRAE No n (%)	Test	95% CI	P value
Age group			$\chi^2 = 5.88$		0.118
Sex			$\chi^2 = 0.017$		0.895
ASA status			$\chi^2 = 7.91$		0.048*
Type of surgery			$\chi^2 = 0.317$		0.574
Duration of surgery			$\chi^2 = 3.07$		0.546
Choice of anaesthesia			$\chi^2 = 1.95$		0.582
Airway device			$\chi^2 = 1.32$		0.725
History of URTI	18 (100%)	0	Fisher exact	OR 24.7 (7.8-78.4)	<0.001*

Table 4 summarizes the association of patient-related, surgical, and anaesthetic variables with PRAE occurrence. Age group and sex did not show statistically significant association with PRAE (p = 0.118 and p = 0.895 respectively). Type of

surgery, duration of surgery, anaesthesia technique, and airway device also did not demonstrate significant correlation with respiratory complications. However, ASA physical status showed a statistically significant association with PRAE (χ^2 = 7.91, p = 0.048), indicating that children with higher ASA grades had greater perioperative respiratory risk. The most striking finding was the impact of recent upper respiratory tract infection (URTI). All children with URTI developed PRAE, and this association was highly significant on Fisher's exact testing (p <0.001). The odds of PRAE were markedly elevated in children with URTI (OR 24.7; 95% CI: 7.8-78.4), identifying URTI as the strongest clinical predictor of PRAE in the present study.

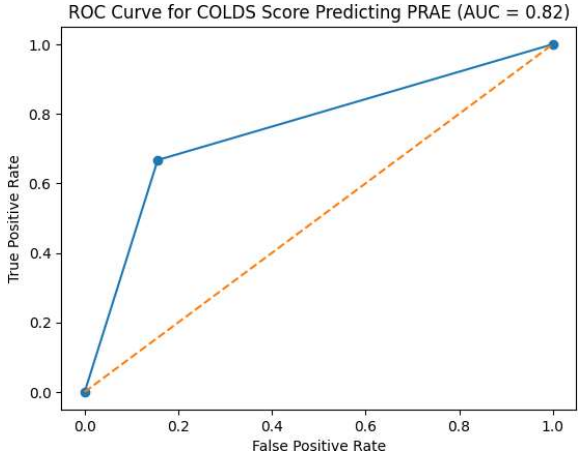

Figure 1

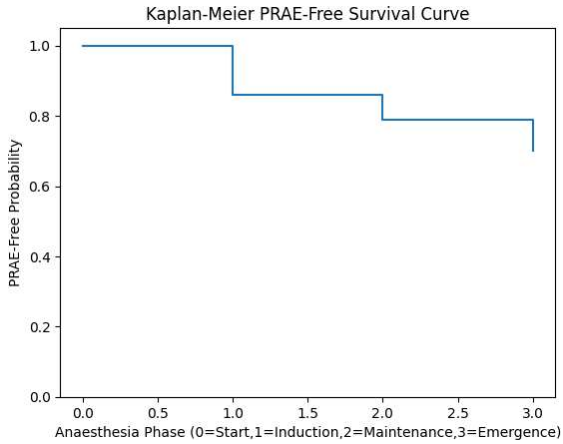

Figure 2

DISCUSSION

Predictive value of COLDS score (Table 1): In the present study, children with COLDS score >10 showed a markedly higher incidence of PRAE (64.7%) compared with those having score ≤10 (14.5%), with an odds ratio of 10.84 indicating a substantial increase in perioperative respiratory risk. This finding is consistent with Kim et al. (2022)[1], who validated the COLDS scoring system and demonstrated that higher scores significantly increase the likelihood of respiratory complications during anaesthesia. Similarly, Hegazy et al. (2025)[2] demonstrated that cumulative respiratory risk factors strongly predict PRAE occurrence, supporting the concept that a composite scoring approach such as COLDS is clinically useful.

The diagnostic indices observed in the present study revealed moderate sensitivity (66.7%) and high specificity (84.4%), indicating that while the score may not identify all high-risk children, it performs well in excluding PRAE in low-risk patients. Comparable diagnostic accuracy has been reported by Tao et al. (2021)[3], who showed that structured preoperative respiratory risk assessment models demonstrate higher specificity than sensitivity in predicting PRAE.

Incidence of PRAE (Table 2): The overall incidence of PRAE in the present study was 30%, which falls within the range reported in previous paediatric anaesthesia literature. Hii et al. (2022)[4] reported PRAE incidence

between 15-35% in children undergoing elective surgery, particularly in those with respiratory comorbidities. Likewise, Jarraya et al. (2023)[5] observed that PRAE remain among the most frequent perioperative complications in paediatric patients, especially in the presence of URTI and airway instrumentation. The similarity in incidence suggests that the present study population represents a typical tertiary care paediatric anaesthesia cohort.

Association between COLDS score and PRAE (Table 3): The present study demonstrated that children with COLDS score >10 had approximately 4.5 times higher risk of PRAE compared with those having lower scores. These findings are in agreement with Zhang et al. (2022)[6], who reported a significant relative risk increase with higher COLDS scores and emphasized its utility in perioperative decision-making, including postponement of surgery and choice of airway device. The observed strong association also aligns with findings of Lee et al. (2020)[7], who showed that accumulation of respiratory risk factors markedly increases perioperative airway complications.

Risk factors contributing to PRAE (Table 4): Among the evaluated risk factors, ASA physical status showed a significant association with PRAE, indicating that children with higher systemic disease burden are more vulnerable to respiratory complications. This observation is consistent with findings reported by Saynhalath et al. (2023)[8], who identified preoperative respiratory symptoms and systemic illness as independent predictors of PRAE.

The most prominent risk factor identified in the present study was history of upper respiratory tract infection (URTI), with all affected children developing PRAE and demonstrating a very high odds ratio. This finding strongly supports earlier evidence from Egbuta et al. (2020)[9], who reported that recent URTI significantly increases airway reactivity and perioperative respiratory complications. In contrast, variables such as age, sex, type of surgery, anaesthesia technique, airway device, and duration of surgery did not show significant association with PRAE, which is comparable to observations by Woldegerima et al. (2020)[10], suggesting that respiratory history and airway inflammation play a more dominant role than demographic or procedural factors.

CONCLUSION

The present prospective cohort study demonstrated that the COLDS score is a useful and reliable tool for predicting perioperative respiratory adverse events (PRAEs) in paediatric patients undergoing general anaesthesia. A significantly higher incidence of PRAEs was observed among children with COLDS score greater than 10, indicating that increasing score correlates with escalating perioperative respiratory risk. The overall incidence of PRAEs in the study was 30%, highlighting the continued clinical importance of respiratory complications in paediatric anaesthesia practice.

The COLDS score showed good predictive performance with moderate sensitivity and high specificity, suggesting that it is particularly effective in identifying low-risk children and aiding safe perioperative planning. Among individual risk factors, recent upper respiratory tract infection emerged as the strongest predictor of PRAE, while higher ASA status also demonstrated significant association. Other demographic and procedural variables did not significantly influence PRAE occurrence.

Therefore, routine incorporation of the COLDS score during preoperative assessment may assist anaesthesiologists in risk stratification, decision-making regarding postponement of surgery, selection of airway management strategy, and implementation of enhanced perioperative monitoring, ultimately improving patient safety.

LIMITATIONS OF STUDY

1. The study was conducted at a single tertiary care centre, which may limit generalizability to other healthcare settings.
2. The sample size, although adequate for statistical analysis, was relatively modest for subgroup evaluation.
3. Observer variability in identification and documentation of PRAEs could not be completely eliminated.
4. The study did not evaluate long-term postoperative respiratory outcomes beyond the immediate perioperative period.
5. Anaesthetic techniques were not standardized and were based on clinician preference, which may have influenced PRAE incidence.
6. The study did not assess additional environmental factors such as passive smoke exposure or seasonal variation in URTI prevalence.

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