Dipartimento di Pediatria

Congresso Nazionale IRC

2019

11 • 12 OTTOBRE

Centro Congressi Veronafiere

Rianimazione neonatale: Verso le Linee Guida 2020

IRC Italian Resuscitation Council

Daniele Trevisanuto
Università degli Studi Padova

Coflicts of interest:

Member of the Neonatal Task Force on Neonatal Resuscitation (ILCOR)

EUROPEAN RESUSCITATION COUNCIL

Guidelines for Neonatal Resuscitation (history)

[<1960] Empirical observations

[1966] AHA committee on cardiopulmonary resuscitation (adults)

[1987] Bloom RS, Cropley C, editors. Textbook of neonatal resuscitation

International Liaison Committee on Resuscitation (ILCOR)

[1992] Guidelines for cardiopulmonary resuscitation and emergency cardiac care. Emergency Cardiac Care Committee and Subcommittees, American Heart Association. Part VII. Neonatal resuscitation. (JAMA, Oct 1992)

[2000]

[2005]


2005 American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) of Pediatric and Neonatal Patients: Neonatal Resuscitation Guidelines

[2010]

[2015]


Resuscitation

European Resuscitation Council Guidelines for Resuscitation 2015 Section 7. Resuscitation and support of transition of babies at birth

Gaps of knowledge
2015 → 2020

- Algorithm
- Initial evaluation
- Meconium aspiration syndrome
- Oxygenation
- Ventilation
- Chest compressions
- Ethics
- Cord clamping
- Education

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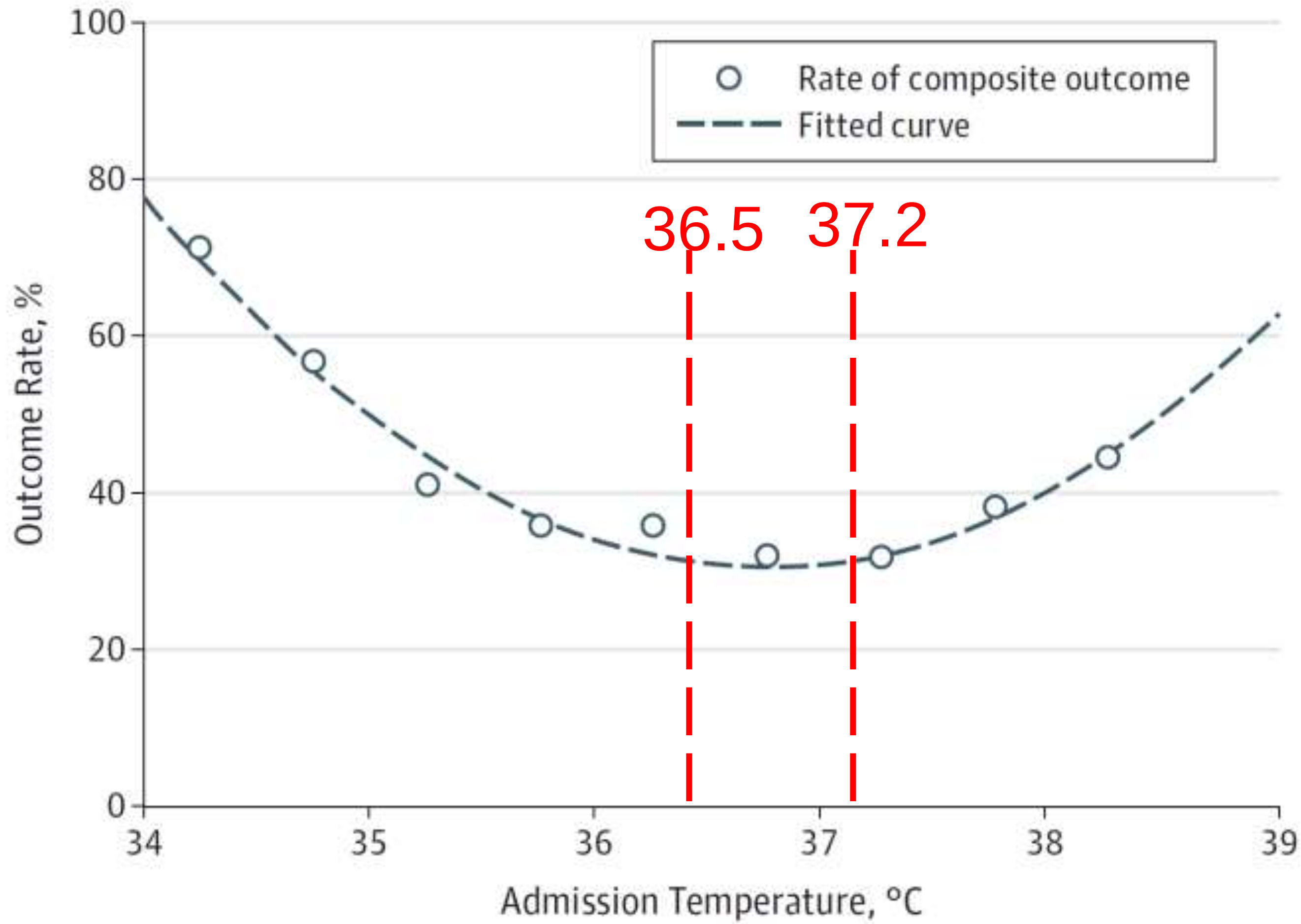
Gaps of knowledge
2015 → 2020

- Flow-chart
- **Initial steps (temperature,** HR detection**)**
- Meconium aspiration syndrome
- Oxygenation
- Ventilation
- Chest compressions
- Ethics
- Cord clamping
- Education

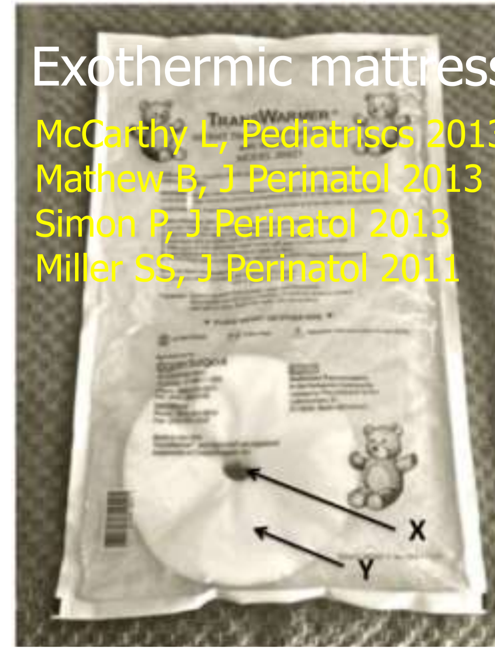
Figure 2. Association of Admission Temperature With a Composite Mortality/Morbidity Outcome



Mortality
Severe neurological injury
Severe ROP
NEC
BPD
Nosocomial infection

Unadjusted data for rate of a composite mortality/morbidity outcome plotted against admission temperature and fitted with a curve indicating the U-shaped relationship between admission temperature and the composite outcome.

Lyu Y, JAMA Pediatr 2105



Trevisanuto D et al. Semin Fetal Neonatal Med 2108

“PICOT” question

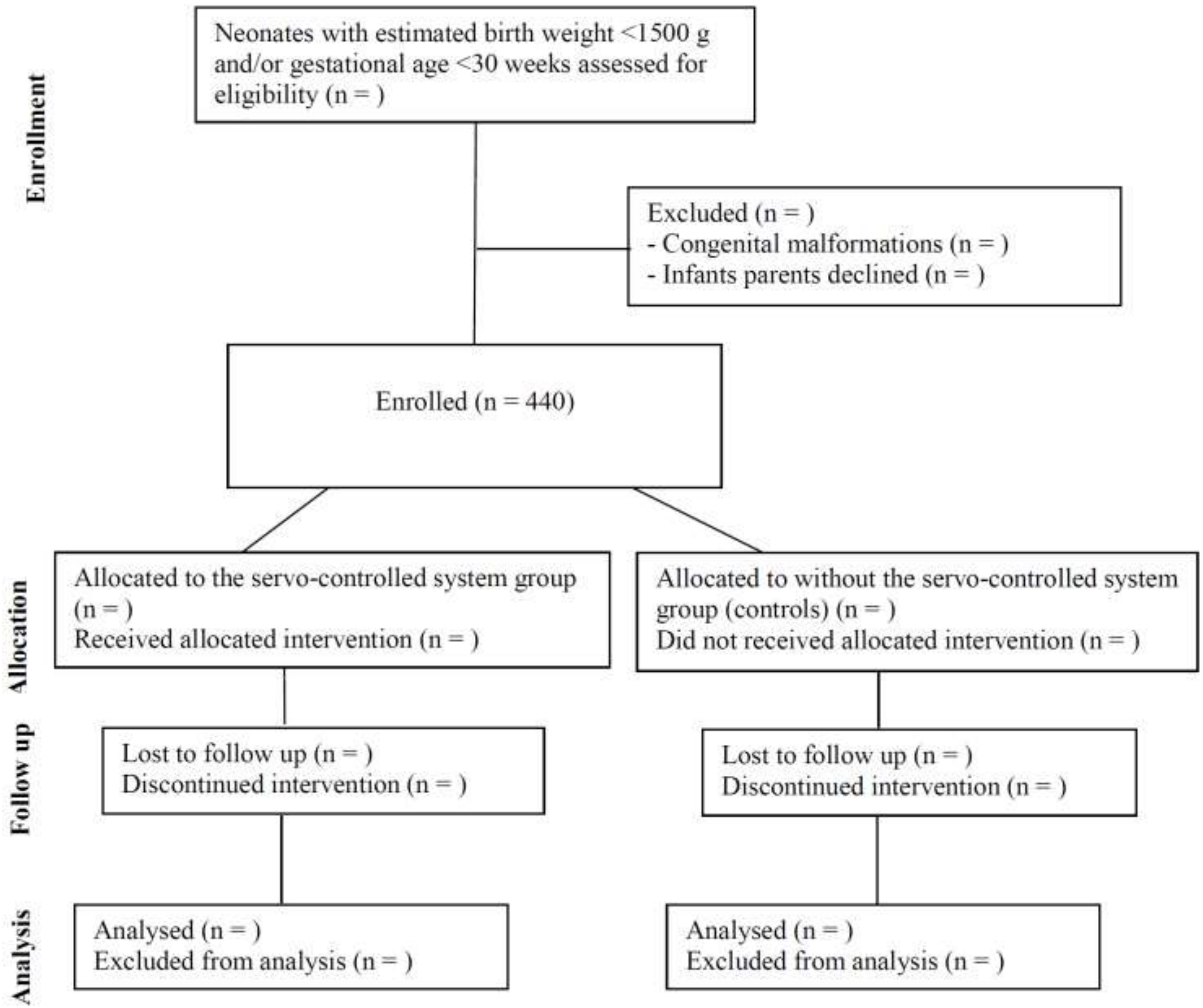
P: in VLBWI (estimated birth weight <1500 g and / or gestational age <30 weeks),
I: does the use of a temperature servo-controlled system in the delivery room,
C: compared to standard of care (without a servo-controlled system),
O: increase the percentage of infants in the normal thermal range (temperature 36.5-37.5°C)
T: at the time of NICU admission?

Servo COntrol in PRreterm Infants
SCOPRI study

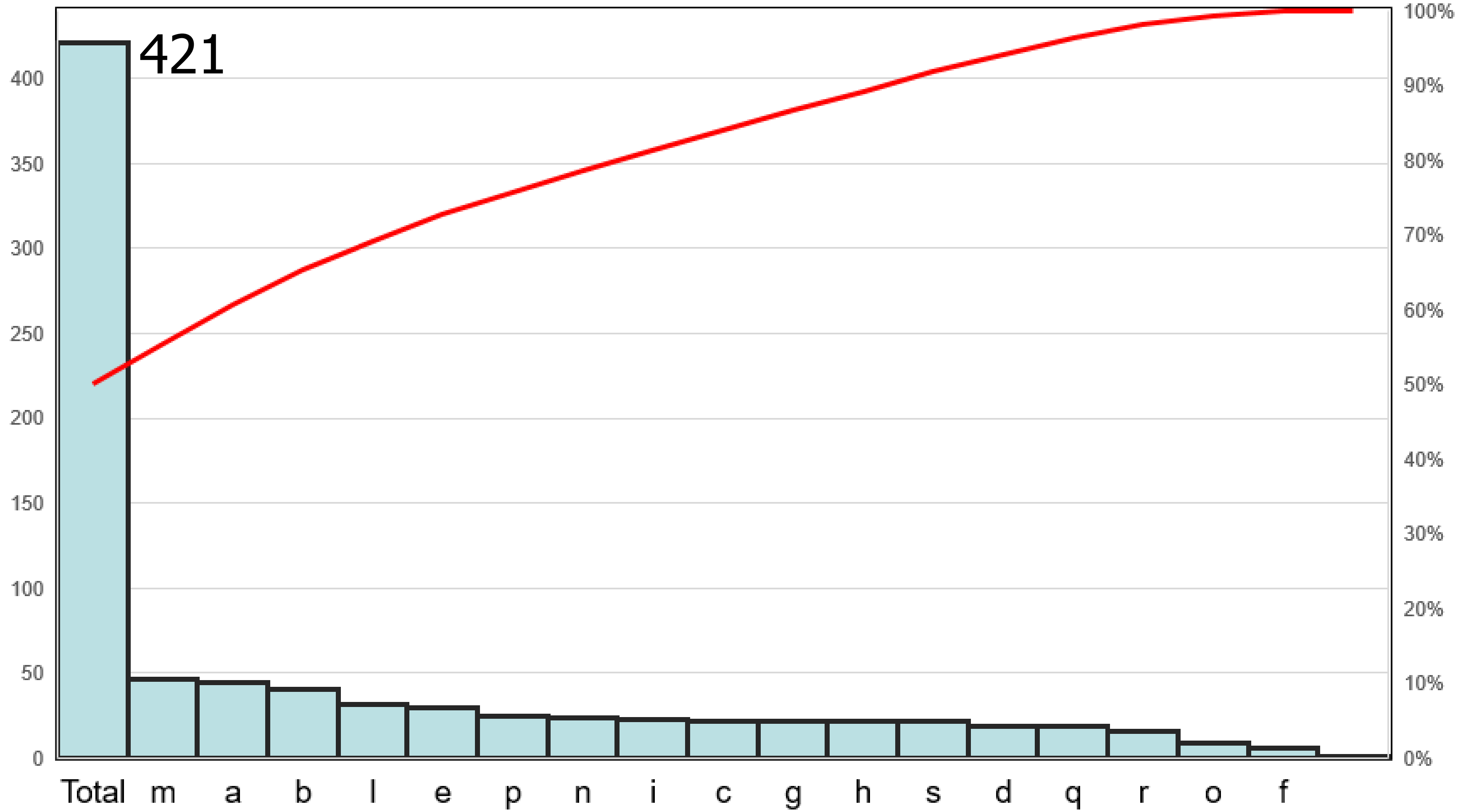
Effect of a servo-controlled system on heat loss at birth in very low birth weight infants: a multicenter, randomized, controlled trial

ClinicalTrials.gov Identifier:
NCT03844204

Fig. 1 Flow diagram of patient randomization



Enrollment (Sept 30, 2019)



Gaps of knowledge
2015 → 2020

- Algorithm
- **Initial steps (**tempereture, **HR detection)**
- Meconium aspiration syndrome
- Oxygenation
- Ventilation
- Chest compressions
- Ethics
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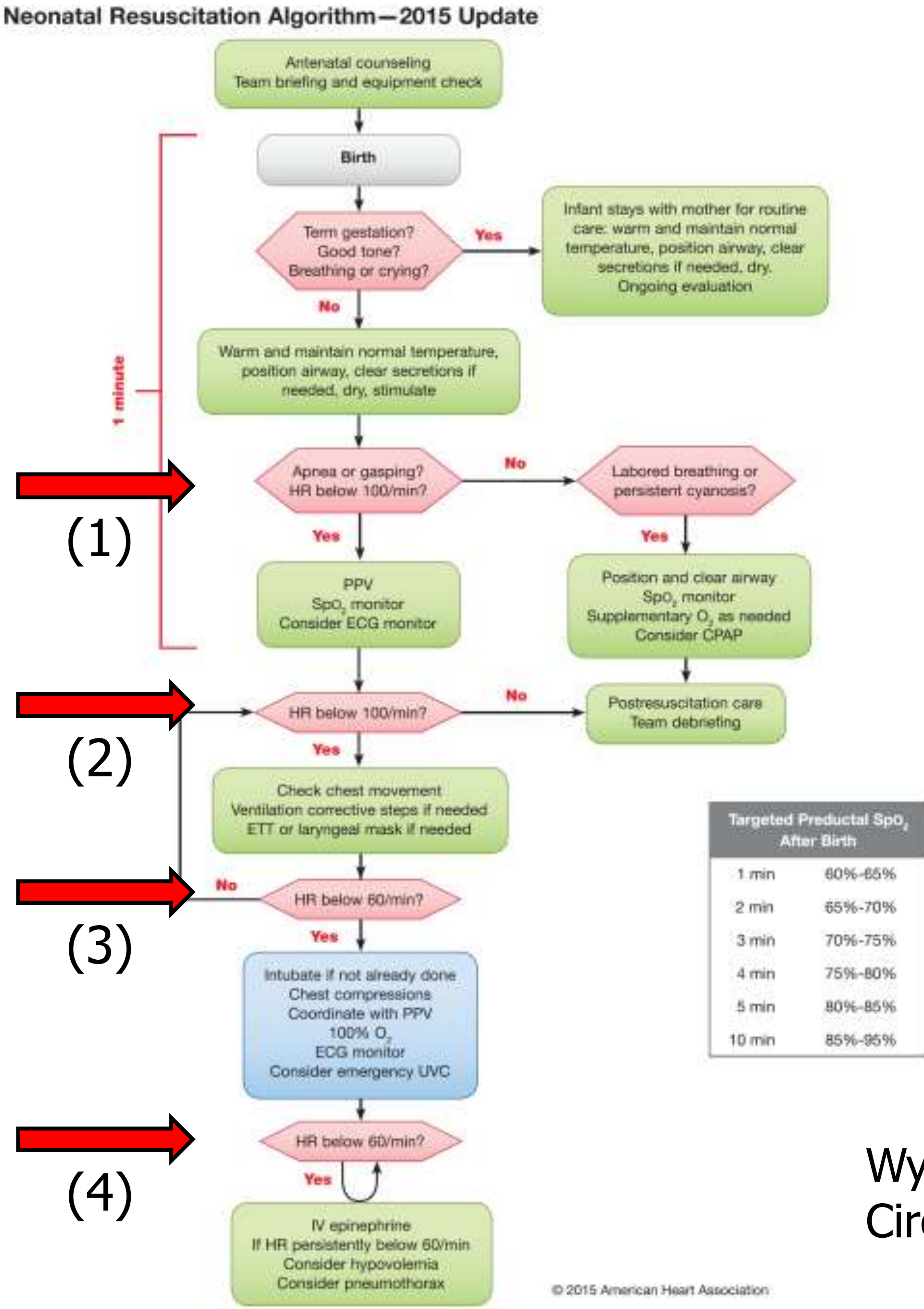
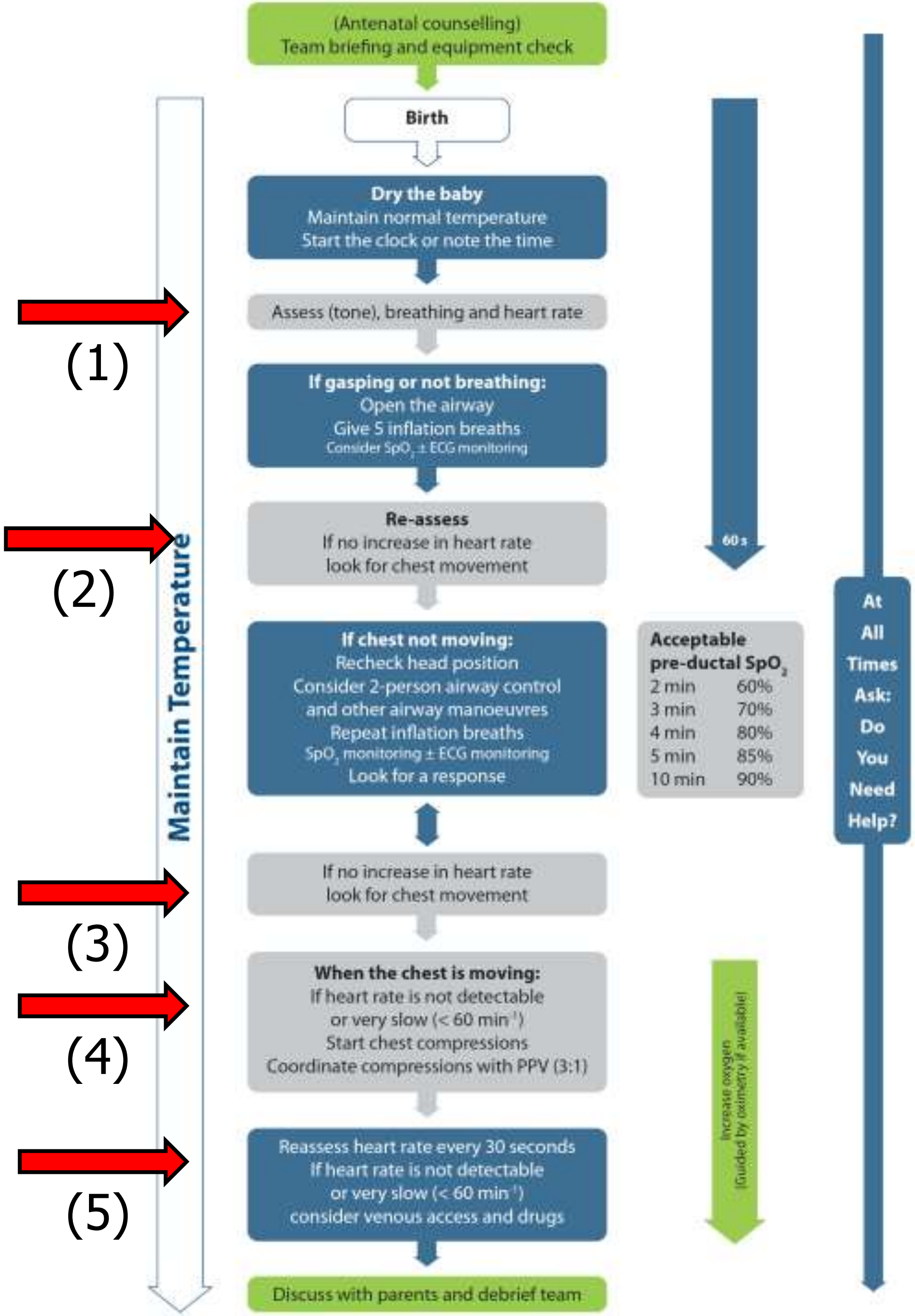


Figure 1. Neonatal Resuscitation Algorithm—2015 Update.

Wyckoff MH et al. AHA Guidelines, Circulation 2015



Wyllie J et al. ERC Guidelines, Resuscitation 2015

Heart rate assessment

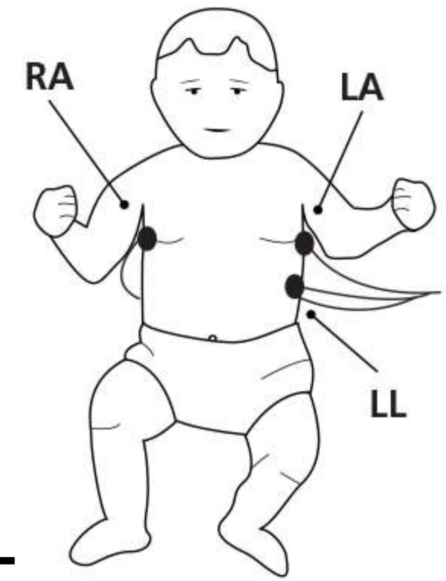
Umbilical cord palpation

<

Auscultation

<

3 lead ECG



Guidelines

2010

2015

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Treatment Recommendation

"In babies requiring resuscitation <u>we **suggest ECG** can be used to provide a rapid and accurate estimation of heart rate</u>. (Weak suggestion, very low quality of evidence)."

Perlman J et al. Circulation 2015

Wyckoff MH et al. 2015 AHA Guidelines

Wyllie J et al. 2015 ERC Guidelines

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- Very-low-quality evidence from 5 nonrandomized studies enrolling 213 patients showing a benefit of ECG compared with oximetry[19–23]
- Very-low-quality evidence from 1 nonrandomized study enrolling 26 patients showing a benefit of ECG compared with auscultation[24]

Perlman J et al. Circulation 2015

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Table 4 – Adjusted associations of the ECG monitoring with medical practice outcomes.

Practice/outcomes	aOR* (95% CI)	*P* value
Delivery room practice interventions		
Supplemental oxygen	1.51 (.87–2.62)	.138
Continuous positive airway pressure	2.82 (1.77–4.51)	<.001
Face mask ventilation	3.85 (1.61–9.21)	.003
Endotracheal intubation	.65 (.45–.94)	.023
Chest compressions	3.59 (1.36–9.46)	.009
Epinephrine use	>99.99 (<.1–>99.99)	.934
Neonatal outcomes		
Death	1.58 (.83–3.03)	.167
Respiratory distress syndrome	.93 (.62–1.41)	.748
Pneumothorax	.70 (.34–1.46)	.343
Bronchopulmonary dysplasia	.94 (.44–1.99)	.867
Mechanical ventilation	.62 (.43–.89)	.011
Sepsis	.77 (.45-1.32)	.337
Necrotizing enterocolitis	5.85 (1.09–31.26)	.039
Symptomatic patent ductus arteriosus	.78 (.39–1.54)	.481
Intraventricular hemorrhage (grade 3/4)	1.27 (.75–2.17)	.375
Severe retinopathy of prematurity	.32 (.14–.71)	.005

aOR, adjusted odds ratio; *CI*, confidence interval.

* Adjusted association represents the odds of outcome for neonatal heart rate monitoring by ECG compared with auscultation/pulse oximetry in the delivery room. There were no significant interactions between ECG monitoring and covariates.

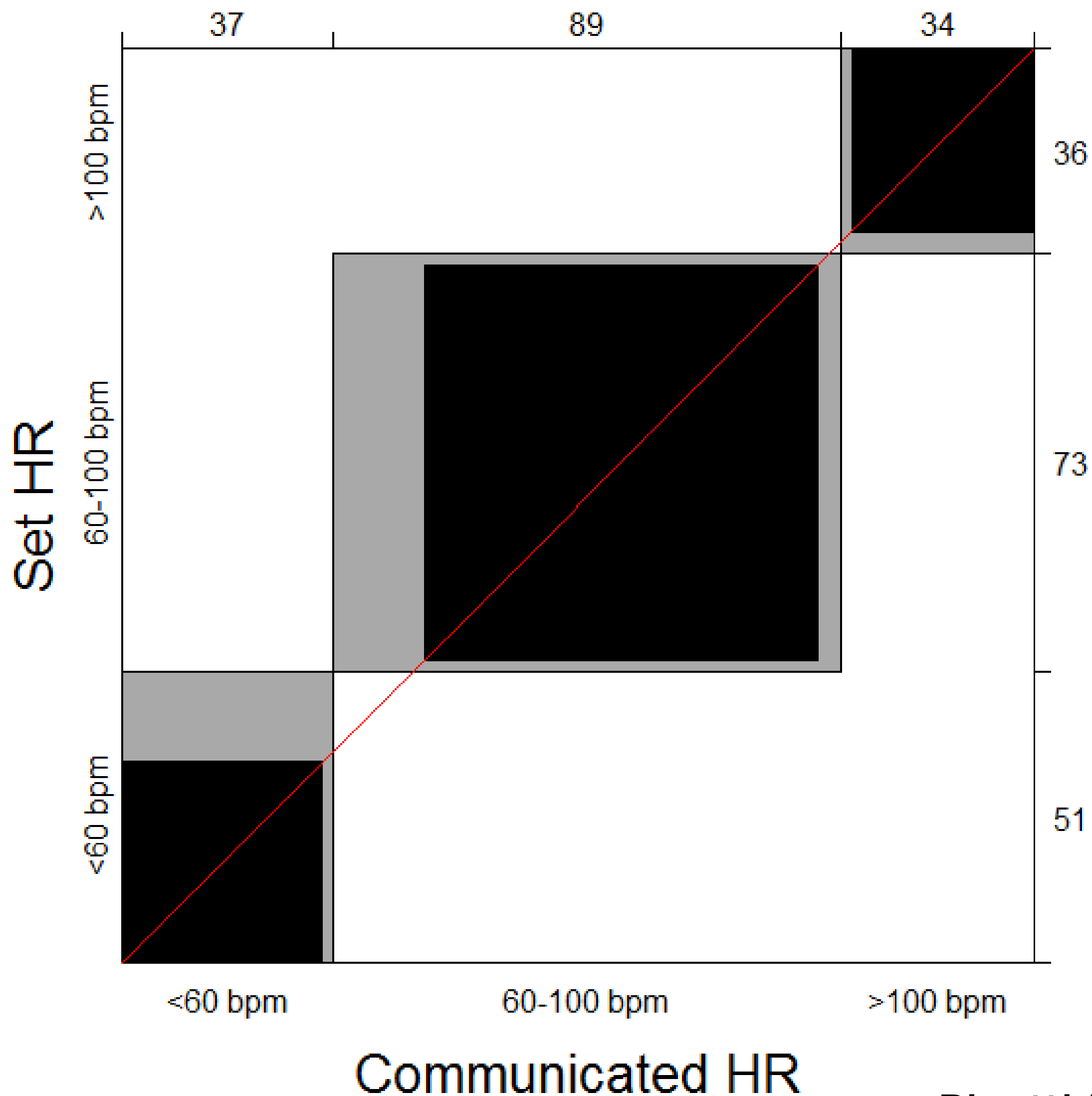
Shah BA et al. Resuscitation 2019

NeoTapAdvancedSupport, NeoTapAS
(free-of-charge mobile application)

http://tap4life.org/

Binotti M et al, ADCF&N Ed 2018

Accuracy in heart rate assessment using NeoTap: a simulation study.



Binotti M et al, ADCF&N Ed 2018

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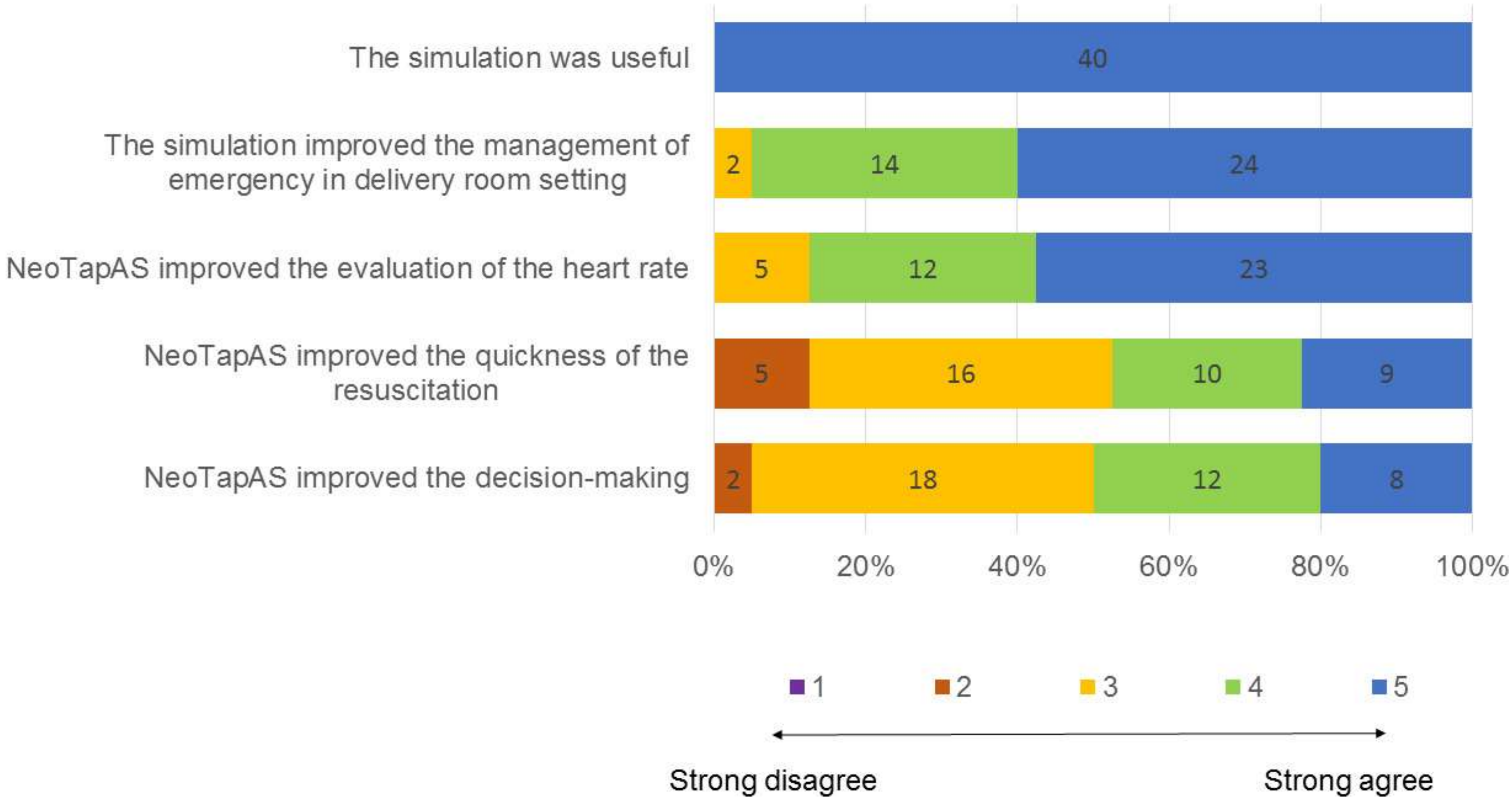
Express your agreement on the following statements (from 1 -strong disagree- to 5 -strong agree-)



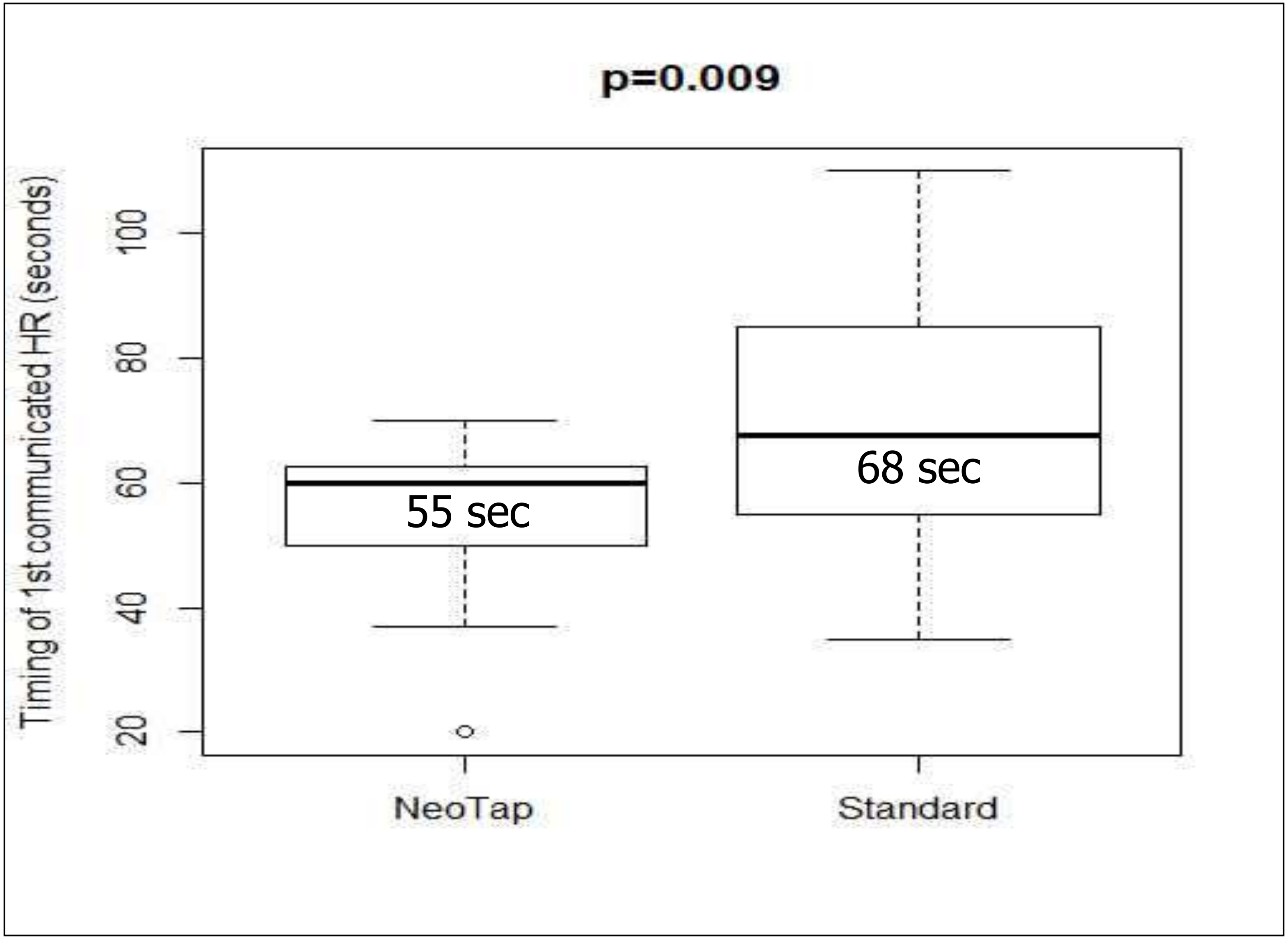
Binotti M et al, ADCF&N Ed 2018

Aim

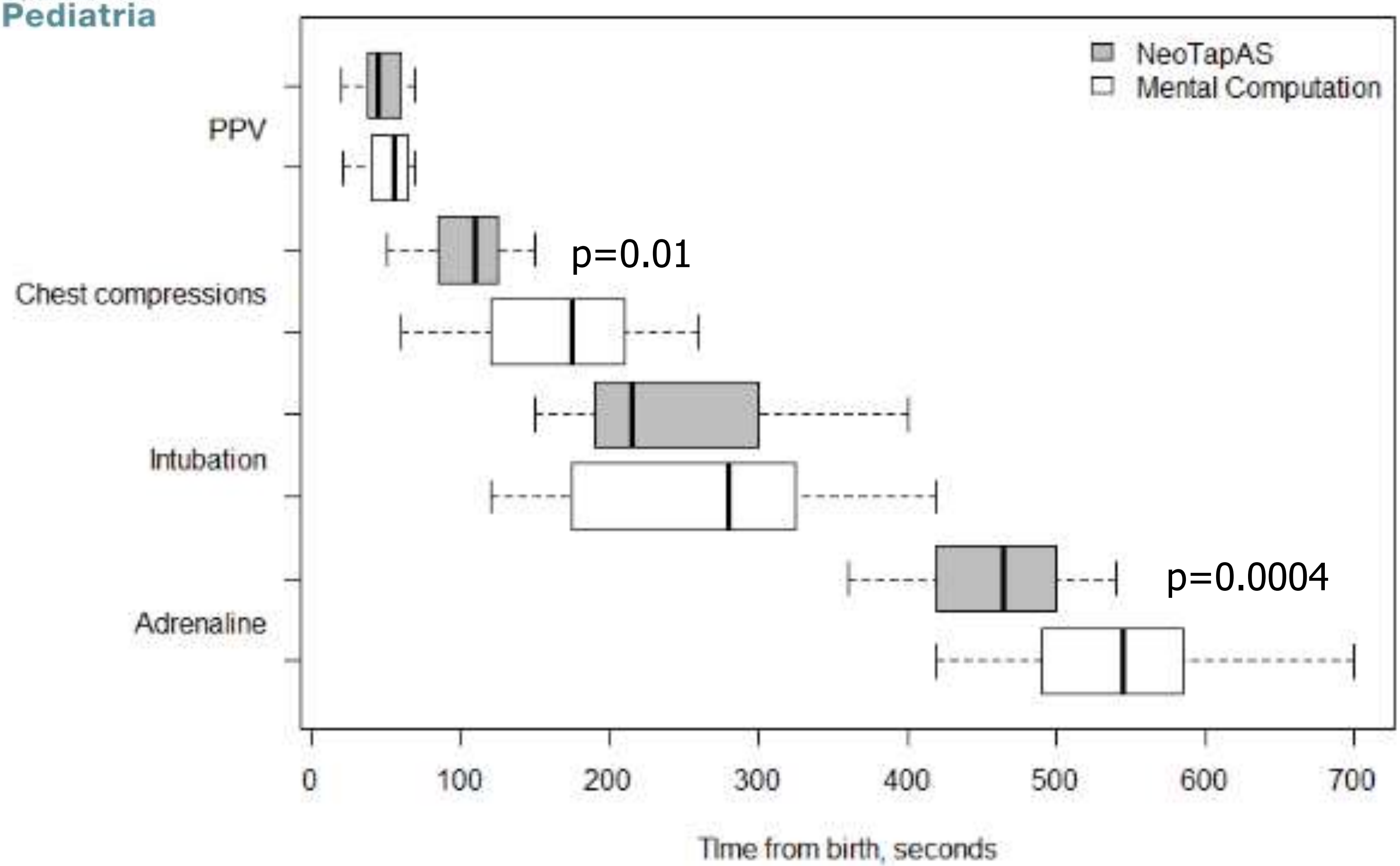
To evaluate the impact of NeoTapAS on timing of HR communication and resuscitation interventions.

Cavallin F. et al. ADCFN Ed 2019

Timing of the first communicated HR



Cavallin F. et al. ADCFN Ed 2019

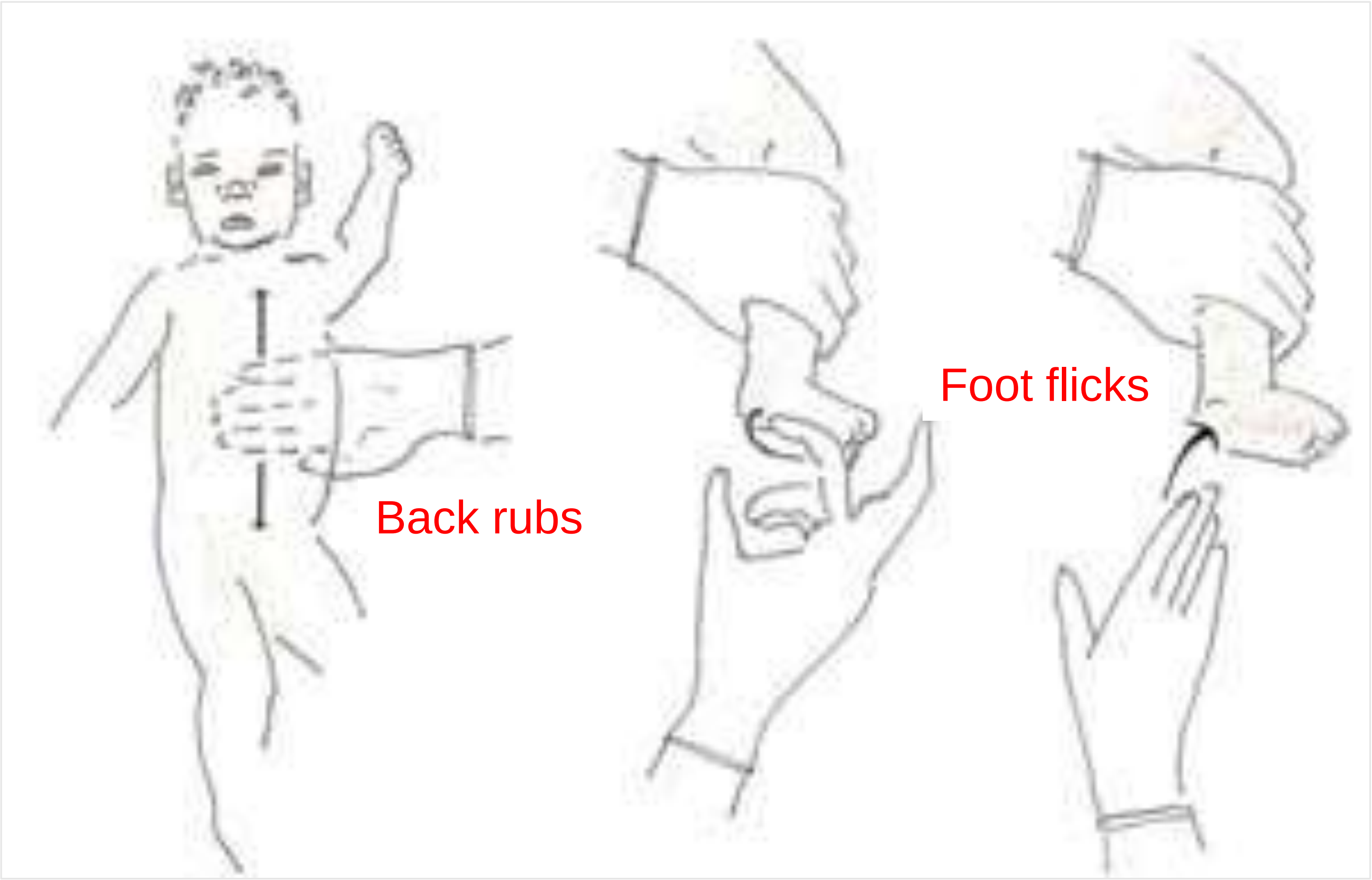


Cavallin F. et al. ADCFN Ed 2019

Stimulation

Source: A. C. Santos, J. N. Epstein, K. Chaudhuri: Obstetric Anesthesia
www.accessanesthesiology.com

Stimulation



Manual of Neonatal Resuscitation, AHA, Ed 2016

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Stimulation

- ✓ **2 observational studies**
- ✓ **High resource settings**

Dekker J et al. Tactile stimulation to stimulate spontaneous breathing during stabilization of preterm infants at birth: A Retrospective Analysis. Front Pediatr. 2017 Apr 3;5:61.

Gaertner VD et al. Physical stimulation of newborn infants in the delivery room. Arch Dis Child Fetal Neonatal Ed. 2018;103:F132-F136.

↓

Back rubs > Foot flicks ?

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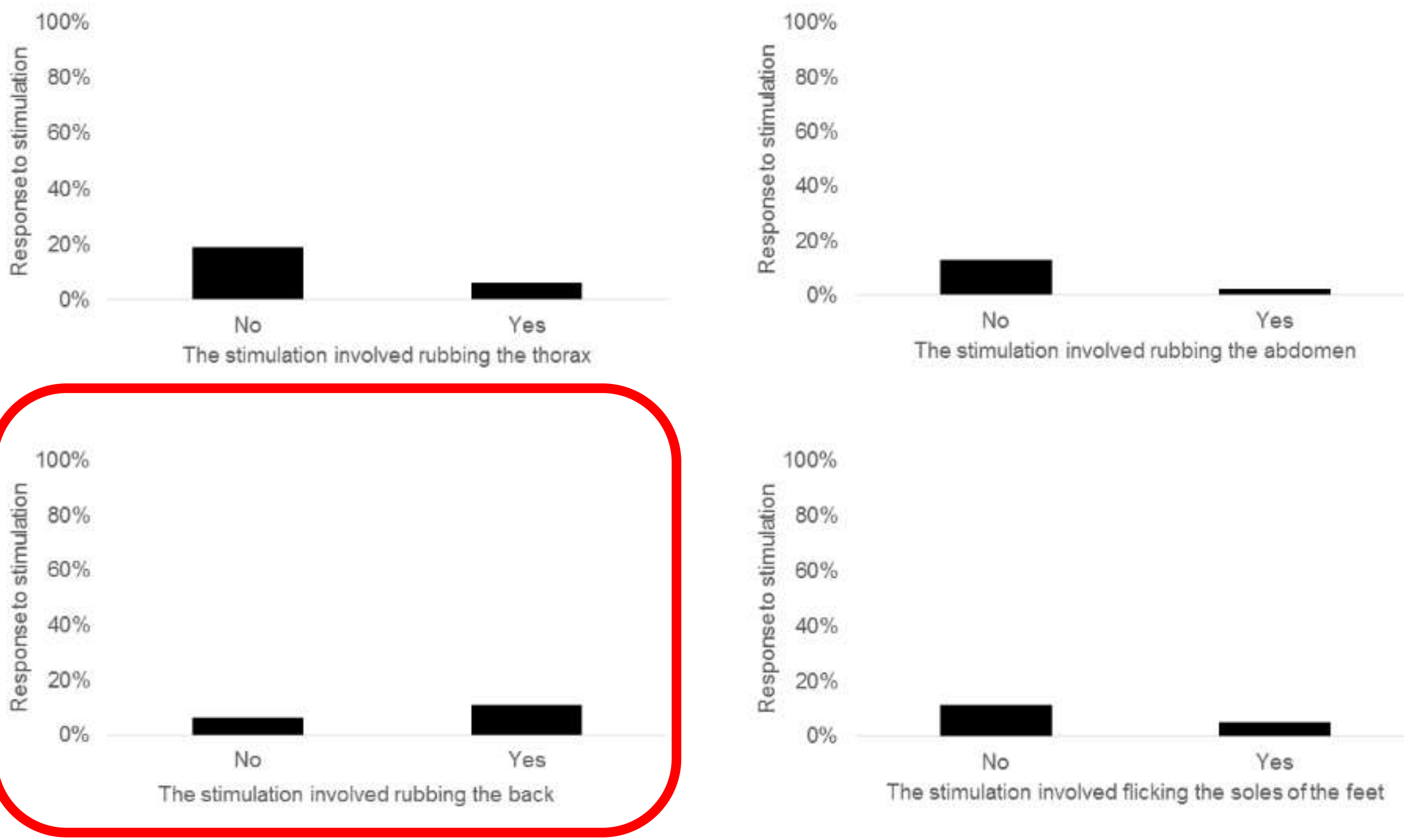

Pietravalle A, BMC Pediatr 2018

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Back rubs or foot flicks for stimulation at birth in a low-resource setting: a randomized controlled trial

Matani Hospital, Uganda

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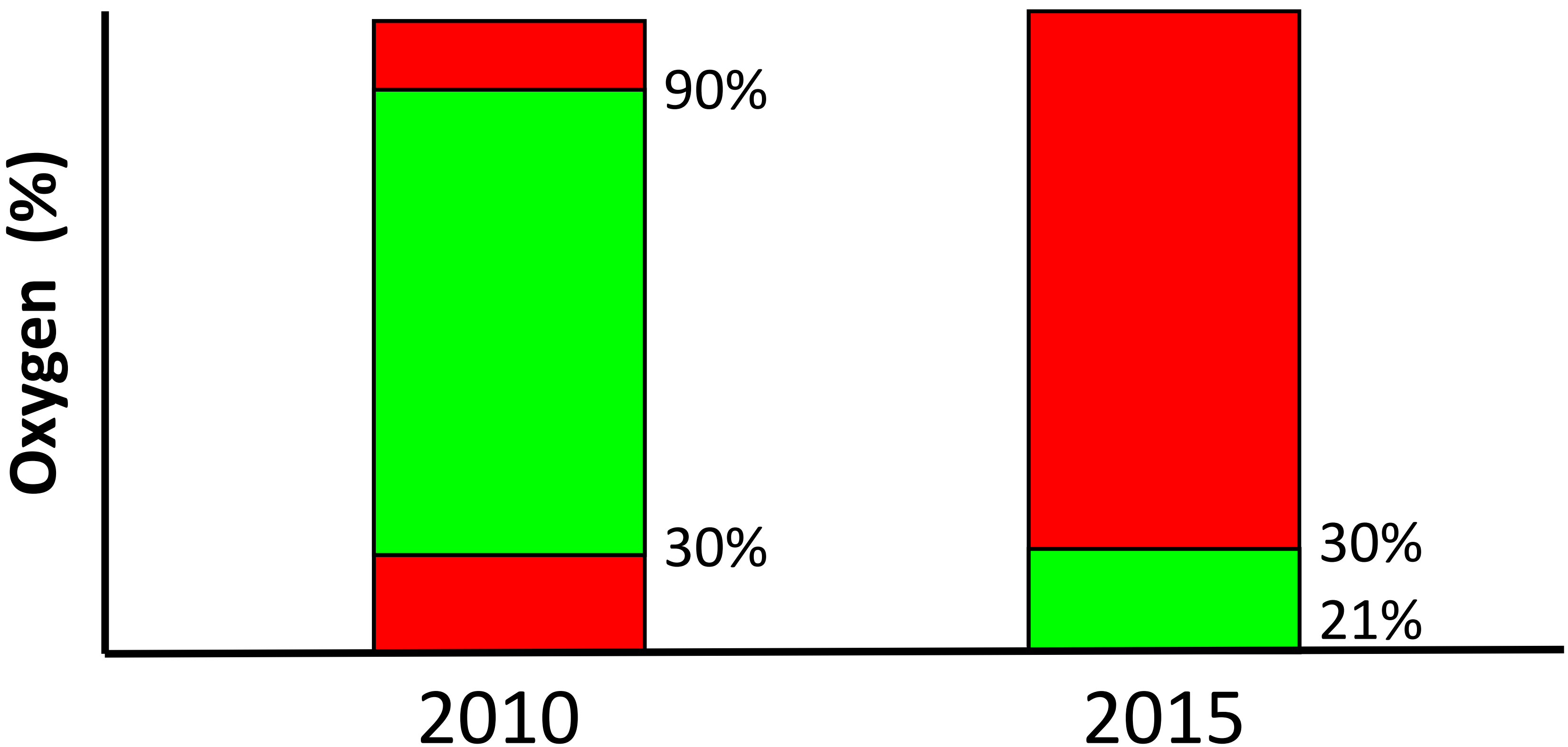
Gaps of knowledge
2015 → 2020

- Algorithm
- Initial steps (temperature, HR detection)
- Meconium aspiration syndrome
- **Oxygenation**
- Ventilation
- Chest compressions
- Ethics
- Cord clamping
- Education

Oxygen to initiate resuscitation in preterm infants (<35 wks)



Wyckoff MH et al. 2015 AHA Guidelines

Wyllie J et al. 2015 ERC Guidelines

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High O_2 (50%–100%) versus Low O_2 (21%-30%)

Outcome	n. subjects	RR (95%CI)
mortality before discharge	607	1.48 (0.8–2.73)
bronchopulmonary dysplasia	502	1.08 (0.59–1.98)
intraventricular hemorrhage	400	0.90 (0.47–1.72)
retinopathy of prematurity	359	1.28 (0.59–2.77)

Perlman J et al. Circulation 2015

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Torpido Study

- Study design: RCT
- GA: <32 weeks' gestation
- Treatment: RA versus 100% oxygen
- SpO2 targets: 65-95% up to 5 min and 85-95% until admission

J.L. Oei et al. Pediatrics 2017

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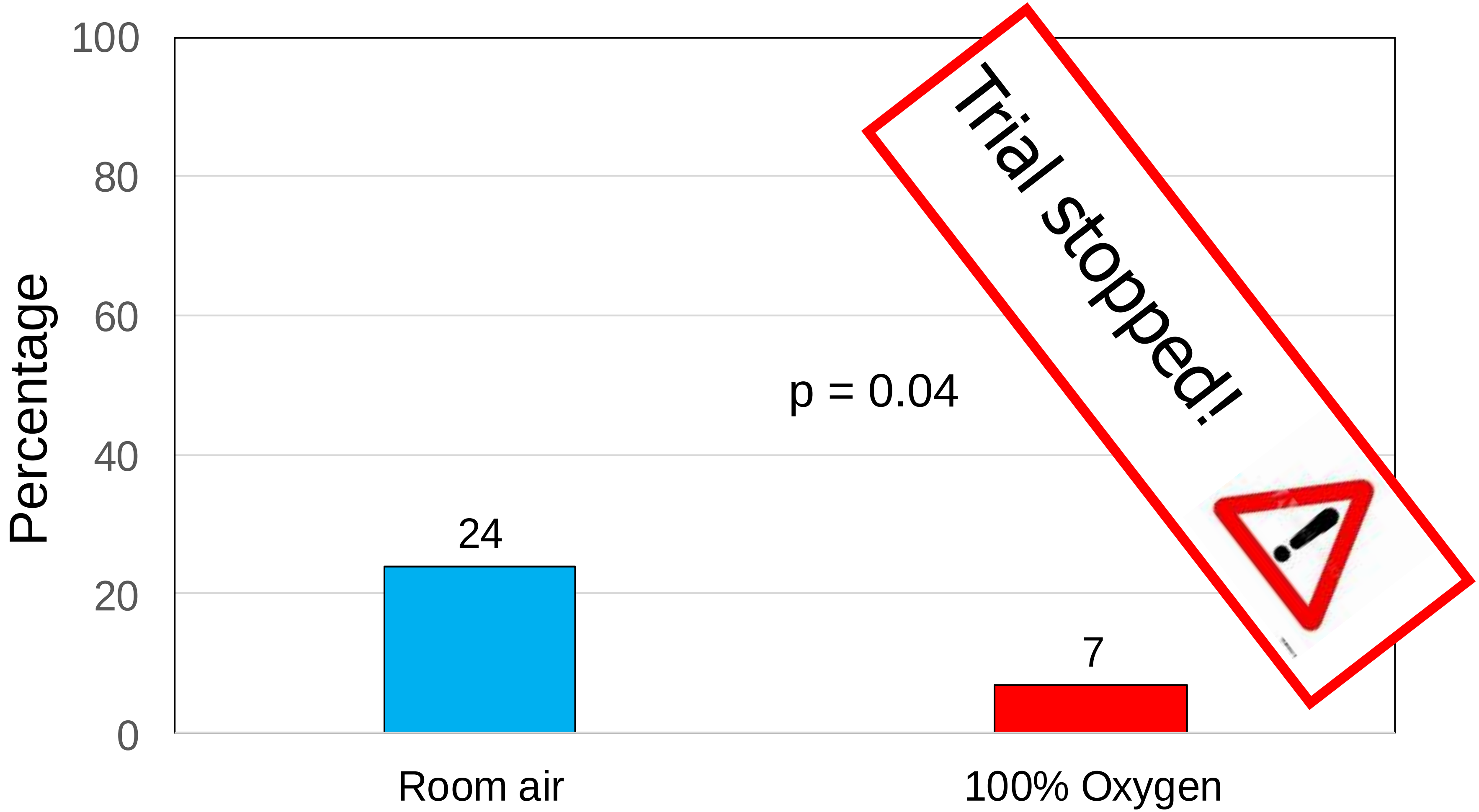
TABLE 4 Mortality

Variable	All Infants		
	RA, $n = 144$	100% O_2, $n = 143$	RR (95% CI)
All deaths	14 (10)	6 (4)	2.3 (0.9–5.7), $P = .10$
Neonatal death (death <28 d)	12 (8)	5 (3)	3.1 (0.9–11.1), $P = .08$
Death before hospital discharge	14 (10)	5 (3)	2.6 (0.9–7.1), $P = .06$
Age of death, d	12 (2–95)	4 (1–11)	$P = .24$
Causes of death[c]			

J.L. Oei et al. Pediatrics 2017

Mortality rate

[subgroup of babies <28 weeks' gestation]



J.L. Oei et al. Pediatrics 2017

Adjusted OR for Outcome - Room Air as reference

Outcome	Intermediate	100% O_2
Primary		
Death or NDI	1.01 (0 .77-1.34)	1.03 (0.78-1.35)
Death or severe NDI	1.14 (0.82-1.58)	1.22 (0.90- 1.67)
Secondary		
Death	1.03 (0.68 -1.56)	0.93 (0.63-1.37)
NDI	1.00 (0.74- 1.35)	1.08 (0.81-1.45)
Severe NDI	1.22 (0.78-1.91)	1.57 (1.05-2.35)
Language score < 70	1.54 (0.89-2.67	1.73 (1.02-2.91)

No significant differences: CP, Cognitive score < 85, Cogntive score < 70, Visual impairmen , Hearing impariment

Soraisham AS et al. J Perinatol 2017

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Initial Oxygen Concentration for Preterm Neonatal Resuscitation

CONCLUSIONS: The ideal initial F_{IO_2} for preterm newborns is still unknown, although the majority of newborns ≤32 weeks' gestation will require oxygen supplementation.

Welsford M et al. Pediatrics 2019

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Recommendation of FiO2 and newborn resuscitation

- Term and near term infants

OR for mortality: 0.69 (95%CI 0.54-0.88) in favour of air

➡ Start with room air – adjust according to SpO2

- Preterm infants 28-31 weeks GA

OR for mortality: 1.9 (95%CI 0.33-11.1)

➡ Start with 21-30% – adjust according to SpO2

- Preterm infants <28 weeks GA

OR for mortality: 5.3 (95% CI 1.35-20)

➡ Don't start with 21%

➡ Start with 30% – adjust according to SpO2

Until more data are available from randomized studies aim at a SpO2 of 80-85% within 5 minutes

Saugstad OD, 2017

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Table 1. Suggestions on how to supply oxygen in the delivery room to newly born infants.

Gestational Age	Initial FiO_2	Target SpO_2 at 5 min
<37 weeks	0.21	85–90%
33^{+0} to 36^{+6} weeks	0.21	85%
29^{+0} to 32^{+6} weeks	0.21-0.30*	80–85%
≤28 weeks	0.3	80%

Lara-Cantón I. et al. Children 2019

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Gaps of knowledge

2015 → 2020

- Flow-chart
- Initial steps (temperature, HR detection)
- Meconium aspiration syndrome
- Oxygenation
- **Ventilation**
- Chest compressions
- Ethics
- Cord clamping
- Education

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Nasal-CPAP

Intubation
+/-
surfactant

<u>Guidelines 2015</u>

<u>CPAP</u>

- **<u>We suggest…</u>** → in favor…

Wyckoff MH et al. 2015 AHA Guidelines

Wyllie J et al. 2015 ERC Guidelines

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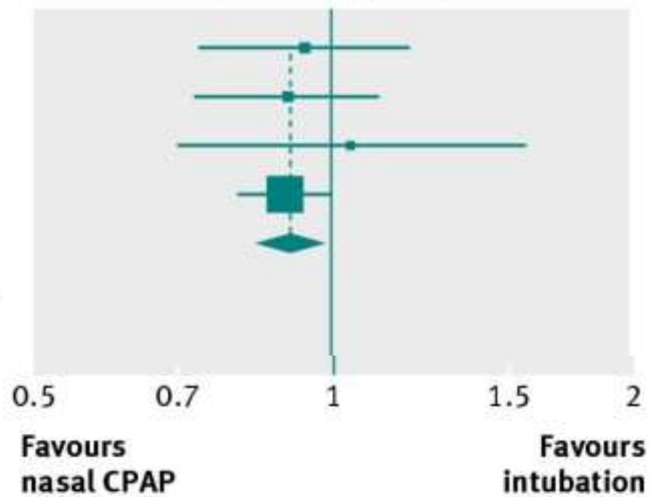
[NNT: 25]

Study or subgroup	No of events/total Nasal CPAP	No of events/total Intubation	Weight (%)	Risk ratio (Mantel-Haenszel) random (95% CI)
Death or BPD				
Dunn 2011[9]	68/223	138/425	12.6	0.94 (0.74 to 1.19)
Morley 2008[7]	108/307	118/303	17.0	0.90 (0.73 to 1.11)
Sandri[10]	33/103	32/105	4.5	1.05 (0.70 to 1.57)
SUPPORT[8]	323/663	353/653	65.9	0.90 (0.81 to 1.00)
Total (95% CI)	532/1296	641/1486	100.0	0.91 (0.84 to 0.99)

Test for heterogeneity: τ^2=0.00, χ^2=0.60, df=3, P=0.90, I^2=0%

Test for overall effect: z=2.10, P=0.04

Risk ratio (Mantel-Haenszel) random (95% CI)



Schmolzer GM, BMJ 2013


Gestational age: 24 wks
Birth weight: 410 g

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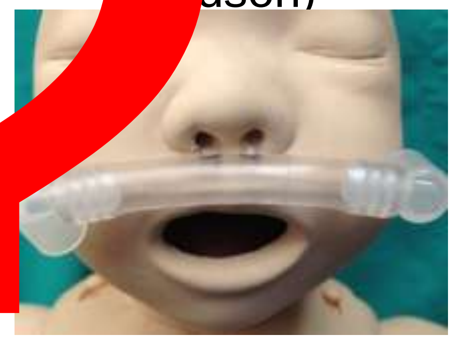
?

Single NF prong

Double NF prong

Short sal prongs
dson)



Short binasal cannulae
(Fisher&Paykel / RAM)

Key Points

Question What is the best noninvasive ventilation strategy for preventing death or bronchopulmonary dysplasia in the first 24 hours of life in spontaneously breathing preterm infants with or at risk of respiratory distress syndrome?

Findings In this meta-analysis, less invasive surfactant administration was the strategy associated with the lowest odds of the composite outcome of death or bronchopulmonary dysplasia compared with either nasal continuous positive airway pressure or mechanical ventilation.

Meaning Less invasive surfactant administration should be considered as a first-line ventilation strategy for spontaneously breathing preterm infants with respiratory distress syndrome.

Isayama T et al. JAMA 2016

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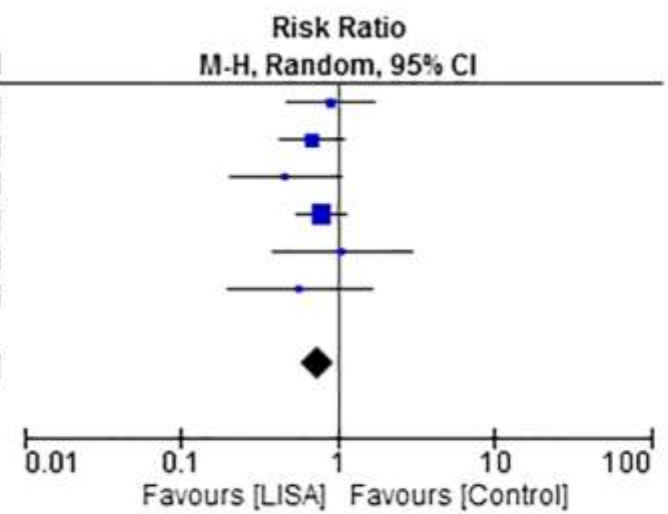
Figure 2 Composite outcome of **death or bronchopulmonary dysplasia at 36 weeks**. LISA, less invasive surfactant administration.

Study or Subgroup	LISA Events	LISA Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Gopel 2011	15	108	17	112	13.3%	0.92 [0.48, 1.74]
Kanmaz 2013	22	100	32	100	25.1%	0.69 [0.43, 1.10]
Mirnia 2013	7	66	16	70	8.1%	0.46 [0.20, 1.06]
Kribs 2015	35	107	43	104	43.3%	0.79 [0.55, 1.13]
Bao 2015	7	47	6	43	5.4%	1.07 [0.39, 2.93]
Mohammadizadeh 2015	4	19	7	19	4.9%	0.57 [0.20, 1.63]
Total (95% CI)		**447**		**448**	**100.0%**	**0.75 [0.59, 0.94]**
Total events	90		121			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.63$, df = 5 ($P = 0.76$); $I^2 = 0\%$
Test for overall effect: $Z = 2.46$ ($P = 0.01$)



Aldana-Aguirre JC, et al. Arch Dis Child Fetal Neonatal Ed 2017

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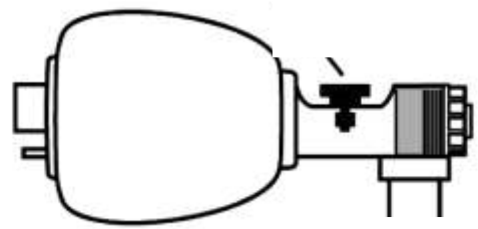
LISA/INSURE vs CPAP

- **P:** In spontaneous breathing preterm infants with distress requiring respiratory support in DR or during stabilization shortly after birth
- **I:** does surfactant administration avoiding prolonged mechanical ventilation via INSURE or LISA
- **C:** compared with CPAP alone
- **O:** change outcome?

or



T-piece

Self-inflating bag

Szyld E et al. J Pediatr 2014

Giunburg R et al. ADCF&N Ed 2018

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Table III. Analysis in the subgroup of VLBW infants

Outcome measure	T-piece group (n = 85)	SIB group (n = 110)	OR (95% CI)*	*P* value*
HR ≥100 bpm at 2 min, n (%)	75 (88.2)	84 (76.4)	0.43 (0.19-0.95)	.037
Intubation for ventilatory support, n (%)	45 (52.9)	76 (69.1)	2.01 (1.12-3.60)	.019
Drugs/chest compressions, n (%)	3 (3.5)	5 (4.6)	1.30 (0.30-5.61)	.723
Mechanical ventilation, n (%)	62 (72.9)	85 (77.3)	1.26 (0.66-2.43)	.487
BPD, n (%)	21 (24.7)	44 (40.0)	2.03 (1.09-3.79)	.036
Air leaks (pneumothorax and/or neumomediastinum), n (%)	3 (3.5)	2 (1.8)	0.51 (0.08-3.1)	.461
Use of oxygen, n (%)	71 (83)	101 (92)	2.2 (0.9-5.5)	.082
Days on oxygen, mean ± SD	21 ± 20	35 ± 27	-	.0007

Szyld E et al. J Pediatr 2014

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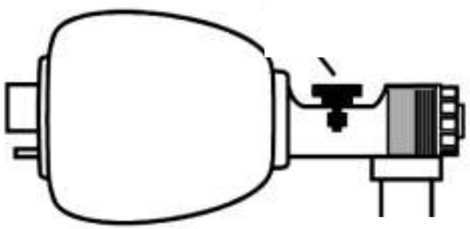
Table 4 Variables associated with survival to hospital discharge without bronchopulmonary dysplasia, intraventricular haemorrhage grades III/IV and periventricular leucomalacia, according to gestational age

	OR	95% CI
Infants with 23–28 weeks of gestational age*		
Caesarean section	1.49	1.10 to 2.02
Birth weight <750g	0.13	0.09 to 0.19
Male	0.64	0.47 to 0.86
Ventilation at birth with the T-piece	1.76	1.24 to 2.50
Advanced resuscitation	0.44	0.22 to 0.89
Fifth-minute Apgar score of 7–10	1.48	1.04 to 2.11
Respiratory distress syndrome	0.42	0.25 to 0.69
Air leaks	0.34	0.17 to 0.68
Pulmonary hypertension	0.280	0.15 to 0.52
Late-onset sepsis with positive blood culture	0.58	0.42 to 0.81
Infants with 28-33 weeks of gestational age**		
Maternal hypertension	0.16	0.06 to 0.41
Caesarean section	1.69	1.08 to 1.67
Birth weight <1000 g	0.22	0.13 to 0.38
Advanced resuscitation	0.31	0.11 to 0.91
Respiratory distress syndrome	0.41	0.26 to 0.65
Air leaks	0.16	0.04 to 0.69
PDA with pharmacological and/or surgical treatment	0.48	0.27 to 0.84
Late-onset sepsis with positive blood culture	0.44	0.28 to 0.68
Necrotising enterocolitis	0.44	0.20 to 0.97

Giunburg R et al. ADCF&N Ed 2018



T-piece > **Self-inflating bag**

Szyld E et al. J Pediatr 2014

Giunburg R et al. ADCF&N Ed 2018

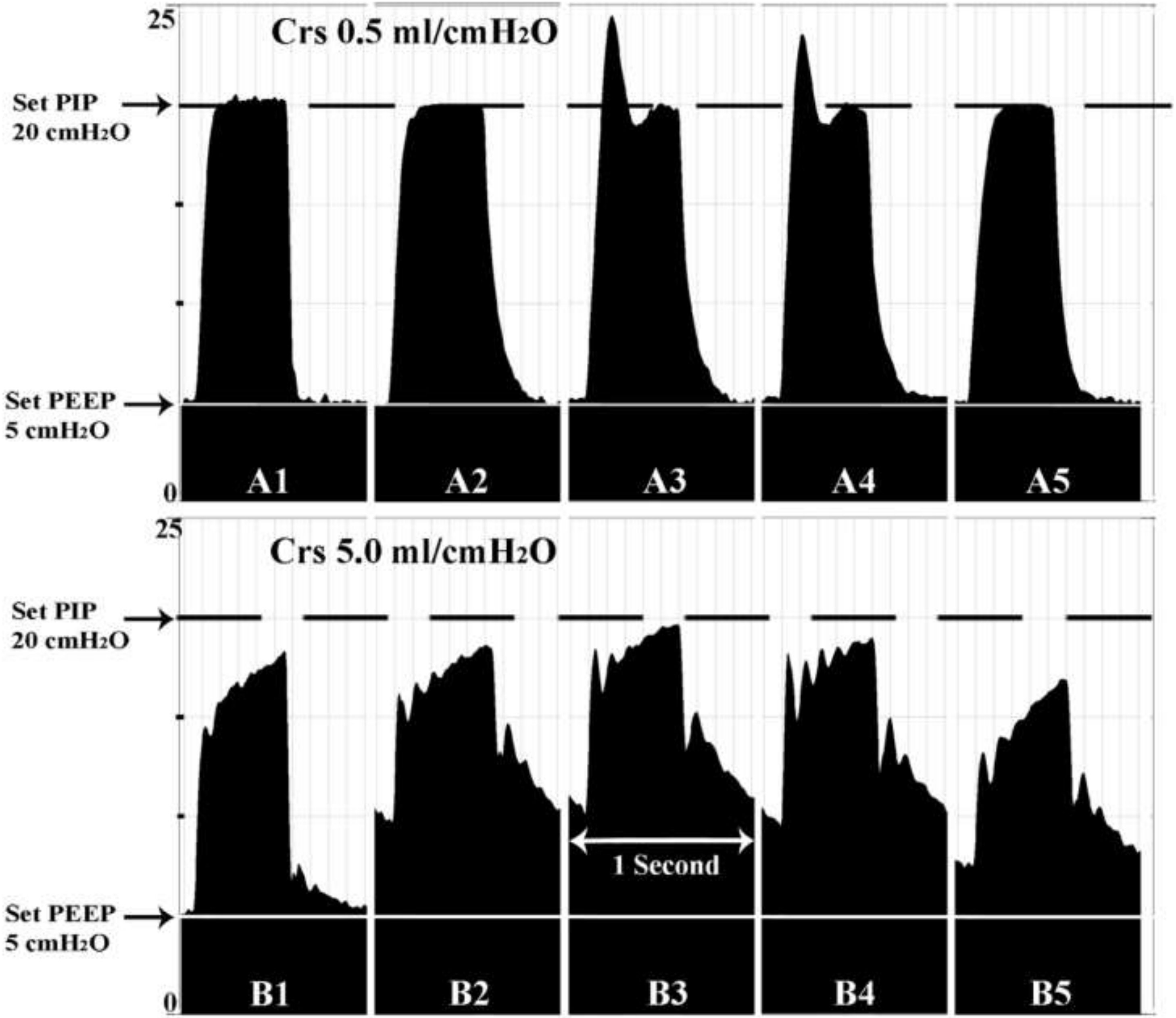
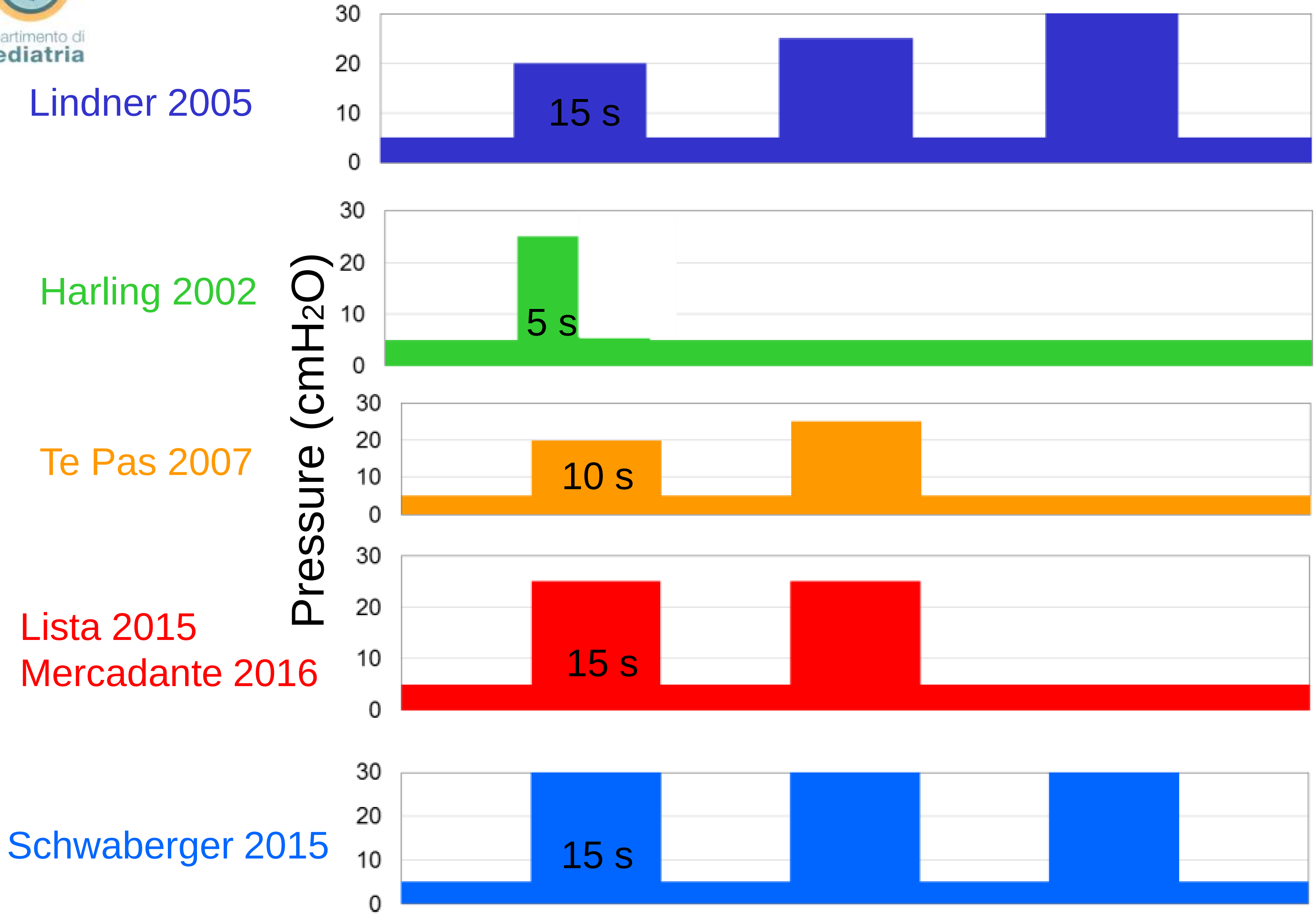


Figure 4 Examples of recorded pressure waveforms for each TPR device tested: 1: rPAP; 2: Neopuff; 3: GE Panda; 4: Draeger Resuscitaire; and 5: Atom at test lung compliances: A: 0.5 mL/cmH$_2$O and B: 5.0 mL/cmH$_2$O. Time scale 1 s per segment. PEEP, positive-end expiratory pressure; PIP, peak inflation pressure; TPR, T-piece resuscitator.

Which T-piece?

Hinder M, ADC 2019

What is a Sustained Inflation?



Courtesy E. Foglia

Guidelines 2015

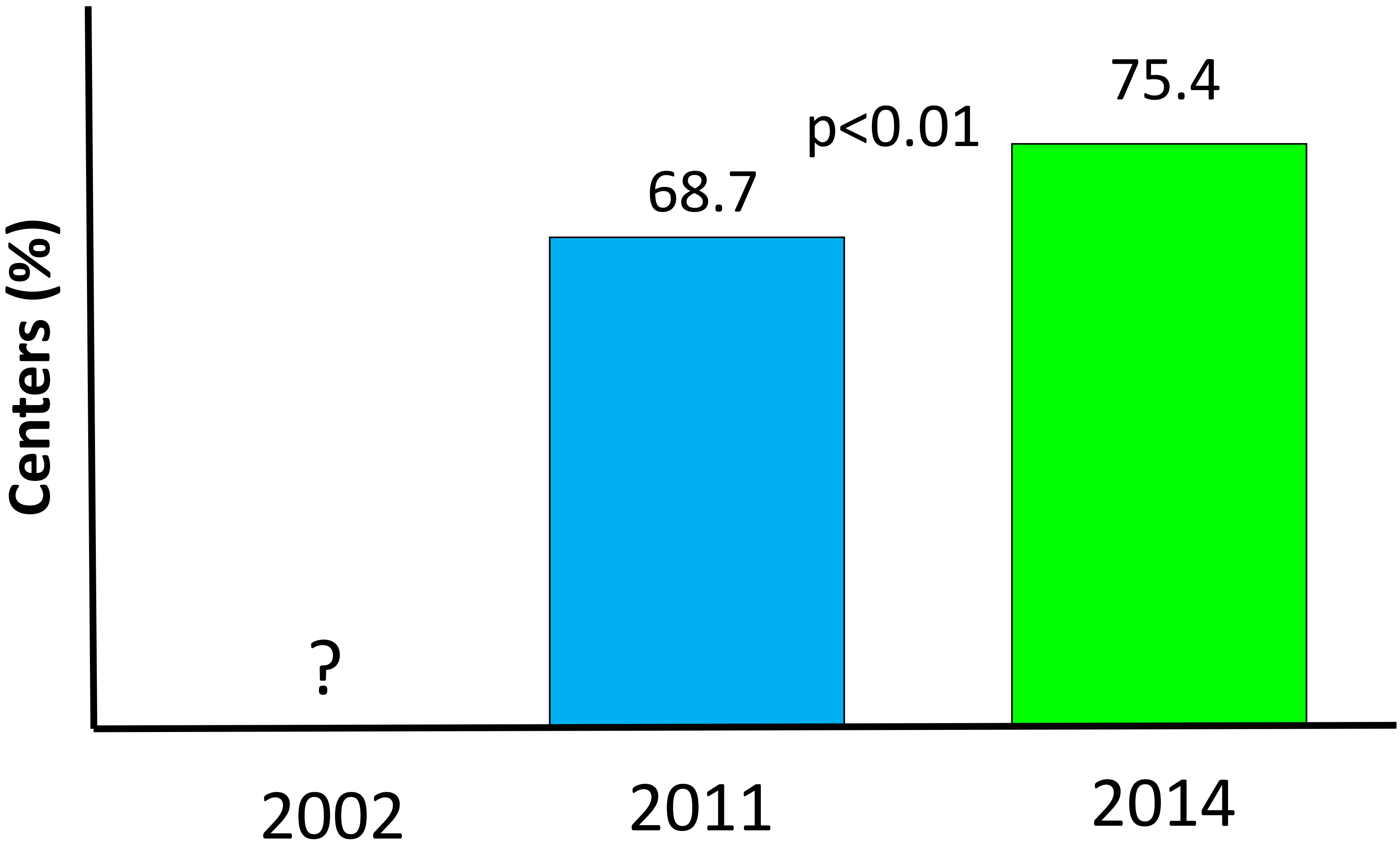
Sustained lung inflation

- **We suggest…** → against…

Wyckoff MH et al. 2015 AHA Guidelines

Wyllie J et al. 2015 ERC Guidelines

Use of sustained lung inflation in Italian level III centres



Petrillo F.

Trevisanuto et al. Resuscitation 2014

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Foglia *et al. Trials* (2015) 16:95
DOI 10.1186/s13063-015-0601-9

TRIALS

STUDY PROTOCOL **Open Access**

Sustained Aeration of Infant Lungs (SAIL) trial: study protocol for a randomized controlled trial

Elizabeth E Foglia[1,2], Louise S Owen[3,4,5], Marta Thio[3,4,5], Sarah J Ratcliffe[6], Gianluca Lista[7], Arjan te Pas[8], Helmut Hummler[9], Vinay Nadkarni[10], Anne Ades[1,2], Michael Posencheg[1,2], Martin Keszler[11,12], Peter Davis[3,4,5] and Haresh Kirpalani[1,2*]

Foglia e et al. Trials 2015

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[23-26 wks]

Table 2. Primary Composite Outcome and Component Secondary Outcomes at 36 Weeks' Postmenstrual Age

Outcome	Resuscitation, No. (%)		Adjusted Risk Difference, % (95% CI)[a]	Adjusted Relative Risk (95% CI)	P Value[b]
	Sustained Inflation (n = 215)	Standard (n = 211)			
Death or bronchopulmonary dysplasia	137 (63.7)	125 (59.2)	4.7 (−3.8 to 13.1)	1.1 (0.9 to 1.2)	.29
Death	45 (20.9)	33 (15.6)	5.2 (−2.3 to 12.7)	1.3 (0.9 to 1.9)	.17
Bronchopulmonary dysplasia	92 (42.8)	92 (43.6)	0.5 (−8.5 to 9.4)	1.0 (0.8 to 1.2)	.92

Kirpalani H et al. JAMA 2019

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[23-26 wks]

Event	Event Rate, No. (%) Sustained Inflation (n=215)	Standard Resuscitation (n=211)	Adjusted Risk Difference, % (95% CI)
Within first 2 days of life			
FiO_2 ≥0.4 for ≥2 h	50 (23.3)	52 (24.6)	-1.9 (-9.8 to 5.9)
Epinephrine	5 (2.3)	2 (1.0)	1.5 (-0.9 to 3.9)
Chest compressions	6 (2.8)	8 (3.8)	-1.4 (-4.7 to 1.9)
Death	16 (7.4)	3 (1.4)	5.6 (2.1 to 9.1)
Within first 10 days of life			
...de I/II	51 (23.7)	44 (20.9)	3.2 (-5.0 to 11.4)
.../IV	21 (9.8)	22 (10.4)	-0.3 (-6.2 to 5.5)
[illegible]	11 (5.1)	19 (9.0)	-4.0 (-9.0 to 1.0)
...mphysema	7 (3.3)	6 (2.8)	0.0 (-3.1 to 3.2)
[illegible]	0	0	
At 2...			
>30% O...	...0.7)	76 (36.0)	-4.5 (-14 to 4.6)
Mechanical su...	[illegible]	91 (43.1)	-3.1 (-12 to 5.5)

Trial stopped!

Kirpalani H et al. JAMA 2019

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Gaps of knowledge
2015 → 2020

- Algorithm
- Initial steps (temperature, HR detection)
- Meconium aspiration syndrome
- Oxygenation
- Ventilation
- Chest compressions
- Ethics
- **Cord clamping**
- Education

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ICC

DCC

UCM

"Would you like to cut the cord?"

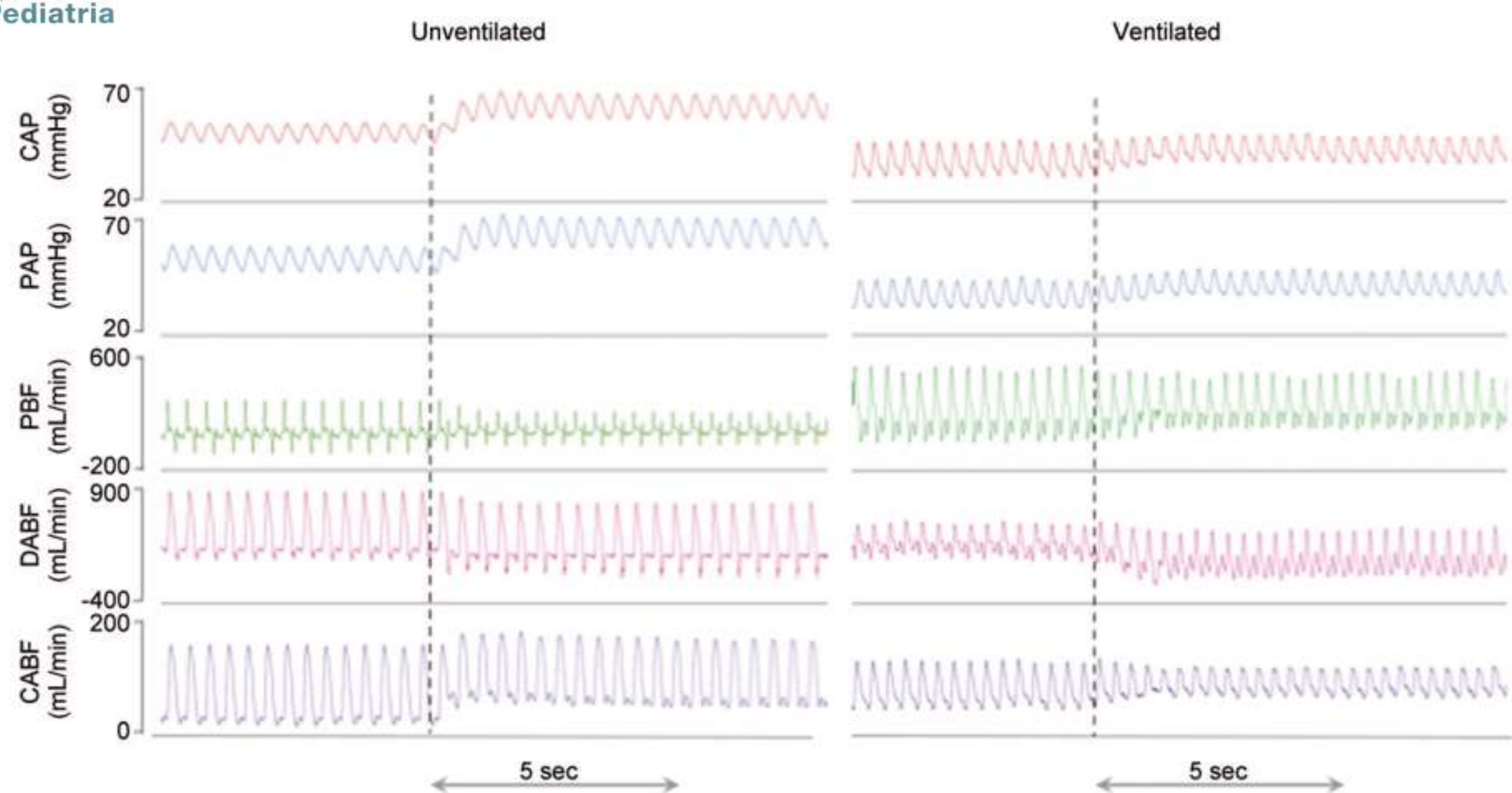


Figure 1. Recordings in unventilated and ventilated lambs before and after umbilical cord occlusion
Carotid arterial pressure (P_{CA}), pulmonary arterial pressure (P_{PA}), pulmonary blood flow (PBF), blood flow through the ductus arteriosus (DABF) and carotid arterial blood flow (CaBF) in unventilated (left) and ventilated (right) lambs before and after umbilical cord occlusion (indicated by dotted line).

Bhatt S et al. J Physiol 2013

Effect of Delayed Cord Clamping on Neurodevelopment at 4 Years of Age: A Randomized Clinical Trial.

CONCLUSIONS AND RELEVANCE:

Delayed CC compared with early CC improved scores in the fine-motor and social domains at 4 years of age, especially in boys, indicating that optimizing the time to CC may affect neurodevelopment in a low-risk population of children born in a high-income country.

Andersson O et al. JAMA Pediatr 2015

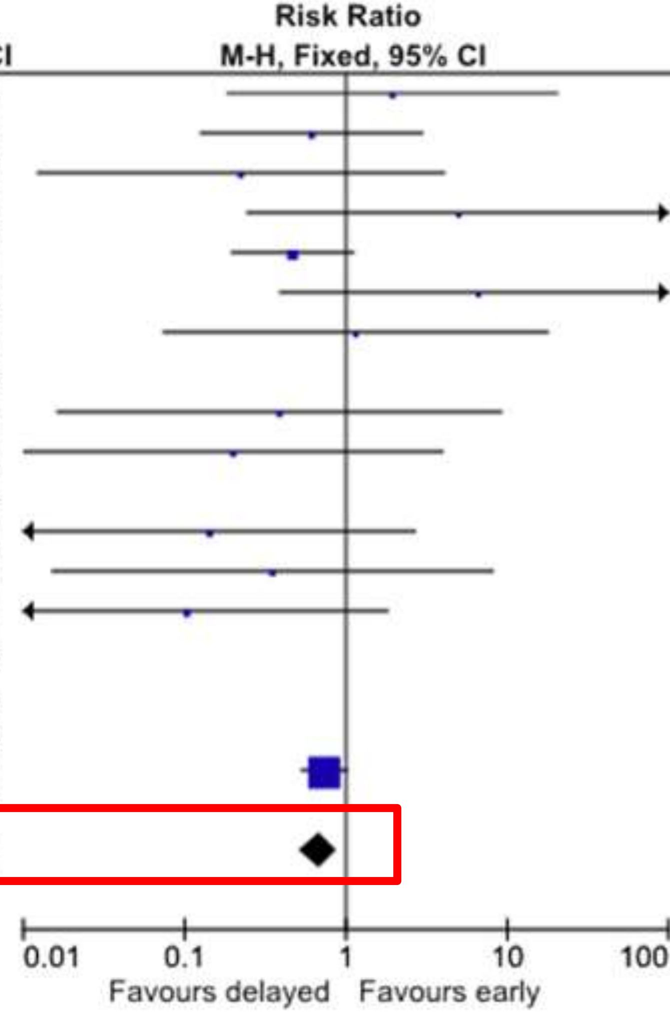
FIGURE 3

Meta-analyses showing effect of delayed clamping on mortality

Study or Subgroup	Delayed Events	Delayed Total	Early Events	Early Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Armanian 2017	2	32	1	31	0.9%	1.94 [0.18, 20.30]
Backes 2016	2	18	4	22	3.1%	0.61 [0.13, 2.96]
Baenziger 2007	0	15	3	24	2.3%	0.22 [0.01, 4.04]
Datta 2017	2	60	0	60	0.4%	5.00 [0.25, 102.00]
Duley 2016	7	135	15	135	12.8%	0.47 [0.20, 1.11]
Hofmeyr 1988	5	24	0	14	0.5%	6.60 [0.39, 111.10]
Hofmeyr 1993	1	40	1	46	0.8%	1.15 [0.07, 17.80]
Kinmond 1992	0	17	0	19		Not estimable
Kugelman 2007	0	30	1	35	1.2%	0.39 [0.02, 9.16]
McDonnell 1997	0	23	2	23	2.1%	0.20 [0.01, 3.95]
Mercer 2003	0	16	0	16		Not estimable
Mercer 2006	0	36	3	36	3.0%	0.14 [0.01, 2.67]
Rabe 2000	0	19	1	20	1.2%	0.35 [0.02, 8.10]
Ranjit 2015	0	44	5	50	4.4%	0.10 [0.01, 1.81]
Strauss 2003	0	45	0	60		Not estimable
Tanprasertkul 2016	0	42	0	44		Not estimable
Ultee 2008	0	18	0	19		Not estimable
WTM APTS 2017	58	784	79	782	67.3%	0.73 [0.53, 1.01]
Total (95% CI)		**1398**		**1436**	**100.0%**	**0.68 [0.52, 0.90]**
Total events	77		115			

Heterogeneity: $Chi^2 = 10.28$, $df = 12$ ($P = 0.59$); $I^2 = 0\%$

Test for overall effect: $Z = 2.75$ ($P = 0.006$)



Meta-analyses showing effect of delayed vs early cord clamping on risk ratio for hospital mortality in 18 trials in 2834 infants <37 weeks' gestation (top) and 3 trials in 996 infants ≤28 weeks' gestation (bottom).

APTS, Australian Placental Transfusion Study; *CI*, confidence interval; *M-H*, Mantel-Haenszel.

Fogarty M et al. AJOG 2018

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Treatment Recommendation

Delay in umbilical cord clamping for at least 1 minute is recommended for new-born infants not requiring resuscitation.

Perlman JM et al. Pediatrics 2010

Resuscitation with intact umbilical cord ?

Weeks AD, et al. BMJ Innov 2015

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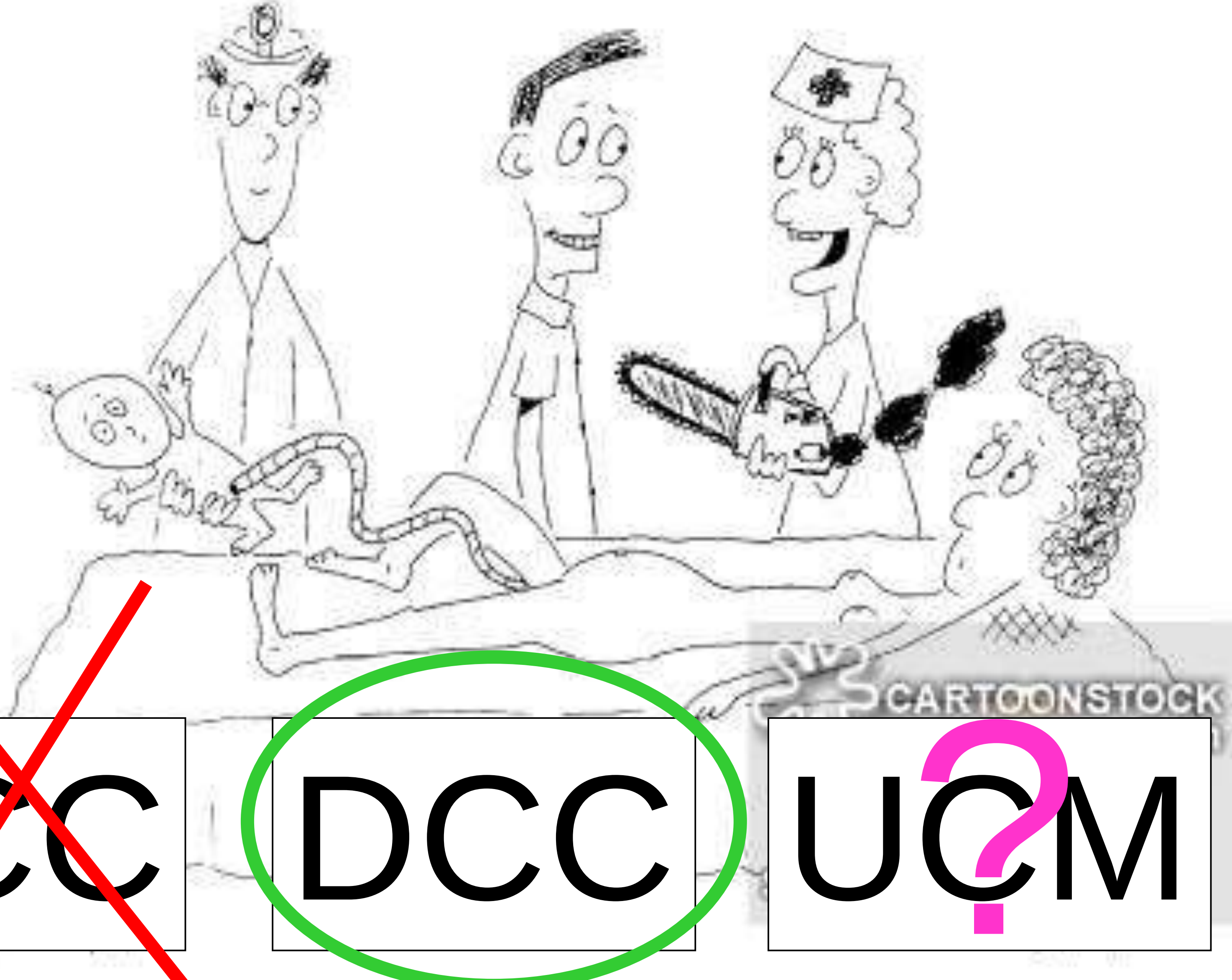


ICC

DCC

UCM ?

"Would you like to cut the cord?"

Original Investigation

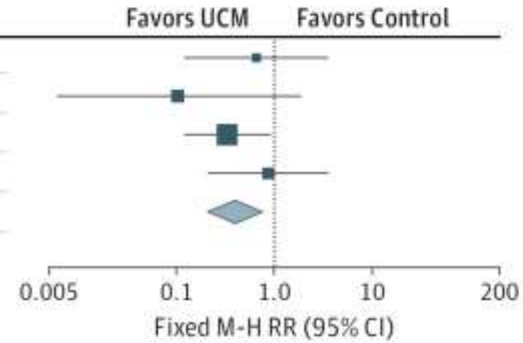
Efficacy and Safety of Umbilical Cord Milking at Birth
A Systematic Review and Meta-analysis

B Oxygen requirement at 36 wk, postmenstrual age in preterm infants[a]

Source	UCM Group No. of Events	UCM Group Total	Control Group No. of Events	Control Group Total	Weight, %	Fixed M-H RR (95% CI)
Alan et al,[16] 2014	2	19	3	19	12.9	0.67 (0.13-3.55)
Hosono et al,[11] 2008	0	18	4	17	19.8	0.11 (0.01-1.82)
Katheria et al,[15] 2014	4	30	12	30	51.4	0.33 (0.12-0.92)
Rabe et al,[14] 2011	3	27	4	31	16.0	0.86 (0.21-3.51)
Total	9	94	23	97	100.0	0.42 (0.21-0.83)

Heterogeneity $\chi^2_3 = 2.41$ ($P = .49$); $I^2 = 0\%$

Test for overall effect: $z = 2.50$ ($P = .01$)

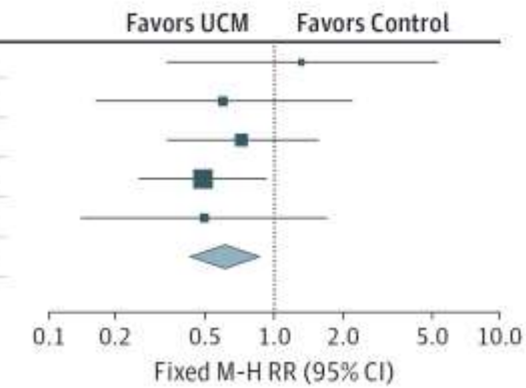


C IVH of all grades[a]

Source	UCM Group No. of Events	UCM Group Total	Control Group No. of Events	Control Group Total	Weight, %	Fixed M-H RR (95% CI)
Alan et al,[16] 2014	4	22	3	22	6.7	1.33 (0.34-5.28)
Hosono et al,[11] 2008	3	20	5	20	11.2	0.60 (0.17-2.18)
Katheria et al,[15] 2014	8	30	11	30	24.6	0.73 (0.34-1.55)
March et al,[12] 2013	9	36	20	39	42.9	0.49 (0.26-0.93)
Rabe et al,[14] 2011	3	27	7	31	14.6	0.49 (0.14-1.72)
Total	27	135	46	142	100.0	0.62 (0.41-0.93)

Heterogeneity $\chi^2_4 = 2.03$ ($P = .73$); $I^2 = 0\%$

Test for overall effect: $z = 2.32$ ($P = .02$)



Al-Wassia H et al. JAMA Pediatr 2015

Benefits of umbilical cord milking versus delayed cord clamping on neonatal outcomes in preterm infants: A systematic review and meta-analysis

Conclusions

UCM wasn't reduced in-hospital mortality and need for transfusion compared to DCC. But our study suggests that UCM may lower the risk of IVH and improve certain neurodevelopmental outcomes compared to DCC in preterm infants.

Nagano N et al. PLOS One 2018

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Guidelines 2015

Cord milking

Treatment Recommendation

"We **suggest against** the routine use of cord milking for infants born at less than 29 weeks of gestation because there is insufficient published human evidence of benefit."

"Cord milking may be considered on an individualized basis or in a research setting as it may improve initial mean blood pressure, hematological indices and intracranial hemorrhage. There is no evidence for improvement or safety in long-term outcomes. (Weak recommendation, low level of evidence)."

Perlman J et al. Circulation 2015

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Premature Infants Receiving Cord Milking Or Delayed Cord Clamping: A Randomized Controlled Non-inferiority Trial

P: In infants with GA 23-31 weeks

I: does Umbilical Cord Milking

C: Delayed Cord Clamping

O: resuce Intraventricular hemorrhage (IVH) or Death

Katheria AC et al. PAS Meeting, Baltimore 2019

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Premature Infants Receiving Cord Milking Or Delayed Cord Clamping: A Randomized Controlled Non-inferiority Trial

Primary outcome

Intraventricular hemorrhage (IVH) or death

DDC	UCM	p-value
19/238 (8%)	28/236 (12%)	0.16

Katheria AC et al. PAS Meeting, Baltimore 2019

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Premature Infants Receiving Cord Milking Or Delayed Cord Clamping: A Randomized Controlled Non-inferiority Trial

[23-27 wks]

Severe intraventricular hemorrhage (IVH)

DDC	UCM	p-value
…9 (6%)	20/93 (22%)	0.0019

Trial stopped!

Katheria AC et al. PAS Meeting, Baltimore 2019

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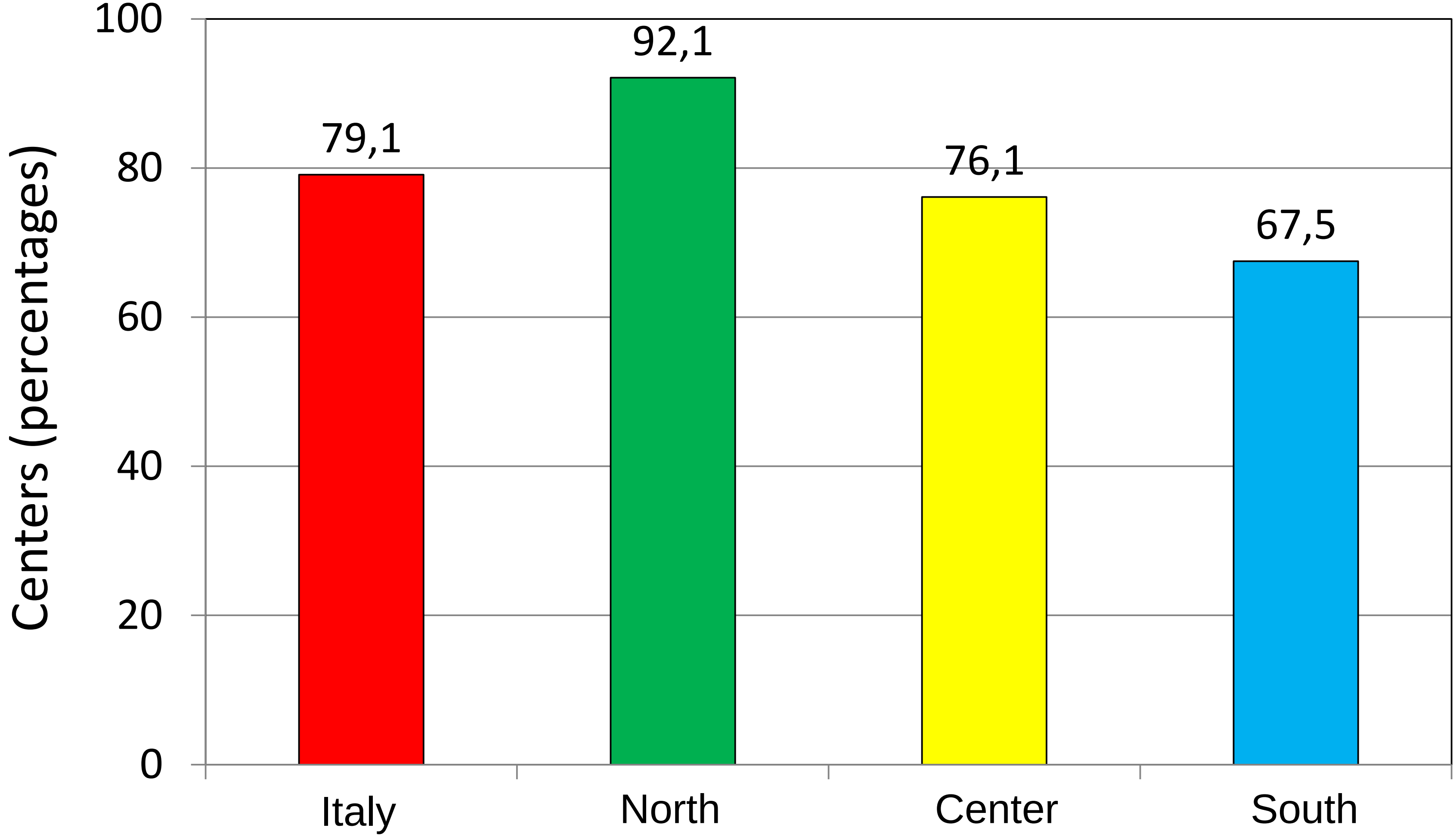
Gaps of knowledge
2015 → 2020

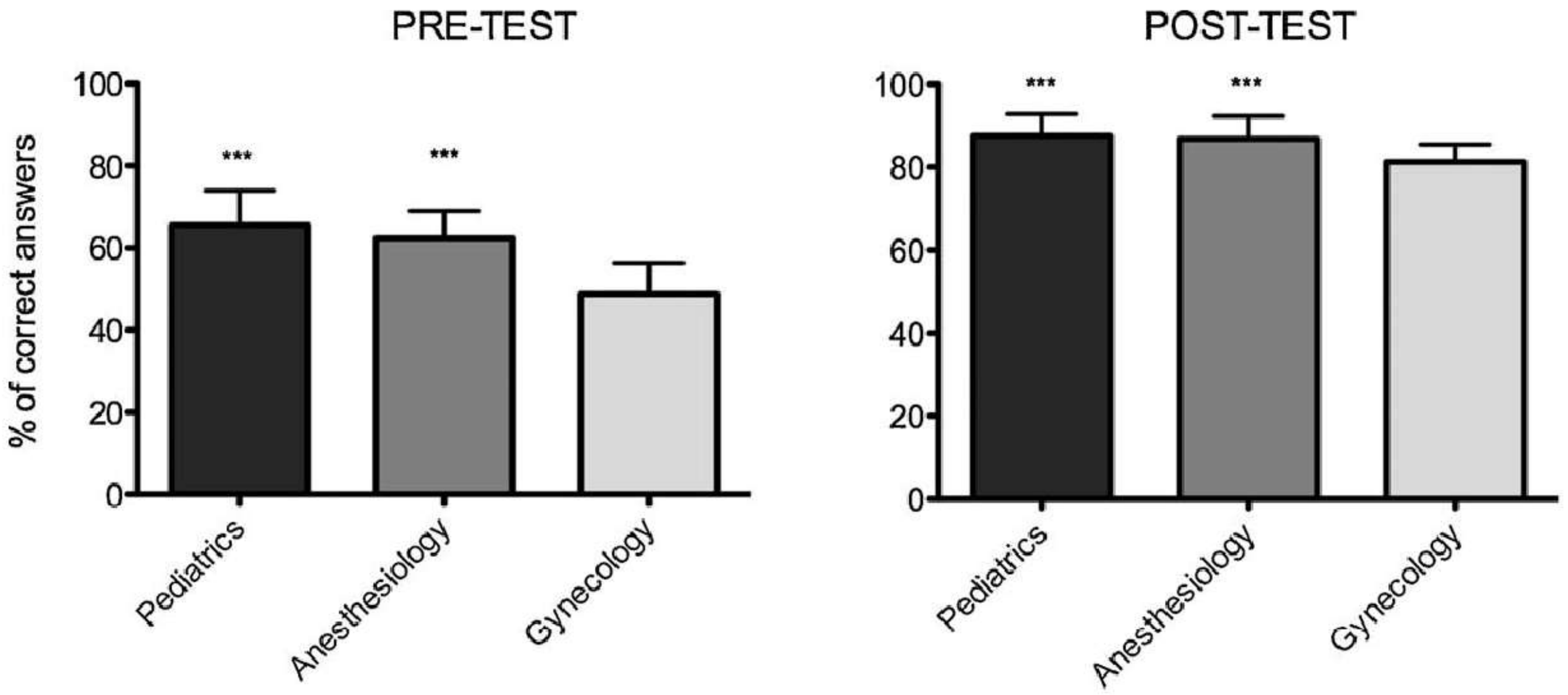
- Flow-chart
- Initial steps (temperature, HR detection)
- Meconium aspiration syndrome
- Oxygenation
- Ventilation
- Chest compressions
- Ethics
- Cord clamping
- **Education**

NRP (NLS) courses



Trevisanuto et al. Acta Paediatr 2014

Knowledge



Parotto M et al. Resuscitation 2010

Manual skills

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Table. Percentage of items performed correctly on the performance evaluation (skills evaluation) immediately after course participation (post-test)

	Carlo et al[1]	Trevisanuto et al
Overall performance evaluation	88 (9)	78 (35)
A. Initial steps	87 (11)	75 (21)
1. Indicates use of (universal) standard precautions	78 (42)	25 (41)
2. Prepares for warming	98 (12)	84 (33)
3. Prepares for positioning or for clearing airway	93 (26)	74 (39)
4. Prepares for ventilation	98 (15)	84 (31)
5. Prepares medications	72 (45)	79 (35)
6. Determines need for the initial steps of resuscitation	76 (43)	90 (28)
7. Places baby on preheated radiant warmer or on mother with neck slightly extended	90 (30)	96 (18)
8. Clears mouth and nose	94 (23)	100 (0)
9. Dries the baby	98 (15)	71 (46)
10. Removes wet linen	84 (37)	61 (49)
11. Slaps foot, flicks heel, or rubs back briefly	72 (45)	61 (49)
B. Ventilation	88 (12)	83 (11)
12. Chooses correct size mask or positions the bag	92 (27)	89 (31)
13. Checks the seal	86 (35)	75 (47)
14. Positions the head and applies the face mask	96 (20)	93 (26)
15. Checks for and removes secretions	92 (27)	89 (31)
16. Ventilates with mouth slightly open	79 (41)	68 (47)
17. Increases ventilation pressure	75 (44)	61 (49)
18. Ventilates 30 seconds at a rate of 40-60 times/min	87 (34)	96 (18)
19. Achieves visible rise and fall of the chest	90 (30)	79 (41)
20. Asks for help to administer chest compressions	94 (24)	75 (44)
21. Continues positive pressure ventilation	95 (21)	82 (39)
22. Checks the heart rate by palpation or stethoscope	85 (36)	93 (26)
23. Checks to ensure adequate chest movement	87 (34)	86 (36)
24. Coordinates ventilations and chest compressions appropriately	81 (39)	93 (26)
C. Chest compressions	93 (14)	71 (19)
25. Locates appropriate position on lower one-third of baby's sternum	95 (21)	89 (31)
26. Provides firm support for baby's back	93 (26)	79 (42)
27. Uses fingertips or ring fingers or distal portion of both thumbs	94 (24)	39 (50)
28. Compresses sternum approximately one-third of the anterior-posterior diameter of the chest	92 (27)	75 (44)
29. Maintains cadence of "one- and two- and three- and breathe- and..".	92 (27)	75 (44)

Data are expressed as means (SD).

Trevisanuto D et al. J Pediatr 2010

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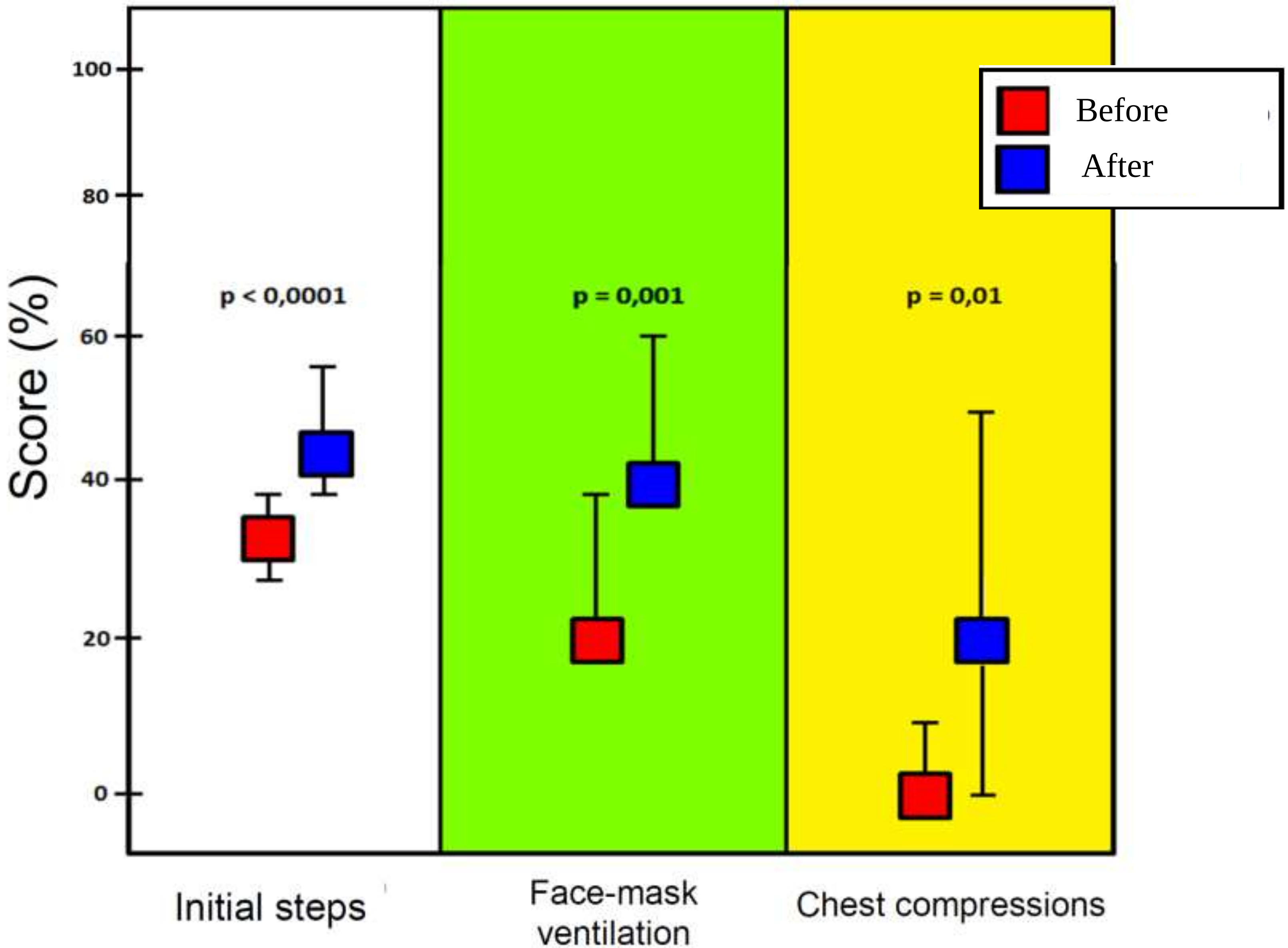
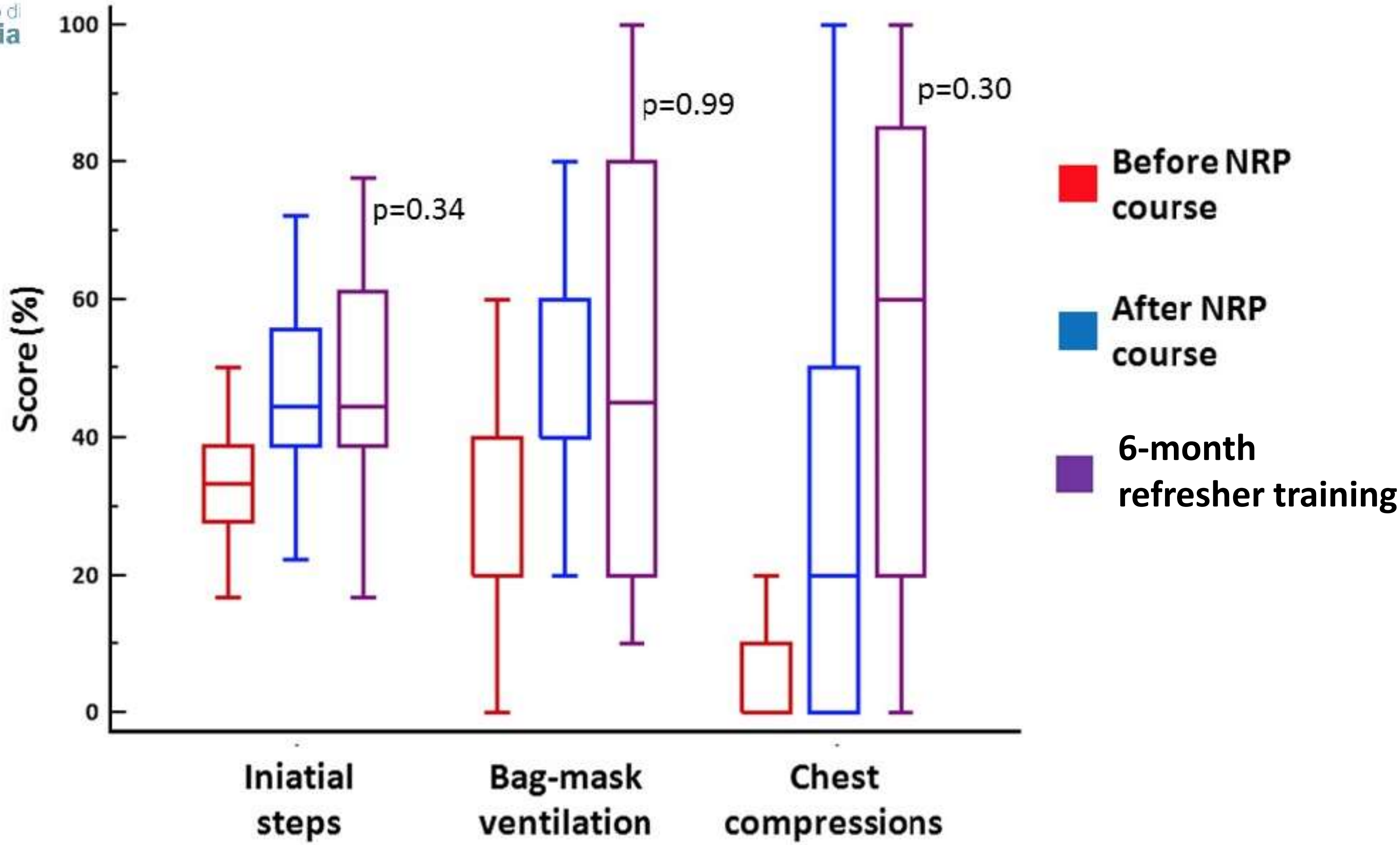
Clinical practice

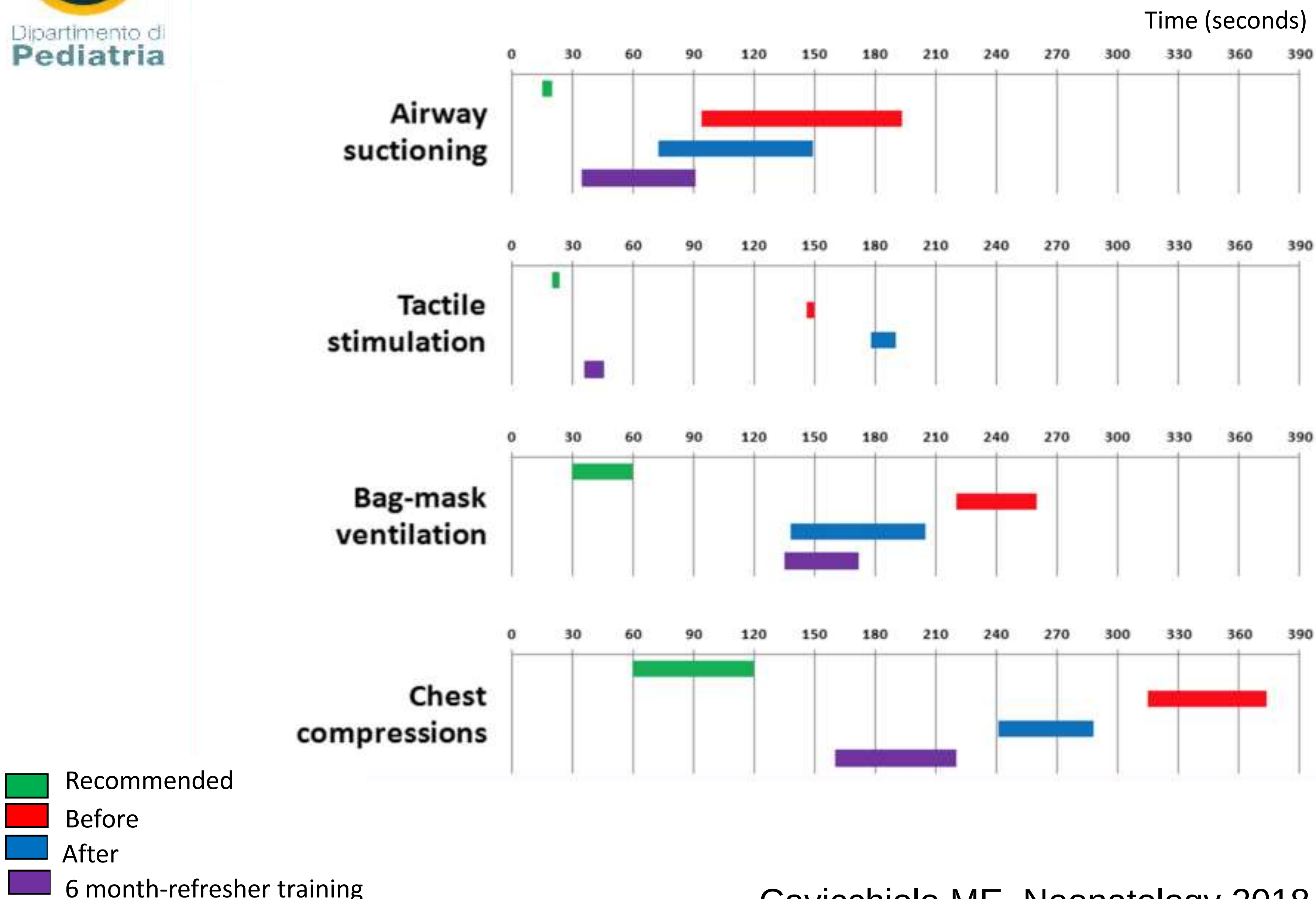
Clinical practice



Trevisanuto D, et al. PlosOne 2015

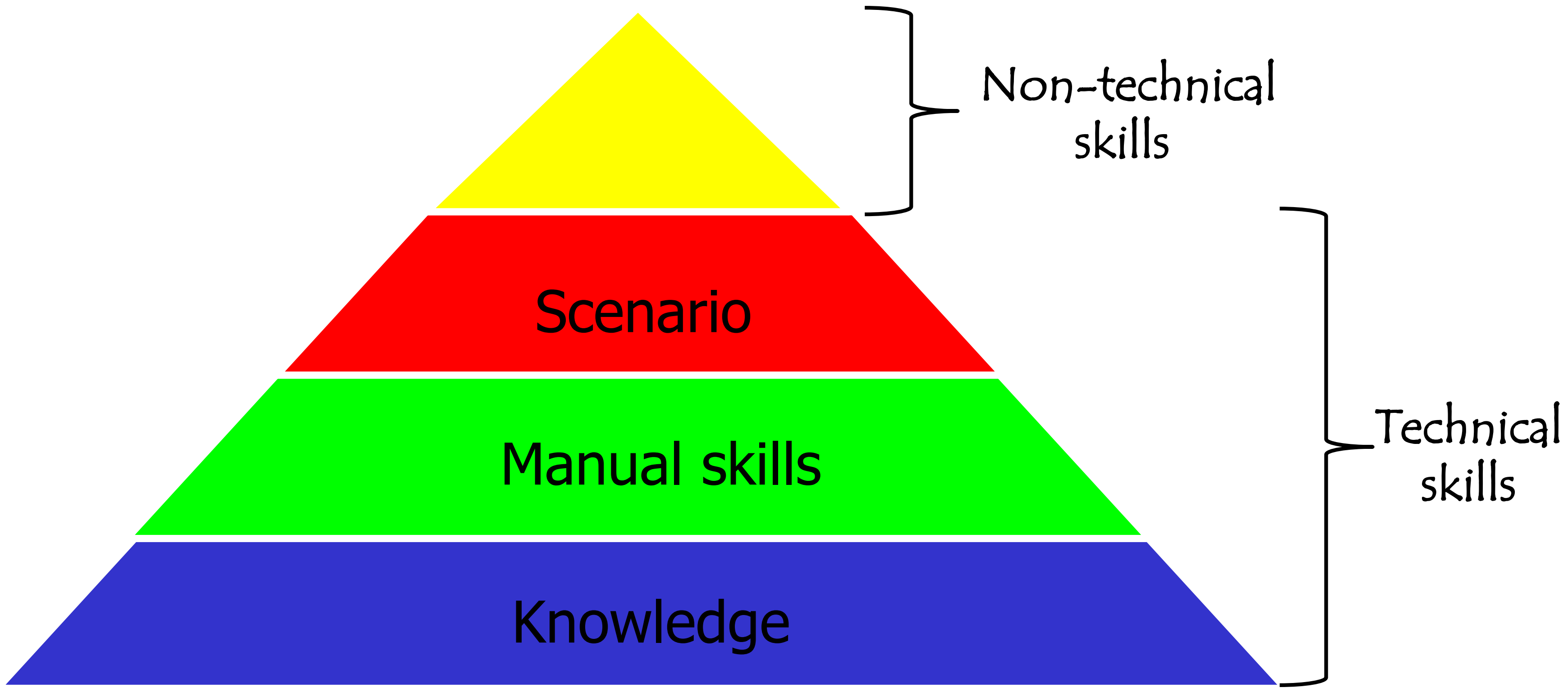


Cavicchiolo ME, Neonatology 2018



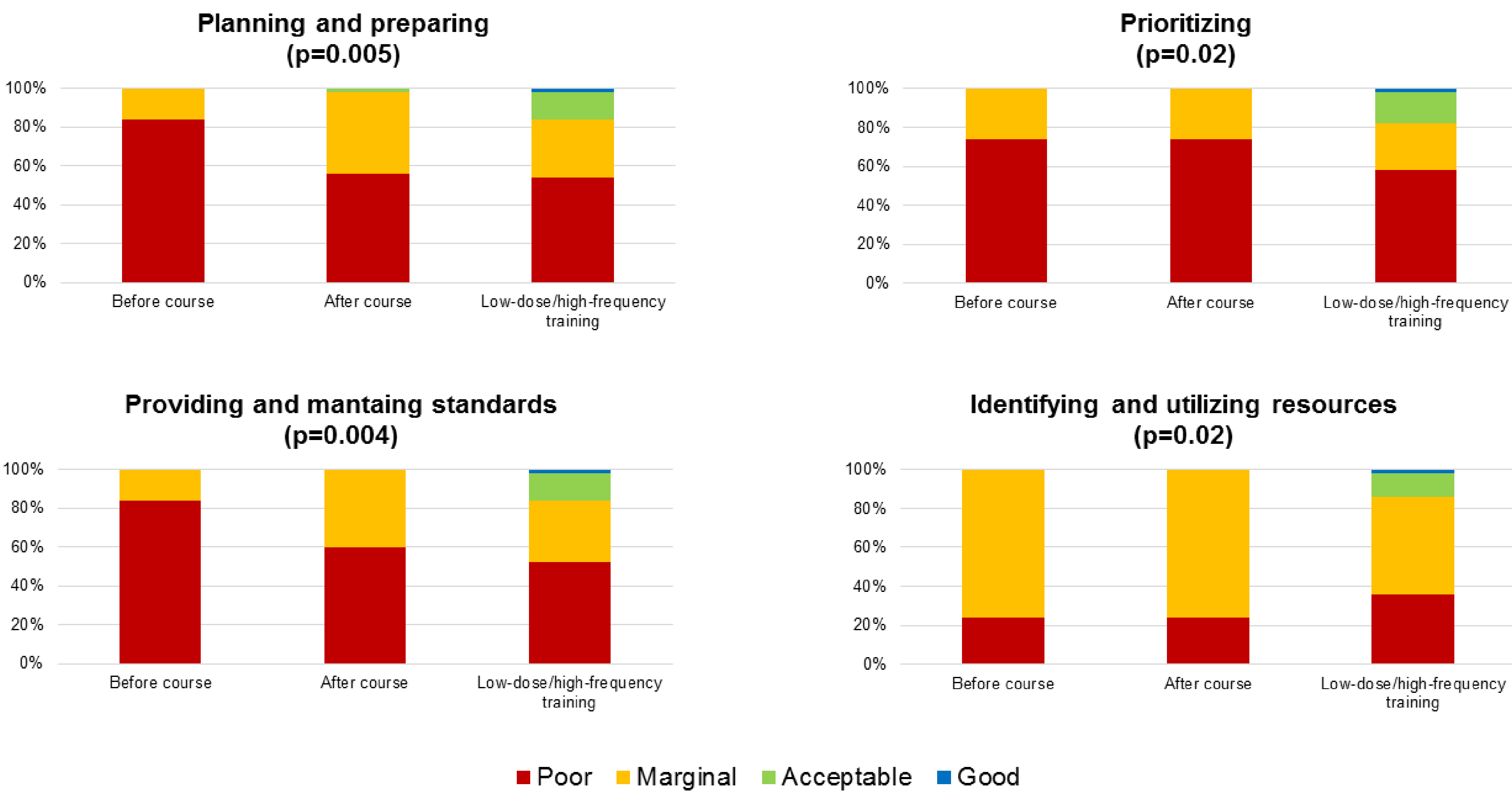
Cavicchiolo ME, Neonatology 2018

Education


Non-technical skills
Scenario
Manual skills
Knowledge
Technical skills

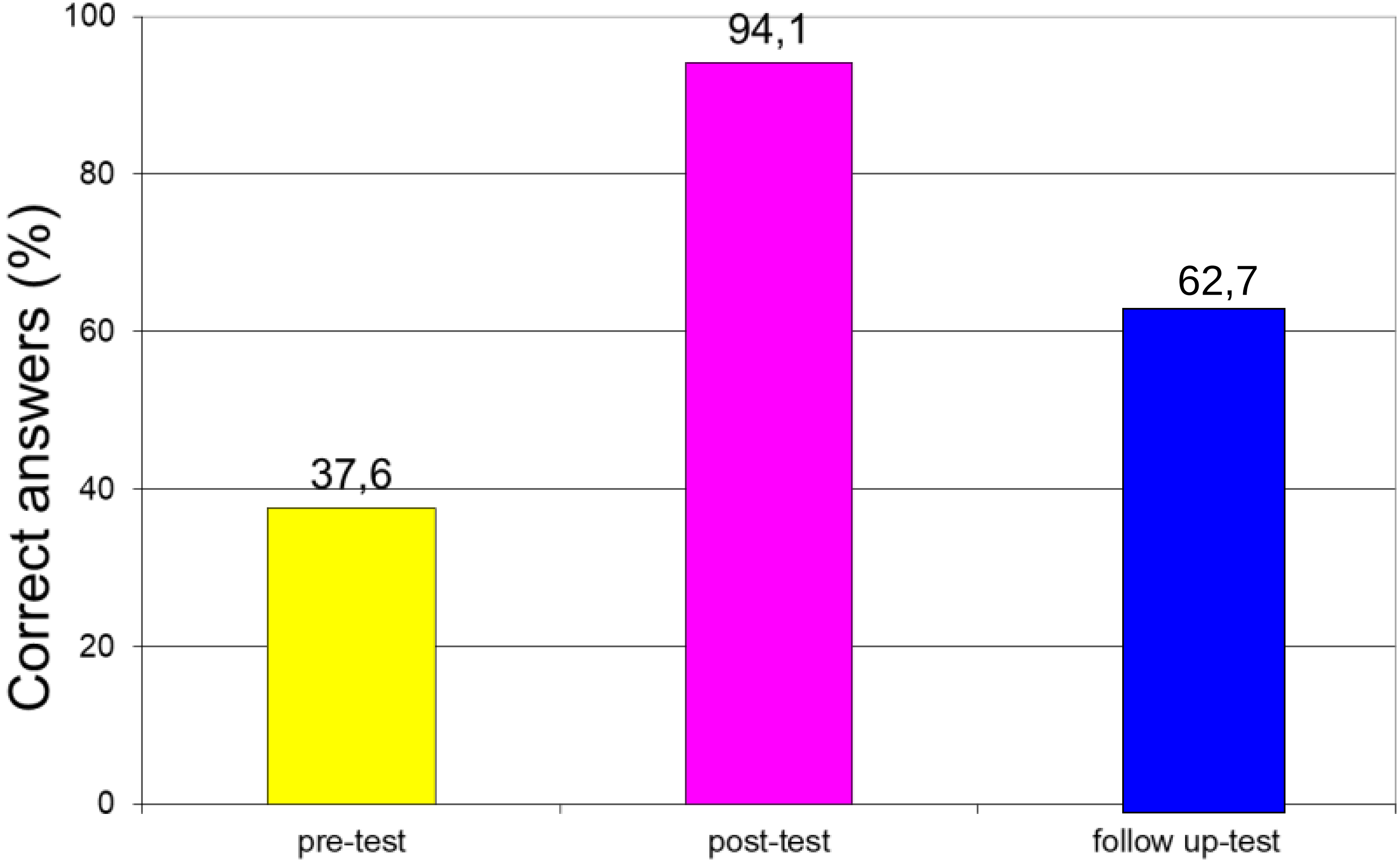
Education

Task management



Cavicchiolo ME et al. Resuscitation 2018

Neonatal resuscitation course for Pediatric Residents
(CORRECT ANSWERS)



Trevisanuto et at, Pediatr Anesth 2005

Conclusions

- Guidelines are based on the ILCOR Consensus on Science
- Hypothermia/hyperthermia are associated with mortality and morbidity
- Low Oxygen concentrations (21-30%) seem reasonable (saturation target a 5 min is the goal)
- CPAP instead of intubation is suggested
- CPAP vs LISA/INSURE needs to be assessed
- SLI is not recommended
- Delayed cord clamping (after breathing) seems to be the best choice
- Milking does not seem to be recommended
- Optimal frequency and contents of training remain to be established

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Thanks...

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Guidelines 2020

- initial O2 for term and preterm infants
- management of infants born through MSAF