Web Table I Summary of Various Studies on Use of Non Invasive Respiratory Support in Children

Author, year	Population	Methodology	Intervention	Objectives/Outcome variables	Results	Conclusion
Yanez et al., 2008 (12) (N=50)	1month -15 years Children with respiratory failure based on FiO2 requirement >50% to maintain SPO2 >94%, with moderate to severe respiratory distress	RCT Study group (N=25): NIV plus standard therapy Control group(N=25): Standard therapy	Study group received inspiratory pressure:12-18 cm H2O expiratory positive airway pressure 6- 12 cm H2O Control group: mask oxygen at FIO2 >50% to keep saturation at >94%	Primary outcome: Need to intubate, Secondary outcome: improvement in vital signs and gas exchange for 48 hrs	Intubation rate was significantly lower in study group (28% vs 60%,p=0.045) Heart rate and respiratory rate were significantly lower after 1 hr of treatment compared with admission in study group.	NIV improves hypoxemia, signs and symptoms of acute respiratory failure and also prevents endotracheal intubation
Fortenberry et al, 1995 (13) (N=28)	Children <18 years with signs of respiratory distress who are likely to get intubated or re-intubated	Retrospective	All children received BiPAP through nasal mask		Respiratory rate decreased significantly with BiPAP(45±18 breaths per minute to 33±11, p<0.001). PaO2 improved (71±13 mm Hg to 115±55), PaCO2, pulse oximetry saturation, and pH all improved significantly (p<0.01) Only 3 of 28 patients required intubation or re-intubation.	Non-invasive nasal positive pressure mask ventilation can be safely and effectively used in pediatric patients to improve oxygenation in mild to moderate hypoxemic respiratory insufficiency and it also avoids reintubation.
Essouri et al.,2006 (14) (N=114)	Children treated by Non invasive positive pressure ventilation(NPPV) over five consecutive years in PICU	Retrospective	Nasal or facial masks were used with dual limb circuit Mode used: Pressure support with positive end expiratory pressure	Failure of NPPV defined by the necessity of endotracheal intubation during the PICU stay	77% were successfully treated by NPPV without intubation The success rate of NPPV was significantly lower (22%) in patients with acute respiratory distress syndrome (p< 0.05) high PRISM II and PELODS at admission were associated with unsuccessful NPPV 9.6% who received NPPV died	NPPV could be proposed as a first-line treatment in children with acute respiratory distress, except in those with a diagnosis of acute respiratory distress syndrome.
Essouri et al., 2015 (15)	Children(1month – 18 years) with acute respiratory distress syndrome(ARDS)	Systematic review on non invasive ventilation in children with ARDS			NPPV can improve gas exchange and potentially prevent intubation and mechanical ventilation in some children with mild pARDS NPPV is not indicated in severe pARDS An oronasal interface provides superior support, The efficacy of high-flow nasal cannula compared with noninvasive positive pressure ventilation is unknown	NPPV can be beneficial in children with pediatric acute respiratory distress syndrome, particularly in those with milder disease.

Gupta P et al., 2012 (17)	Children between the ages 1 day and 18 years with acute respiratory failure who required NIV in a cardiovascular intensive care unit (CVICU)	Retrospective	Prophylactic group: NIV was given directly after extubation Non- prophylactic group: NIV was given after signs and symptoms of respiratory failure developed. Modes of NIV used were CPAP and BiPAP. CPAP or EPAP was initiated with 4–5 cm H2O for all and maximum of 10–12 cm H2O IPAP was initiated at 6–8 cm H2O and maximum of 18–20cm H2O was given	To identify the predictors of NIV success in preventing extubation failure in critically ill children with heart disease. To assess the efficacy of prophylactic NIV therapy To determine the characteristics, outcomes, and complications associated with NIV therapy in pediatric cardiac patients	221 events were included 172 responders (77.8 %) and 49 non-responders (22.2 %) were noted 201 events received CPAP with 156(78%) responders, 20 events received BiPAP with 16(80%) responders 58 events (26.3 %) were assigned to the prophylactic group and 163 events (73.7 %) to the nonprophylactic group. The prophylactic group experienced significantly shorter CVICU stay (median, 49 vs 88 days; p = 0.03) and hospital stay (median, 60 vs 103 days; p = 0.05)	NIV can be safely and successfully applied in critically ill children with cardiac disease to prevent extubation failure
Fernandez, et al.,2016 (18) (N=200)	Children 3days – 16 years age requiring NIV after heart surgery in a PICU over 12 years	Retrospective observational study comparing the first 6 years of the study with the last 6 years.	Physician driven use of NIV (CPAP/BiPAP)		Duration of NIV was 3 days (median) Mortality rate was 3.9%. The use of NIV was increased from 13.2% in first 6 years to 29.2% in the second 6 years (p <0.001). CPAP was the most common modality of NIV (65.5%). The use of BiPAP increased from 15% in first 6 years 42.9% in the second 6 years period (p < 0.001) NIV failed in 15% of patients. The mortality rate did not change between the two periods	NIV is increasingly being used in the postoperative period of heart surgery It is associated with a lesser need for invasive mechanical ventilation CPAP was the most common modality and in the in the latter years, the use of BIPAP has increased significantly
Kovacikova L et al, 2013 (19) (N=82)	Children 1day – 18 years age with congenital heart disease (post operative)	Prospective observational study	NPPV with pressure support and/or pressure control mode was applied Median PEEP used 10 cm H2O (4–12) Median maximum IPAP used was 21 cm H2O (10–28) Interfaces used were Naso-pharyngeal tube, Oro-nasal mask, or helmet	NPPV was used (1) in patients with hypoxemic or hypercarbic respiratory failure or those who were likely to require intubation based on clinical signs; (2) as a preventive measure in patients with high risk for extubation failure	Within the first hour of NPPV, partial pressure PaO2/FiO2 was increased, and pCO2, RRwere decreased. In 59.8 % of cases, NPPV prevented tracheal intubation The Aristotle Basic Complexity score, presence of infection, residual cardiac defect, and pH <7.36 in the first hour were independent predictors of NPPV failure	NPPV improved oxy-genation and decreased respiratory effort in pediatric cardiac patients, A high-complexity surgical score, presence of infection, residual cardiac defect, and pH <7.36 in the first hour are predictors of NPPV failure
Pancera CF et al. 2008 (20) (N =239)	Immunocompromised children with acute respiratory failure	Retrospective Two groups 1.NIVgroup(N=120), defined as children who received NPPV as the first choice for at least 24 hours 2. Invasive	The NIV mode used was pressure support with positive end-expiratory pressure. Nasal mask was used Decision to initiate NIV was by the	To evaluate the feasibility of NPPV in PICU To assess the clinical efficacy of NPPV To identify predictive factors	1/4thof the patients from the NIV group subsequently required intubation. Independent predictive factors for intubation were solid tumors cardiovascular dysfunction and	NIV can be used as first- line treatment in children with malignancies who develop acute respiratory failure, except those with severe hemodynamic compromise

		ventilation group(N=119) defined as children who received conventional MV as the first choice	physician	for endotracheal intubation	therapeutic intervention scoring system score (TISS) >40 points	
Piastra et al., 2009 (22) (N=23)	Immunocompromised children with acute respiratory distress syndrome (ARDS)	Retrospective	Mode: pressure support mode or pressure controlled Interface: face mask/helmet	To evaluate the feasibility of non-invasive ventilation (NIV) in immunocompromised children with ARDS	Early and sustained improvement in P/F ratio were observed in 82 and 74% of cases, respectively. 13 out of 23 (54.5%) avoided intubation and were discharged from the PICU PICU and intra-hospital mortality was higher for NIV-non responders (p <0.001) PICU stay was shorter for NIV responders (p = 0.03).	NIV administration is feasible and well tolerated in immunocompromised children with ARDS. A short NIV trial can be used to verify the usefulness of the technique.
Basnet et al., 2012, (23) (N=20)	Children age 1-18 years admitted to PICU with status asthmaticus with a clinical asthma score 3-8 after receiving one dose of methylprednisolone, 1 hr of continuous albuterol (SABA), and three doses of ipratropium bromide	RCT NPPV plus standard treatment versus standard treatment alone	BiPAP mode with face mask/nasal mask was used Inspiratory positive airway pressure was gradually increased to 8 cm H2O to achieve a tidal volume of 6–9 mL/kg and end-expiratory positive airway pressure to 5 cm H2O	Improvement in the clinical asthma scores	Improvement in clinical asthma score was significantly greater in non invasive positive pressure ventilation group compared to standard group at 2 hrs, 4–8 hrs, 12–16 hrs, and 24 hrs after initiation of interventions (p<0.01). There were no major adverse events related to NPPV. 9 out of 10 patients tolerated NPPV through the duration of the study	Early initiation of non invasive positive pressure ventilation, along with short acting β-agonists and systemic steroids, can be safe, well-tolerated, and effective in the management of children with status asthmaticus
Thill et al., 2004 (24) (N=20)	Children admitted to the pediatric intensive care unit with acute lower airway obstruction	RCT, cross over	Group 1: 2 hrs of NIV followed by crossover to 2 hrs of standard therapy Group 2: 2 hrs of standard therapy followed by 2 hrs of NIV BiPAP was used using nasal mask IPAP of 10 cm H2O and an EPAP 5 cm H2O, were used	Improvement in clinical asthma severity (CAS) score	Non invasive ventilation decreased signs of work of breathing compared with standard therapy There was no serious morbidity associated with noninvasive ventilation.	Non invasive ventilation can be an effective treatment for children with acute lower airway obstruction
Pilar et al., 2017 (25) (N=42)	Children (1.5 – 14 years) with acute severe asthma admitted to PICU	Retrospective Patients were given high flow nasal cannula (HFNC) or non invasive ventilation (NIV) as per physician discretion	For NIV, BiPAP mode was used with full face masks or oronasal masks as interface IPAP of 8 cmH2 O and EPAP of 4 cmH2O were used to achieve a tidal volume of 6-9 ml/kg. IPAP and EPAP were titrated based on tidal volume, saturation and clinical signs For HFNC, flow rates: 2 L/kg/min for the first 10 kg plus 0.5 L/kg/min for each kg above that (maximum	Primary outcome measure was failure of initial respiratory support (need to escalate from HFNC to NIV or from NIV to invasive ventilation). Secondary outcome measures were the duration of respiratory support and PICU length of stay (LOS)	22 received NIV 20 received HFNC The mean EPAP was 5cmH2O (4-7) and the mean IPAP was 12cmH2O (8-17) No treatment failure in NIV group 8 children (40%) in the HFNC group required escalation to NIV. The PICU length of stay was similar in both the groups. HFNC failure subgroup had longer respiratory support duration and longer PICU stay compared to HFNC success subgroup.	Early initiation of NIV is a safe and feasible initial alternative for the treatment of severe asthma exacerbation. HFNC could potentially delay the initiation of NIV in severe cases and result in longer PICU stay, and the consequent morbidity and cost

			flow 50 L/min)			
Fioretto et al., 2015 (27) (N=108)	Children aged 1month to 3 years who were intubated and mechanically ventilated for 48 hours	RCT	NIV group(N=55): NIV was provided using conventional ventilator with PC-SIMC-PS mode. Initial PEEP of 5 cm H2O, IPAP of 15 cm H2O, PS of 10 cm H2O, and FiO2 of 50% Maximum PEEP of 10cmH2O Maximum IPAP of 20cmH2O and maximum PS of 15cm H2O were used A nasal or facial mask was used as interface. Standard group (N=53): Oxygen by nasal cannula		Reintubation rates in NIV group was 9.1% and in standard group was 11.3%(p=>0.05) No difference in length of PICU stay or hospital stay	No differences were seen between groups. The number of excluded patients was high
Juan P. Bonora et al., 2018 (29) (N=255)	Children aged 1 month to 18 years old who required post extubation NIV	Retrospective multicenter Rescue NIV (N=112): implementation of NIV within 48 hours of extubation due to respiratory failure Elective NIV (N=143): implementation of NIV prophylactically after extubation	NIV modes included pressure support ventilation, pressure-assist/control ventilation, bi-level pressure support, continuous positive airway pressure	To determine the rate of post-extubation NIV success and the factors associated with failure or success	The rates of success in rescue and elective NIV were 68.8% and 72.7%, respectively Mortality was higher among patients in whom rescue NIV failed	The use of post-extubation NIV may be a useful to prevent re-intubation
Mayordomo-Colunga J et al., 2010 (30)	Children admitted to PICU who had invasive ventilation for at least 12 hours and then extubated	Prospective observational study Types of NIV elective NIV: when the patient was extubated directly to NIV rescue NIV: when the child developed respiratory failure within 48 hours ofextubation	BiPAP was used Nasal mask, facial mask/helmet were used as interface In elective NIV, EPAP was set at 1-2 cmH2O higher than previous PEEP during invasive ventilation. In rescue NIV, initial EPAP was 4-5 cmH2O IPAP was started at 6-8 cmH2O in both	To determine post-extubationNIVcharacteristics and to identify risk factors of postextubation NIV failure.	rescue and elective NIV had success rate of 50% 81% respectively(p = 0.037).	Post-extubation NIV seems to be useful in avoiding reintubation when applied immediately after extubation