The Golden Hour: Stabilization of the High-risk Neonate at Birth

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- I have no financial relationships to disclose
- I will not be discussing off-label applications for devices or pharmaceuticals

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- Other families

The Need

- Neonatal intensive care should begin immediately after birth
- Inconsistency of practice (‘dealer’s choice’)
- “Seeds of neonatal morbidity are sown in the delivery room”

Neonatal Resuscitation: Schultze method

Arch Dis Child Fetal Neonatal Ed 2006;91:F369–F373.

Monitoring / Management in the DR

- Need to ‘raise the bar’
- Neonatal intensive care should begin immediately after birth
- Incorporation of intensive care environment in the DR could improve outcomes
- Routine pulse oximetry
- Ventilator in the DR might be helpful
- Tidal volume monitoring?

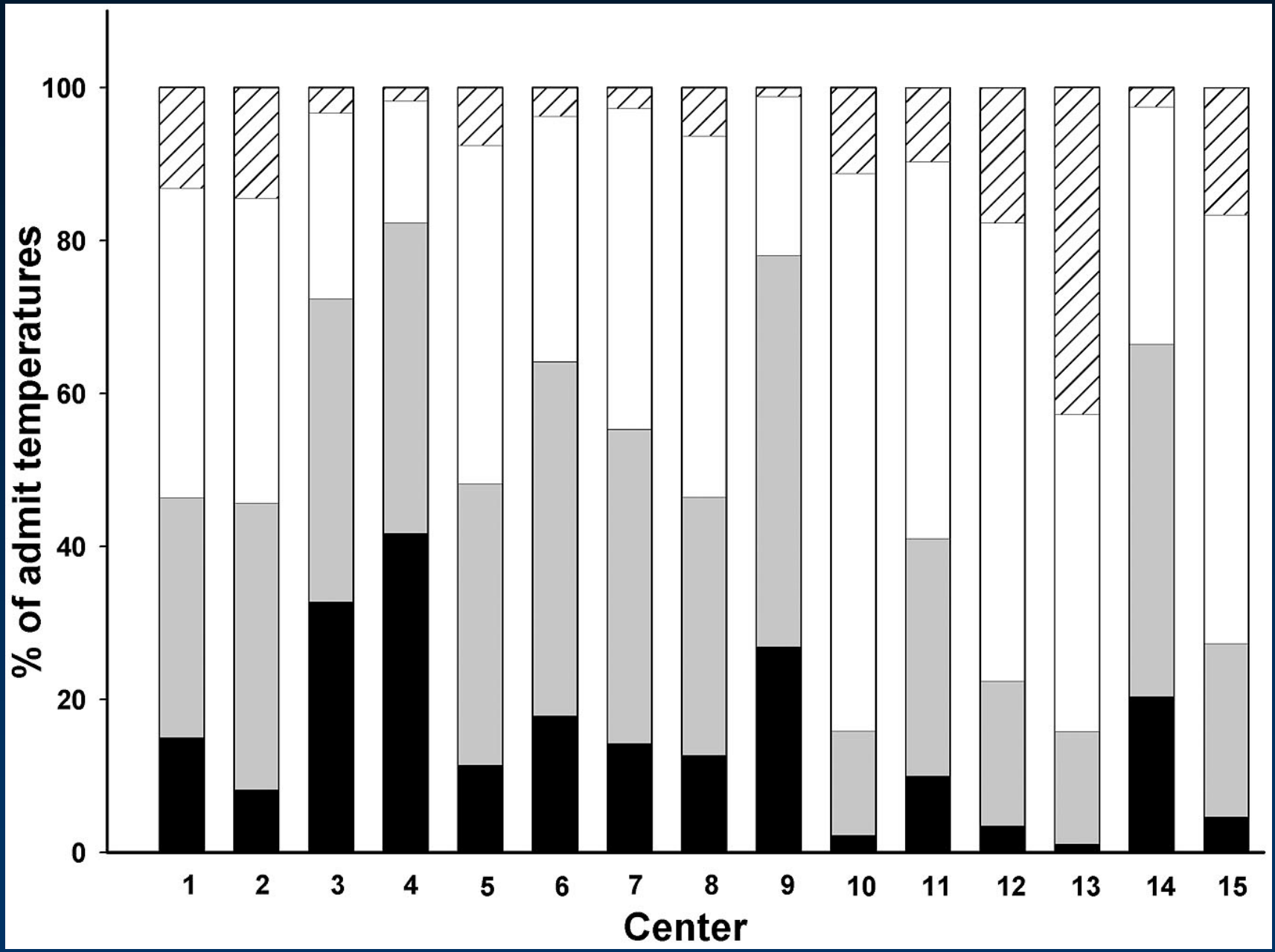
Vento et al . *Pediatrics 2008;122;1113-1116*

Five Domains

1. Learning system. Performance monitoring and project management
2. The baby
3. The family
4. The stabilization team
5. Physical environment of delivery room


Neonatal Resuscitation Program™ - Reference Chart
Standby


SMART Board
LeCroix

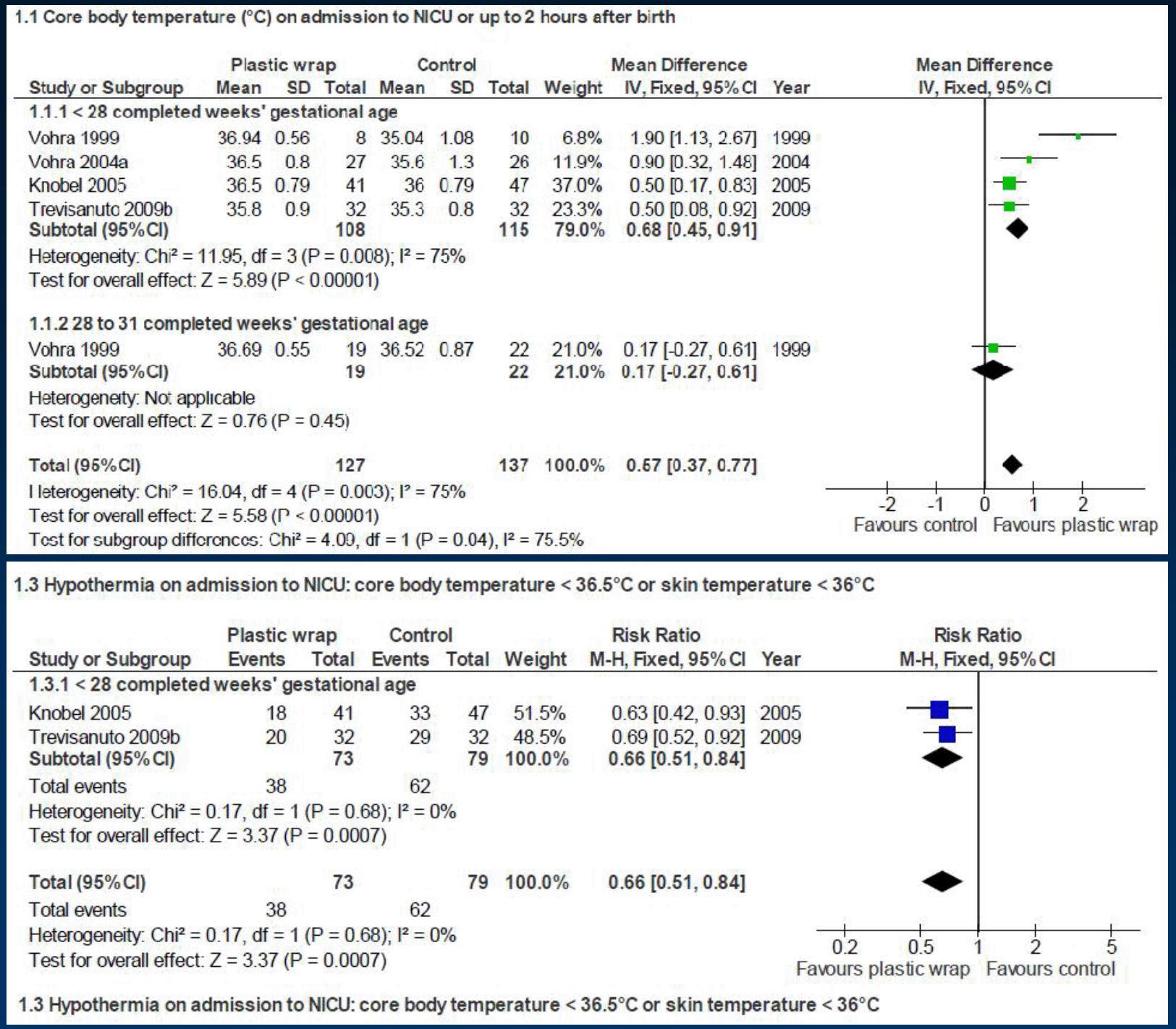


< 35, 35 – 35.9, 36 – 36.9, ≥ 37 deg C

Laptook et al. Pediatrics 2007

Study	NICU Admissions	Frequency of Admission Hypothermia	OR (95% CI) of Mortality
Epicure study (UK)	< 25 weeks 811 babies	40% below 35 C	1.72 (1.17, 2.56)
Laptook et al (USA)	< 1500 g 5277 babies	47% below 36.0 C 14% below 35.0 C	OR rose 1.28 (1.16, 1.41) per 1 C fall
Malaysian VLBW study group	< 1500 g 868 babies	33% below 36.5 C	1.26 (1.06, 1.50)
da Mota Silveira et al (Brazil)	320 babies born at home and admitted	32% below 36.5 C	3.09 (2.15, 4.43)

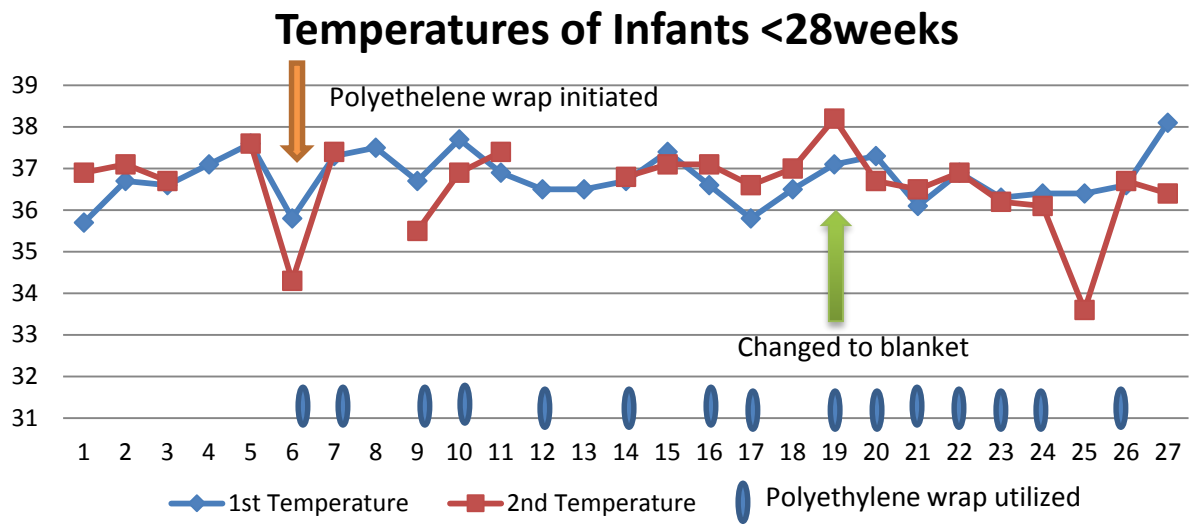
McCall et al. Cochrane Review 2010



Temperature Maintenance

- Pre-heated radiant warmer
- Temperature of delivery room at 77 deg F
- Plastic wrap if ≤ 28 weeks gestation
- Chemical mattress
- Measure infant temperature by ten minutes
- Place infant on servo ASAP

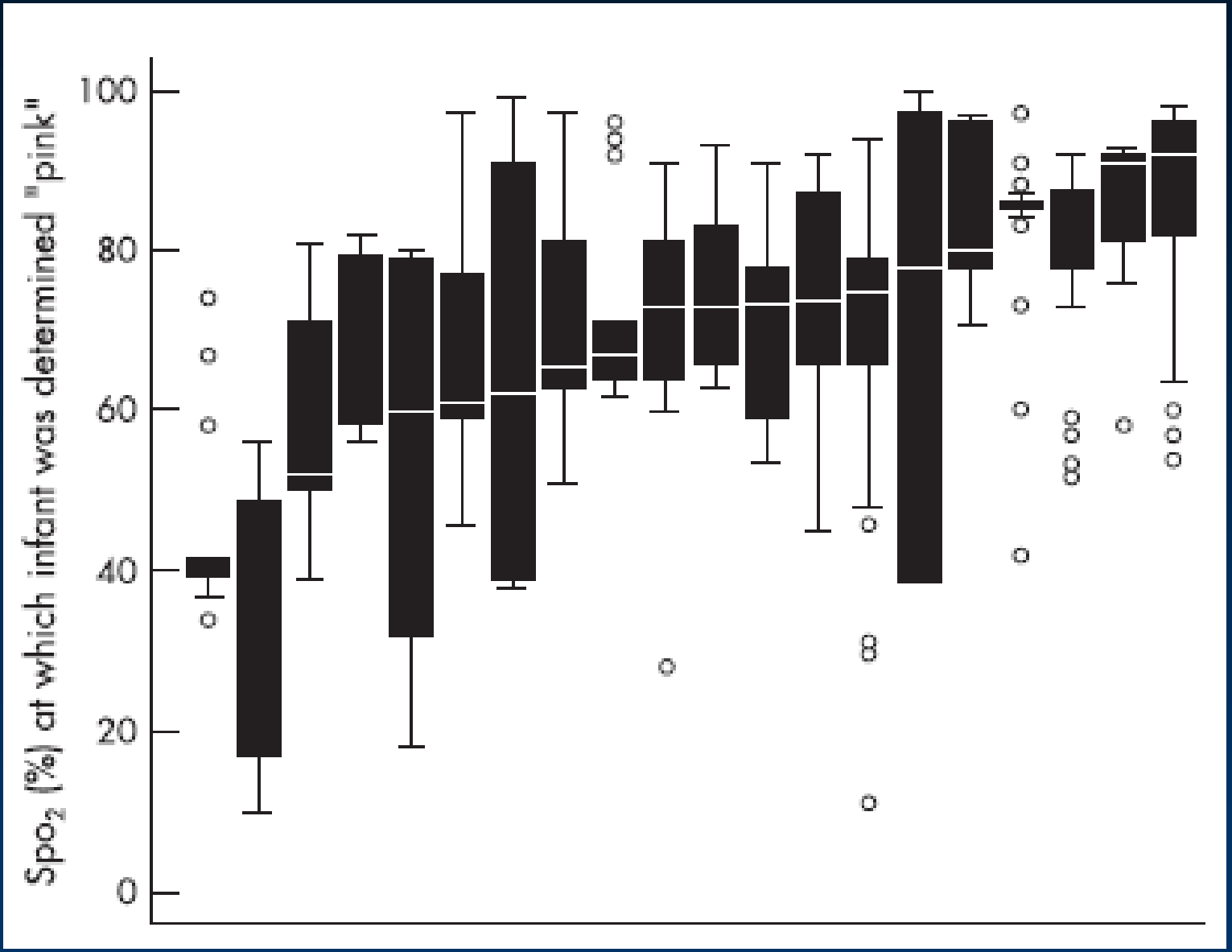
Temperature Management



Polyethylene wrap

Polyethylene blanket

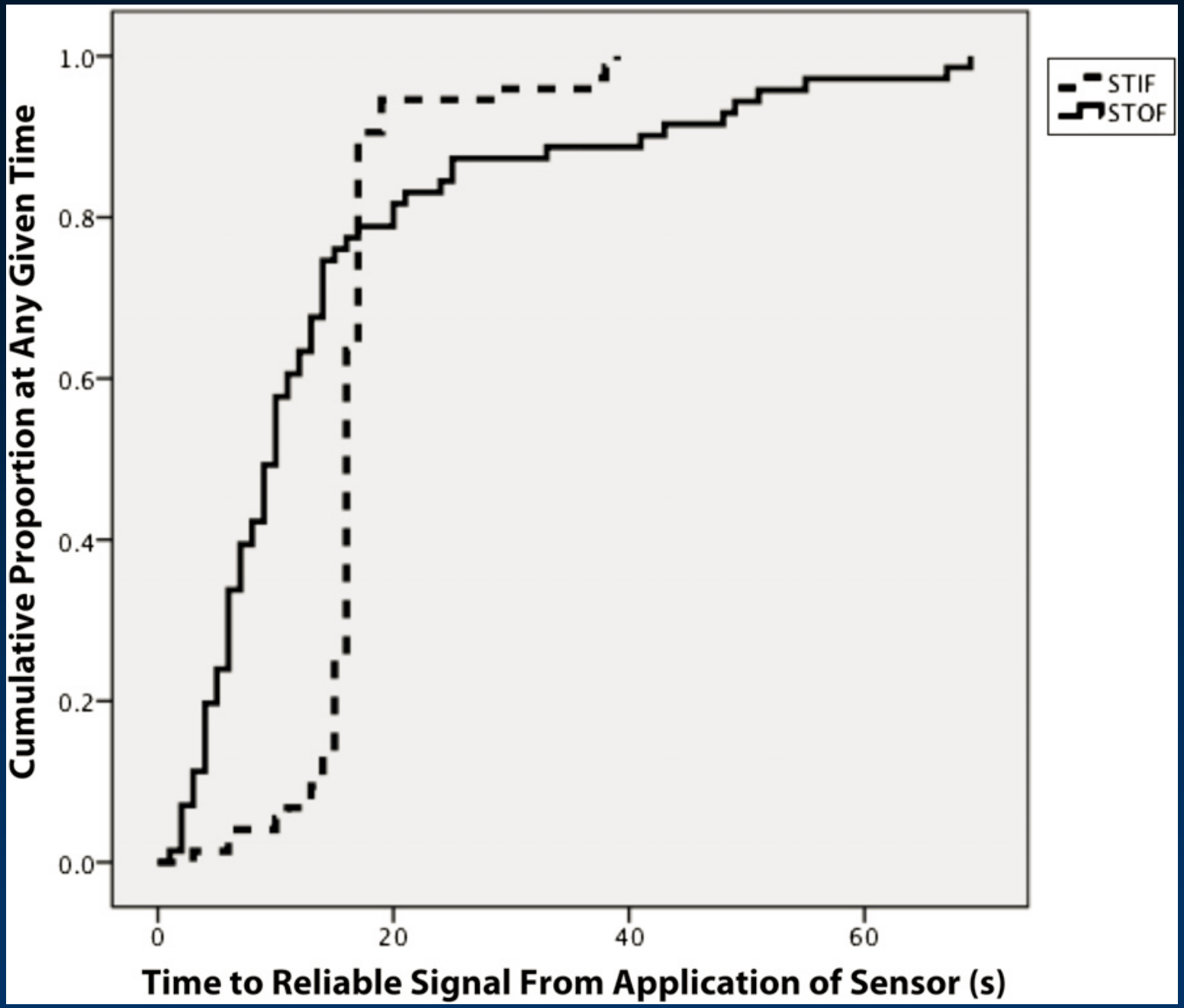
Color Assessment at Birth



O'Donnell et al. Arch Dis Child Fetal Neonatal Ed 2007;92:F465–F467

Pulse Oximetry Monitoring

- Pulse oximeter probe on right hand
- Correct sequence: place on hand first, then connect to monitor
- Saturation reading within 2 min
- ‘Black hand’ noted on videos



Louis et al Pediatrics 2014

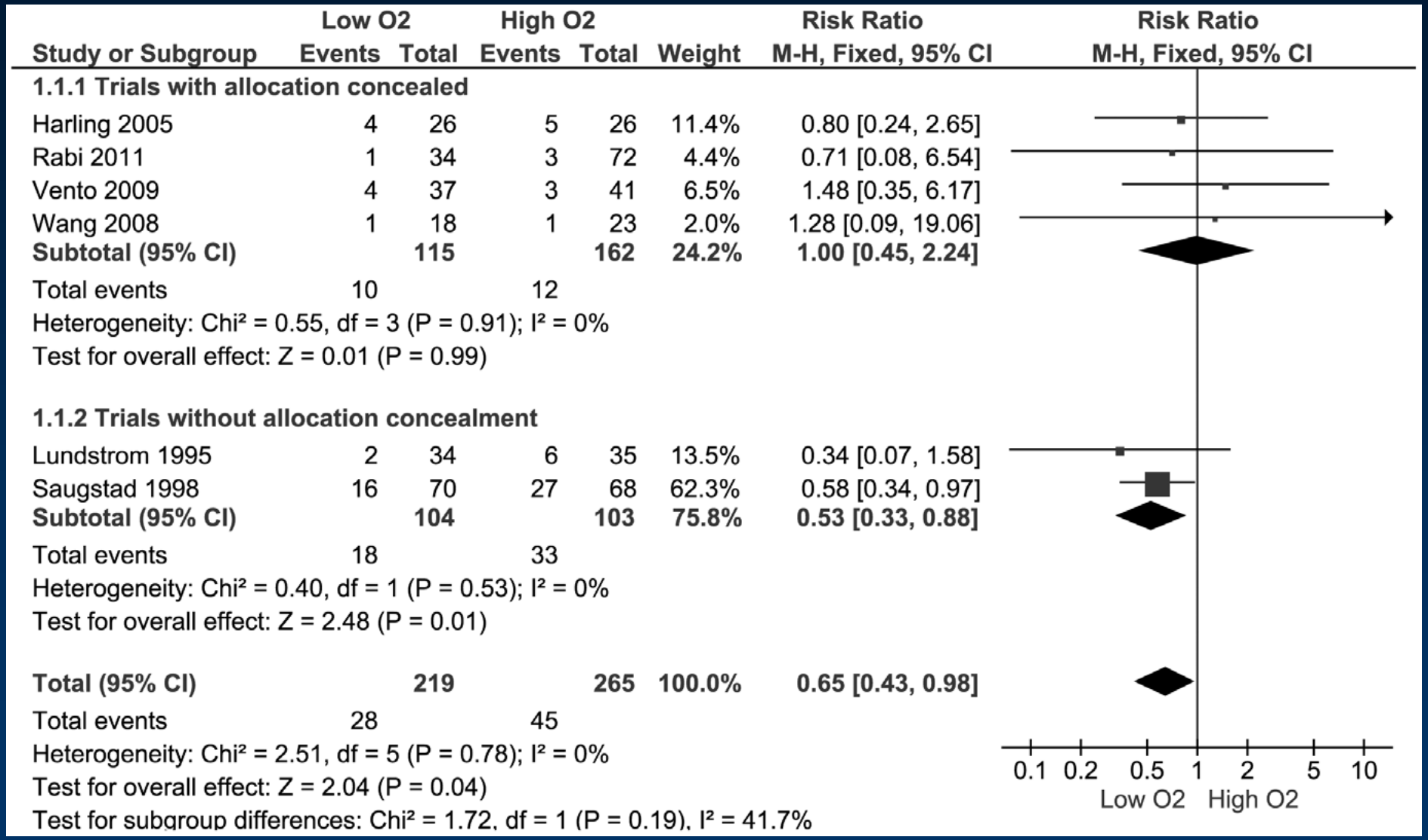
Room Air vs 100% O_2 in Term Infants Effect on Mortality

Study or subgroup	Treatment events	Treatment total	Control events	Control total	Weight	Risk ratio M-H, fixed, 95% CI
Randomized trials						
Toma, 2006 [15]	0	27	0	27		Not estimable
Toma, 2006 [16]	0	20	0	24		Not estimable
Toma, 2007 [17]	1	30	2	26	1.6%	0.43 (0.04, 4.51)
Vento, 2001 [9]	1	300	7	237	5.9%	0.11 (0.01, 0.91)
Vento, 2003 [10]	1	55	2	51	1.6%	0.46 (0.04, 4.96)
Vento, 2005 [13]	2	17	4	22	2.6%	0.65 (0.13, 3.13)
Subtotal (95% CI)		449		387	11.7%	0.32 (0.12, 0.84)
Total events	5		15			
Heterogeneity: $\chi^2 = 1.87$, d.f. = 3 (p = 0.60), $I^2 = 0\%$						
Test for overall effect: Z = 2.30 (p = 0.02)						
Quasi-randomized trials						
Bajaj, 2005 [14]	17	107	17	97	13.5%	0.91 (0.49, 1.67)
Ramji, 1993 [7]	3	42	4	42	3.0%	0.75 (0.18, 3.15)
Ramji, 2003 [11]	24	204	39	214	28.8%	0.65 (0.40, 1.03)
Saugstad, 1998 [8]	40	280	60	311	43.0%	0.74 (0.51, 1.07)
Subtotal (95% CI)		633		664	88.3%	0.74 (0.57, 0.95)
Total events	84		120			
Heterogeneity: $\chi^2 = 0.74$, d.f. = 3 (p = 0.86), $I^2 = 0\%$						
Test for overall effect: Z = 2.35 (p = 0.02)						
Total (95% CI)		1,082		1,051	100.0%	0.69 (0.54, 0.88)
Total events	89		135			
Heterogeneity: $\chi^2 = 4.16$, d.f. = 7 (p = 0.76), $I^2 = 0\%$						
Test for overall effect: Z = 2.98 (p = 0.003)						

Saugstad et al. Neonatology 2008;94:176–182

Low vs High (>50%) O_2 in Preterms

Effect on Mortality prior to Hospital Discharge



Study or Subgroup	Low O2 Events	Low O2 Total	High O2 Events	High O2 Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.1.1 Trials with allocation concealed						
Harling 2005	4	26	5	26	11.4%	0.80 [0.24, 2.65]
Rabi 2011	1	34	3	72	4.4%	0.71 [0.08, 6.54]
Vento 2009	4	37	3	41	6.5%	1.48 [0.35, 6.17]
Wang 2008	1	18	1	23	2.0%	1.28 [0.09, 19.06]
Subtotal (95% CI)		**115**		**162**	**24.2%**	**1.00 [0.45, 2.24]**
Total events	10		12			
Heterogeneity: Chi² = 0.55, df = 3 (P = 0.91); I² = 0%						
Test for overall effect: Z = 0.01 (P = 0.99)						
1.1.2 Trials without allocation concealment						
Lundstrom 1995	2	34	6	35	13.5%	0.34 [0.07, 1.58]
Saugstad 1998	16	70	27	68	62.3%	0.58 [0.34, 0.97]
Subtotal (95% CI)		**104**		**103**	**75.8%**	**0.53 [0.33, 0.88]**
Total events	18		33			
Heterogeneity: Chi² = 0.40, df = 1 (P = 0.53); I² = 0%						
Test for overall effect: Z = 2.48 (P = 0.01)						
Total (95% CI)		**219**		**265**	**100.0%**	**0.65 [0.43, 0.98]**
Total events	28		45			
Heterogeneity: Chi² = 2.51, df = 5 (P = 0.78); I² = 0%						
Test for overall effect: Z = 2.04 (P = 0.04)						
Test for subgroup differences: Chi² = 1.72, df = 1 (P = 0.19), I² = 41.7%						

Brown et al PLoS ONE 7(12): e52033

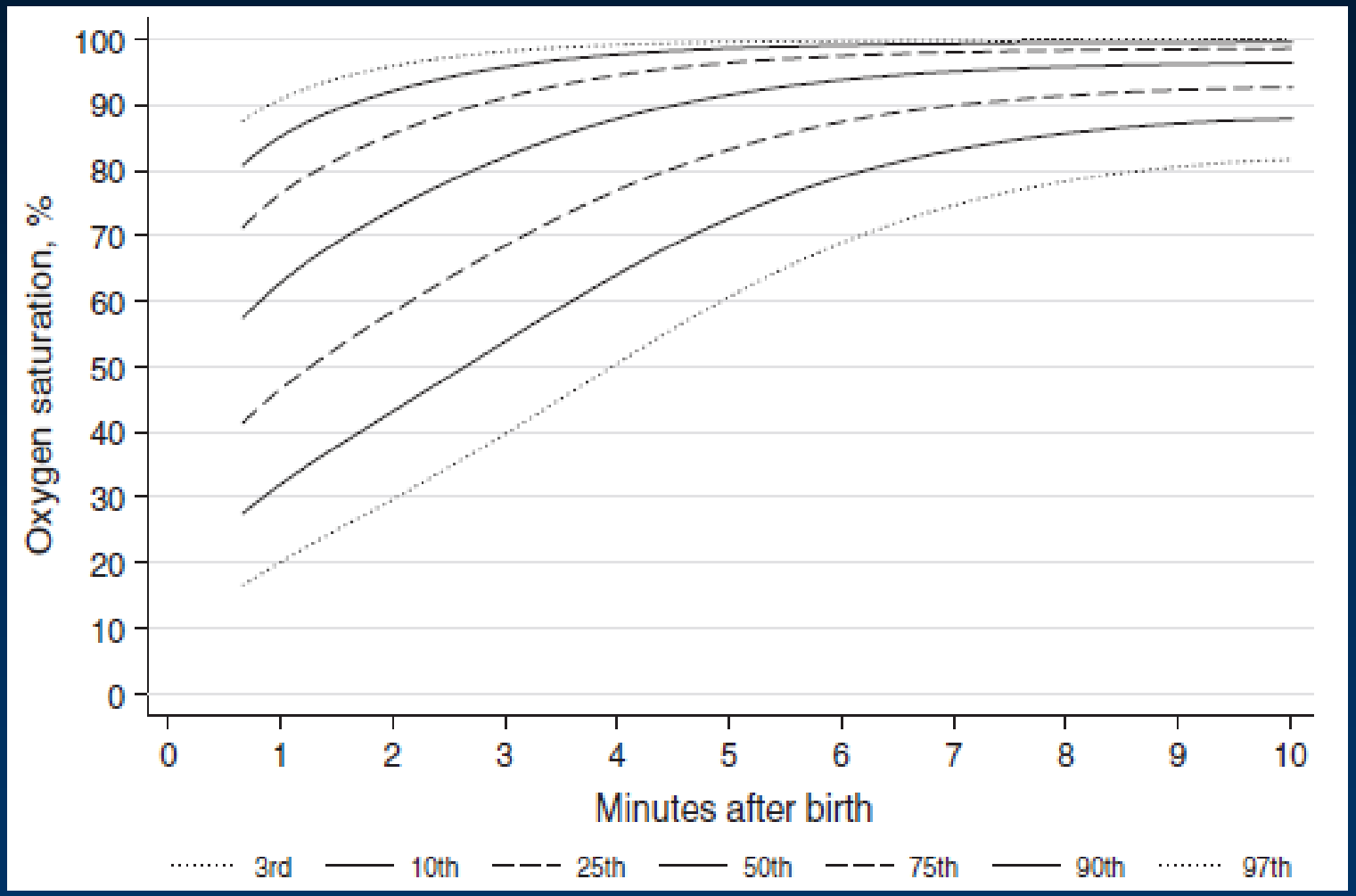
Low vs High (>50%) O_2 in Preterms
Additional Randomized Trials

- Vento 2009 [30 vs 90%]: Less ventilator days, duration of O2 supplementation & BPD
- Kapadia 2013 [room air vs 100%]: less oxidative stress and less BPD
- Rook 2014 [30 vs 65%]: no difference in oxidative stress or BPD
- No long-term follow up in any trial so far

Oxygen Management

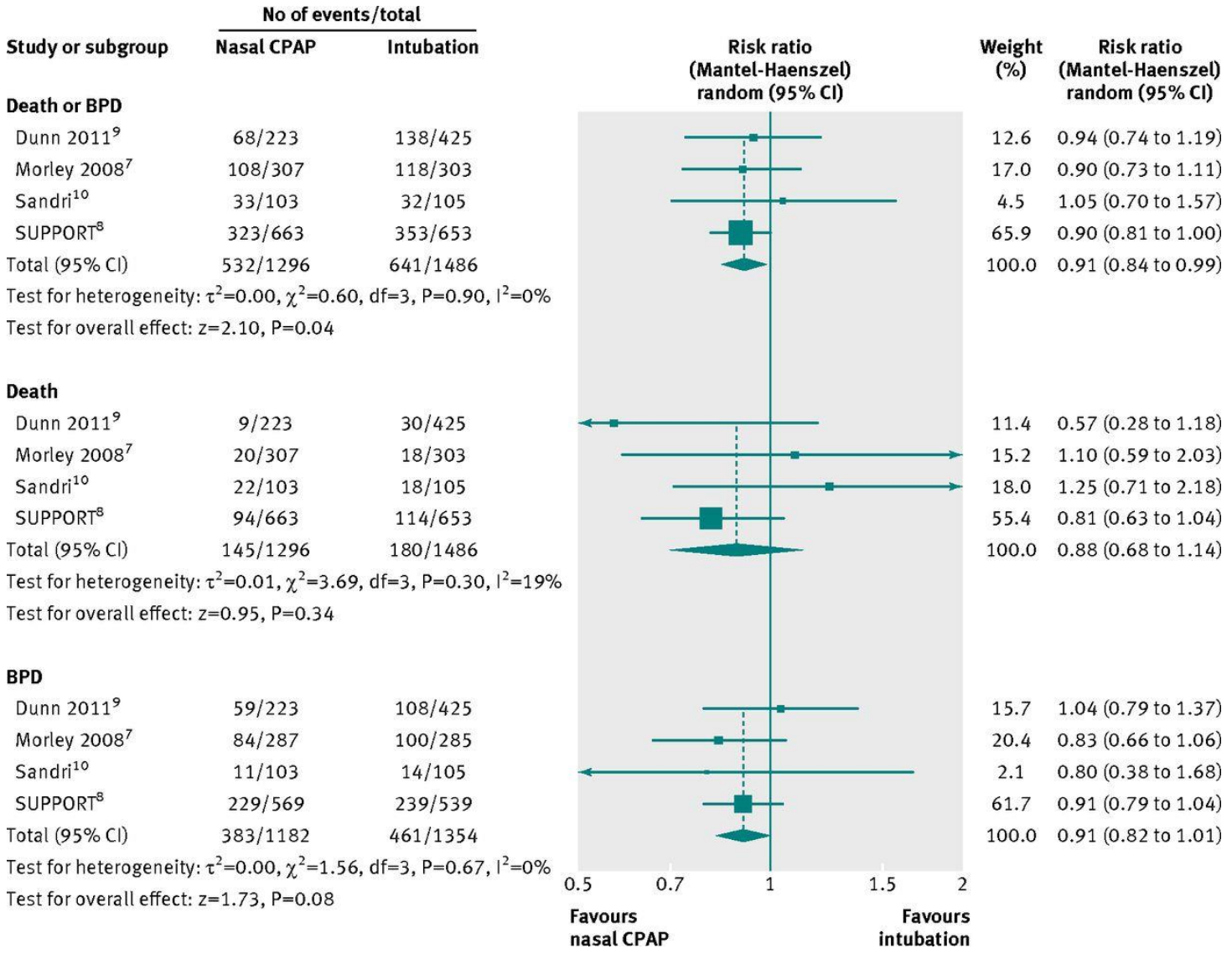
- Starting FiO2 of 0.4 for preterm infants
- Use FiO2 1.0 if baby not responding
- Prevent rapid increase of oxygen saturation
- Target O_2 saturation:
  - 80-85% at five min, 85-95% at ten min

Oxygen Saturation Percentiles for All Infants with No Medical Intervention

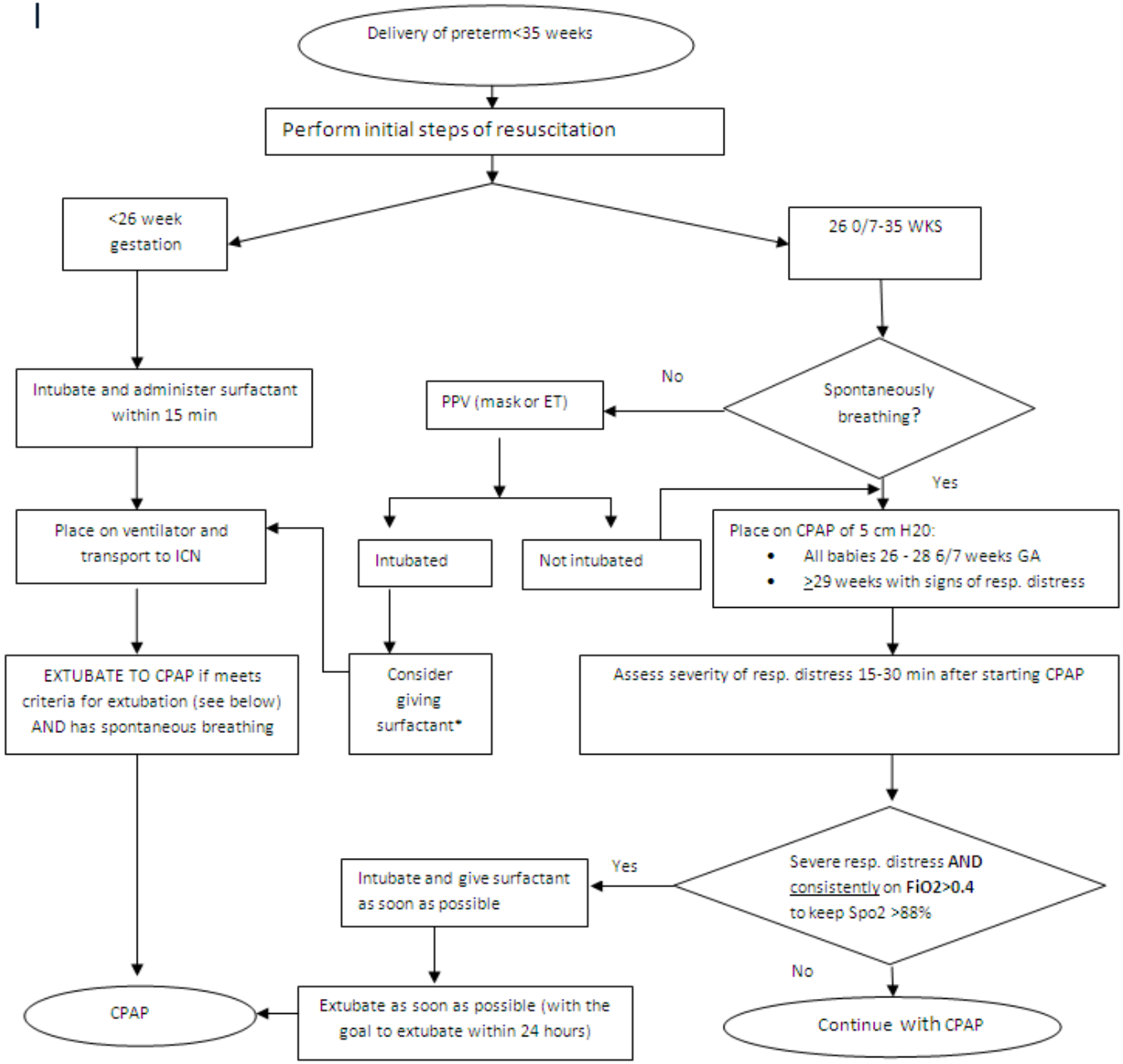


Dawson et al. *Pediatrics* 2010;125:e1340–e1347

Fig 2 Forest plot comparison of death or bronchopulmonary dysplasia (BPD), or both, at 36 weeks corrected gestation; death; and bronchopulmonary dysplasia at 36 weeks corrected gestation.



Schmölzer G M et al. BMJ 2013;347:bmj.f5980

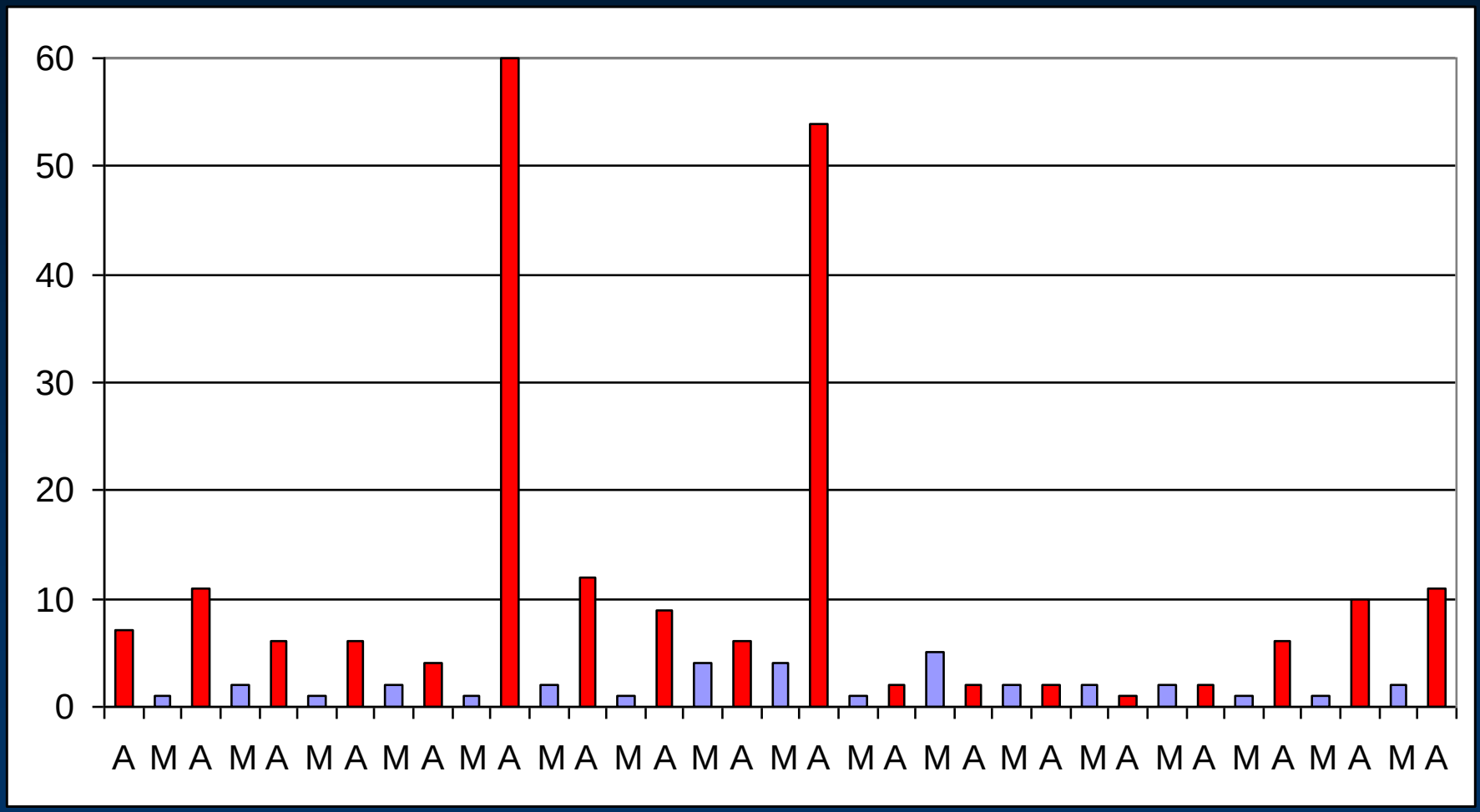


*Babies who are intubated for respiratory depression only or for apnea (without lung disease) may not need surfactant. An example is a baby whose mother received magnesium sulfate

Hudson Prongs

Ram Cannula

Manual PPV during Resuscitation: Looking at Manometer vs Elsewhere Total time: 245 secs; Manometer: 34 secs (14%)




NEOPUFF
Fisher & Paykel
310

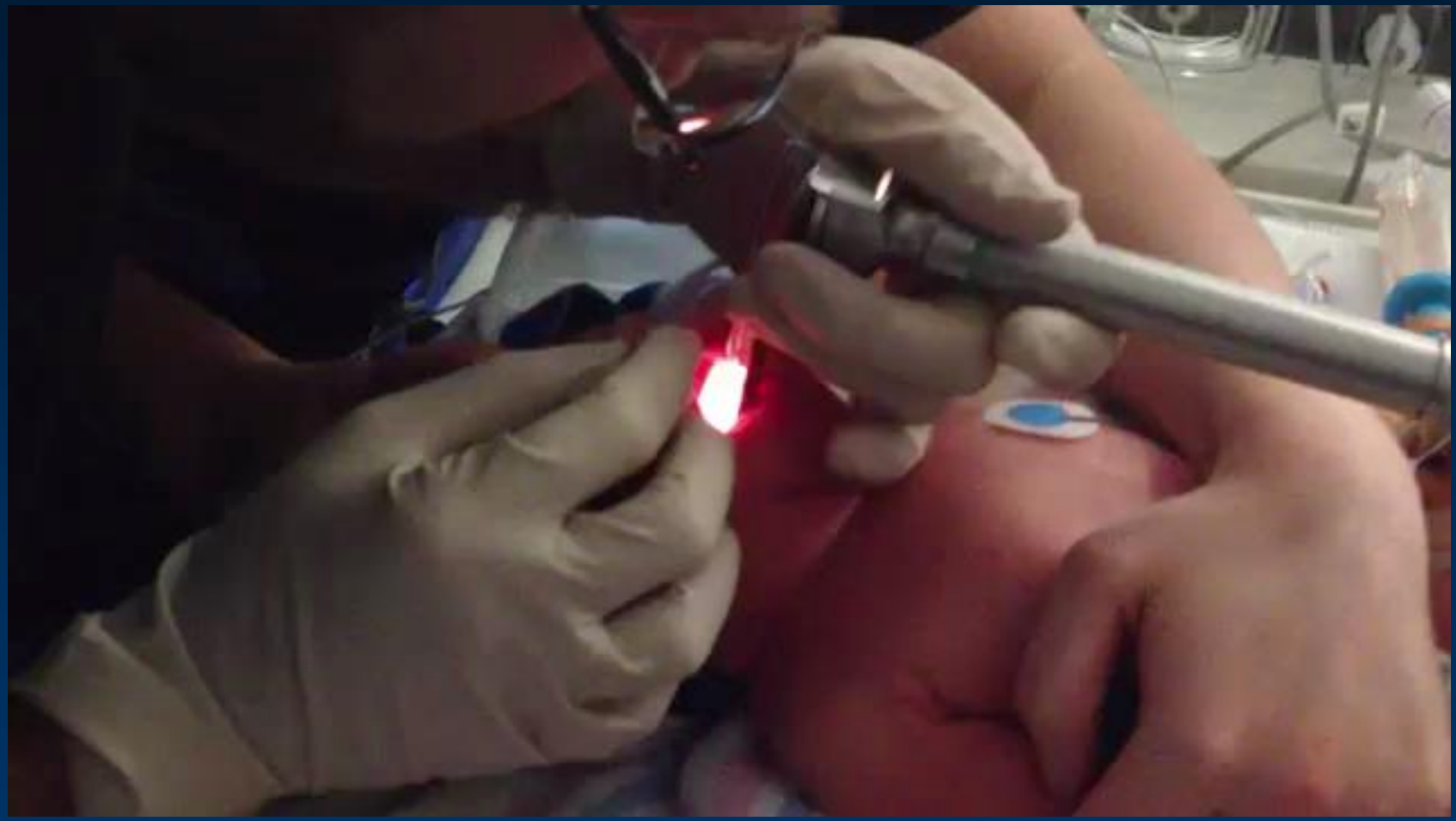
Wood FE, et al. Arch Dis Child Fetal Neonatal Ed 2008;93:F230e4.

Wilson EV, et al. Arch Dis Child Fetal Neonatal Ed 2013;0:F1–F3.

Intubation Safety

- Use bag mask ventilation as safety net
- No inexperienced intubators
- Two attempts per intubator
- 30 seconds per intubator
- State intubation indicators loudly and explicitly
- Call for back-up early - Stat airway team
- Psychology of intubation

Minimally Invasive Surfactant Therapy



Cardiovascular Support

- Measure HR per NRP and announce a number loudly
- Auscultation needs silence, quiet environment
- Nurses sometimes not confident about auscultated heart rate
- Avoid chest compressions without adequate ventilation

Radetzky March

Case Report

Severe Hemorrhage from the Umbilical Cord at Birth: A Preventable Cause of Neonatal Shock

Neetu Singh and Gautham Suresh

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Academic Editors: C. Aldana-Valenzuela, W. B. Moskowitz, J. Muraskas, and I. Riaño Galán

Posthemorrhagic anemia is a rare but important cause of anemia in neonates, second only to hemolytic anemia of newborn. Most cases of posthemorrhagic anemia are reported from fetomaternal hemorrhage or umbilical cord accidents in utero. This case report describes a preterm infant who developed severe anemia and shock immediately after delivery related to an acute hemorrhage through patent umbilical cord vessels secondary to a tear in the umbilical cord at the site of cord clamping. We believe that umbilical cord bleeding from errors in cord clamping could be an important cause of acute blood loss in the delivery room and that it may result in significant clinical morbidity, especially in extremely premature infants.

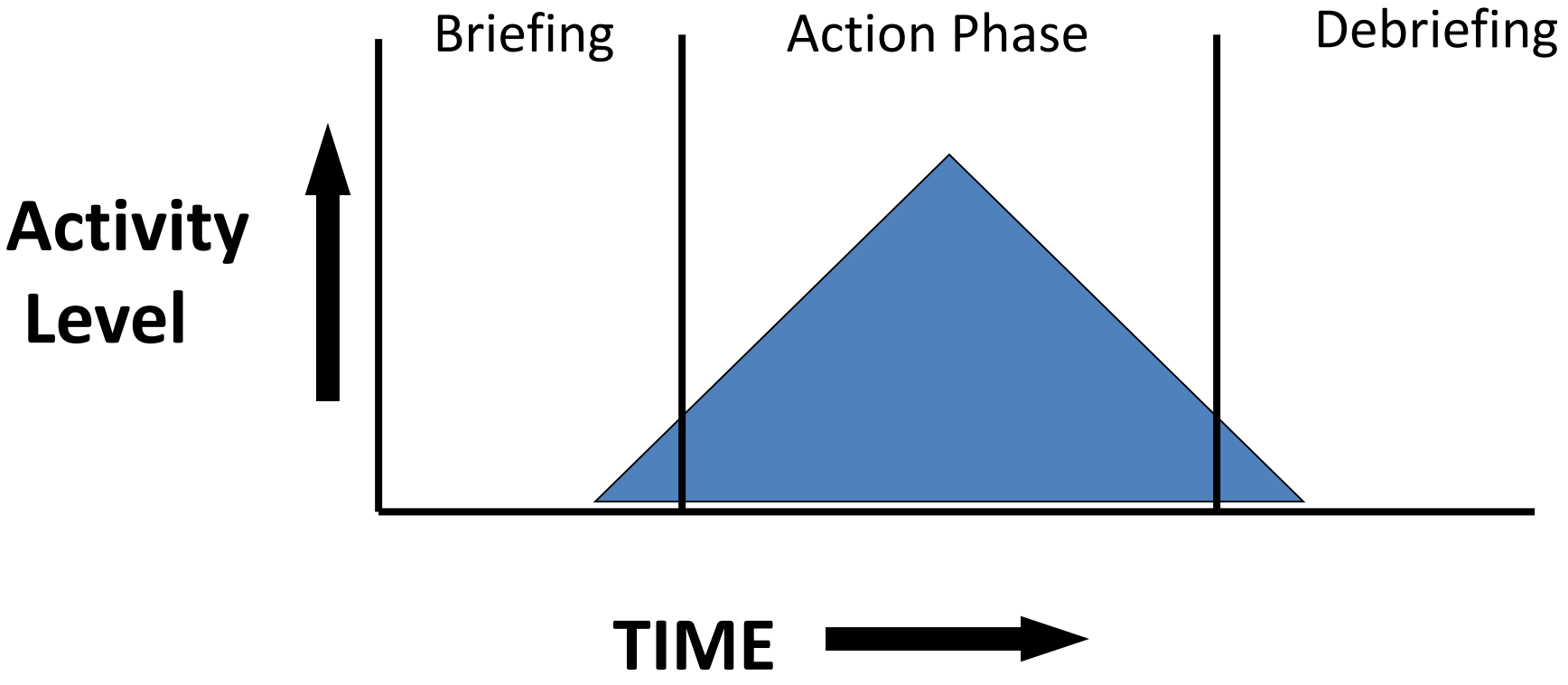
Family Support During Resuscitation

- Briefing : assign family support person
- Training for family support person
  - Scripted statements
  - Simulations
- Involve family members in development of practices, policies and in training
- ‘My birth story’ cards


THE SATURDAY
EVE POST
Samuel M. Vauclain—William Hazlett Upson—James Warner Bellah
Wesley Stout—Eleanor Hoyt—Samuel Crowther—Booth Tarkington

Teamwork: Temporal Model

Neonatal Resuscitation Team Episode



Modified from Fernandez et al. Acad Emerg Med 2008; 15:1–9

Briefing

- Introduction of team members
- Assignment of roles
- Leadership assignment
- Review of maternal, family details
- Contingency planning
- Equipment check
- Setting of tone and atmosphere for resuscitation
- Use of a checklist

High-risk Resuscitation Checklist

- Prior to all high-risk deliveries
- Assists in briefing, foundation of good teamwork
- Ensures that equipment is available, room setup is optimal, roles are clear, sequence of activities is clear, and contingencies are planned for
- Multiple revisions and refinements over time with experience and reflection

Nurses / LNAs
• PANDA temp set to 77° F
• Radiant warmer on
• Pulse oximeter ready
• Warm blankets OR • Plastic wrap available (for infants ≤ 28 weeks) • Transwarmer if less than 28 weeks
• Suction ready
• Medication dosage sheet available
RCP
• Face mask present, right size
• Laryngoscope present, working
• ET tubes present, appropriate size
• CO2 detector present
• Neopuff set up • Fio2 at 40%
• Ventilator set up
TEAM
• Team leader identified

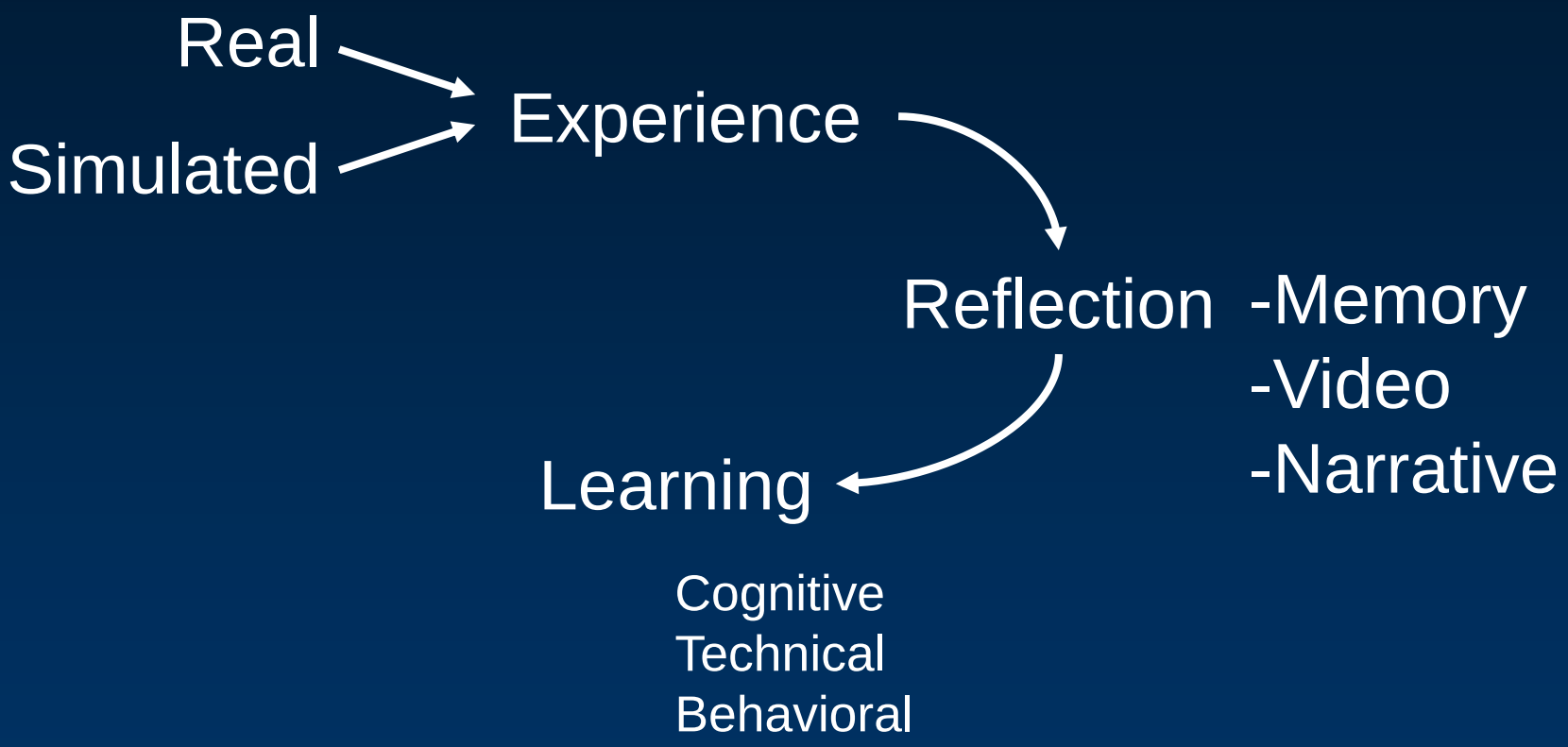
Action Phase

1. **Leadership**
2. **Communication**
3. **Situation monitoring**
4. **Mutual support**

Debriefing

- Should be done after each resuscitation
- Requires facilitator with skill, sensitivity
- Non-judgmental, non-critical approach
- Balance ‘truth versus grace’
- Three open ended questions
  - What went well?
  - What could have been done better?
  - What should we do differently next time?

Simulation Based Training

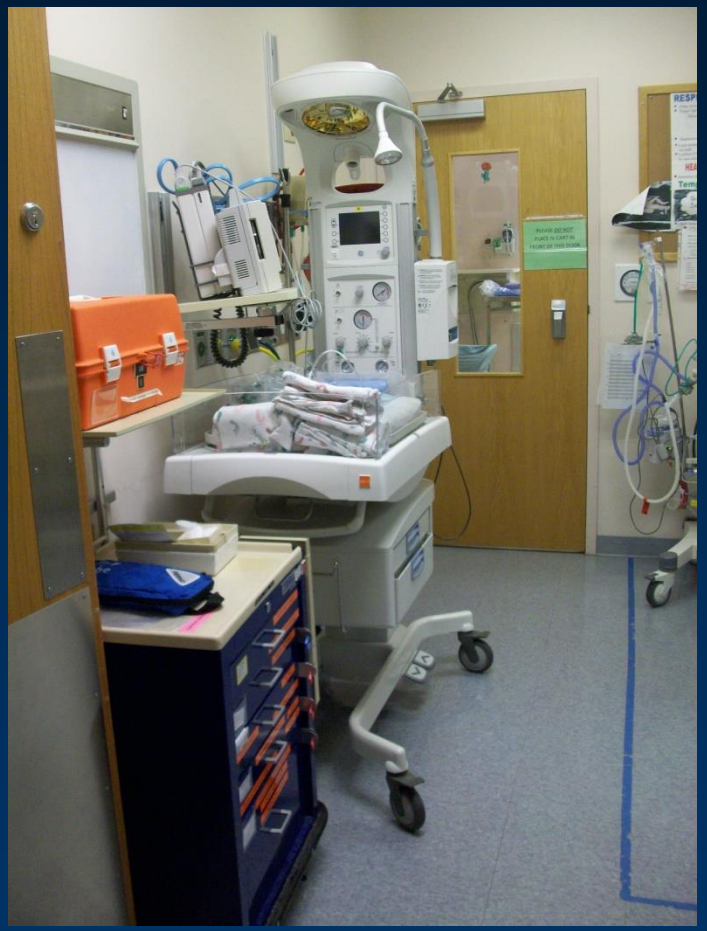


Improvements based on in-situ Simulations

- Weight-based med sheets in code cart
- Code carts redesigned - more user friendly
- Emergency umbilical line placement kit
- Second monitor screen added to be in full view of respiratory therapists

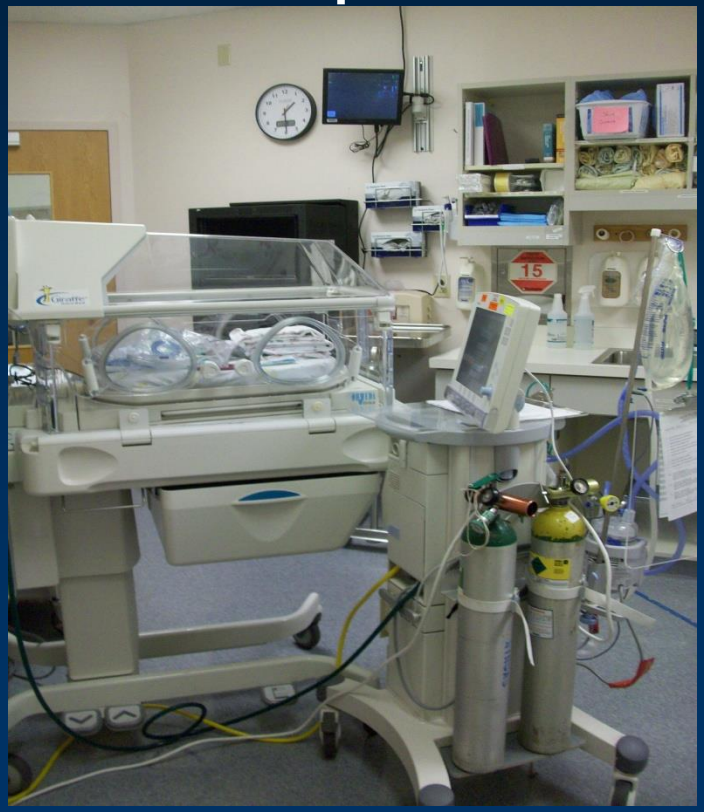
Delivery Room Layout Changes

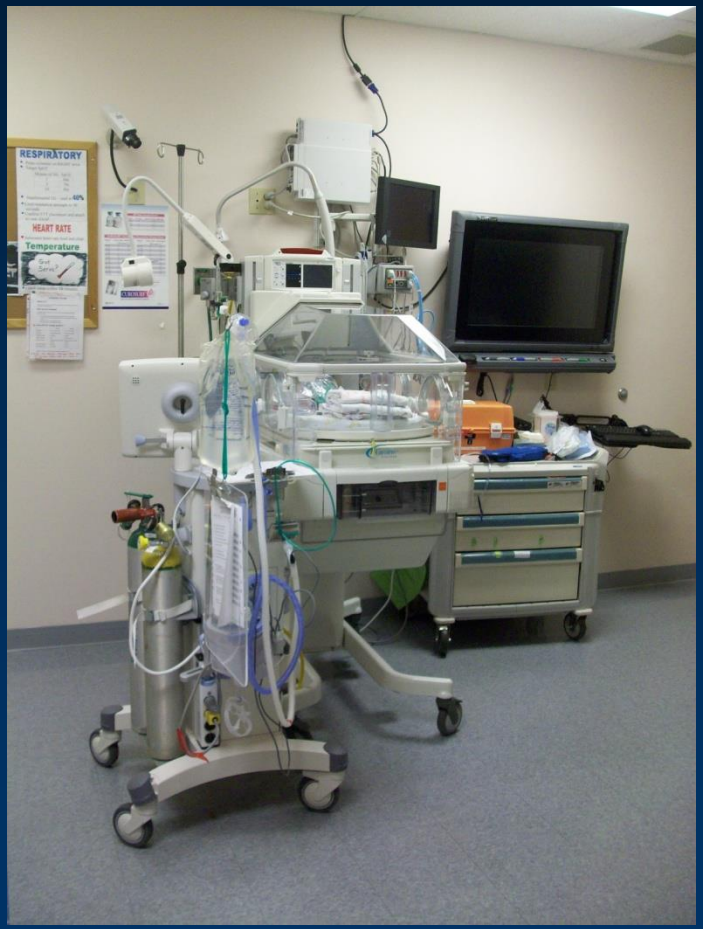
- Bed position



Delivery Room Layout Changes

Ventilator position





Delivery Room Layout Changes

RESPIRATORY

- Pulse oximeter on RIGHT wrist
- Target SpO2

Minute of life	SpO2
1	60s
5	70s
10	80s

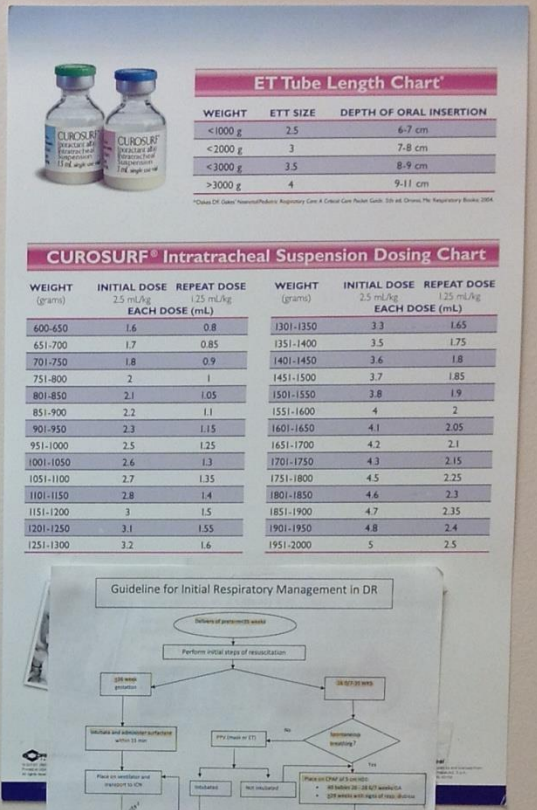
- Supplemental O2 – start at 40%
- Limit intubation attempts to 30 seconds
- Confirm ETT placement and attach to vent ASAP

HEART RATE

- Announce heart rate loud and clear

Temperature

- Check temp within 10 minutes



ET Tube Length Chart*

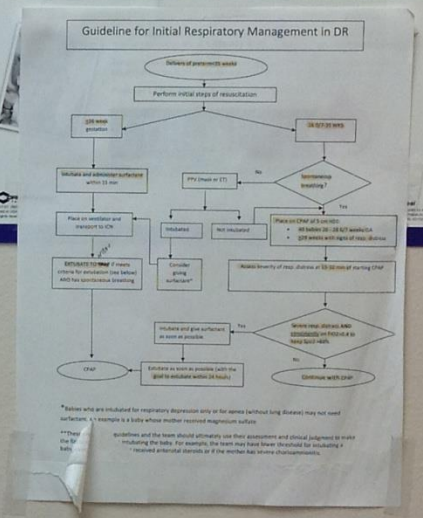
WEIGHT	ETT SIZE	DEPTH OF ORAL INSERTION
<1000 g	2.5	6-7 cm
<2000 g	3	7-8 cm
<3000 g	3.5	8-9 cm
>3000 g	4	9-11 cm

*Chakos DP, Oates' Neonatal/Pediatric Respiratory Care A Critical Care Pocket Guide. 5th ed. Orrono, Me: Respiratory Books; 2004.

CUROSURF® Intratracheal Suspension Dosing Chart

WEIGHT (grams)	INITIAL DOSE 2.5 mL/kg EACH DOSE (mL)	REPEAT DOSE 1.25 mL/kg EACH DOSE (mL)
600-650	1.6	0.8
651-700	1.7	0.85
701-750	1.8	0.9
751-800	2	1
801-850	2.1	1.05
851-900	2.2	1.1
901-950	2.3	1.15
951-1000	2.5	1.25
1001-1050	2.6	1.3
1051-1100	2.7	1.35
1101-1150	2.8	1.4
1151-1200	3	1.5
1201-1250	3.1	1.55
1251-1300	3.2	1.6

WEIGHT (grams)	INITIAL DOSE 2.5 mL/kg EACH DOSE (mL)	REPEAT DOSE 1.25 mL/kg EACH DOSE (mL)
1301-1350	3.3	1.65
1351-1400	3.5	1.75
1401-1450	3.6	1.8
1451-1500	3.7	1.85
1501-1550	3.8	1.9
1551-1600	4	2
1601-1650	4.1	2.05
1651-1700	4.2	2.1
1701-1750	4.3	2.15
1751-1800	4.5	2.25
1801-1850	4.6	2.3
1851-1900	4.7	2.35
1901-1950	4.8	2.4
1951-2000	5	2.5




FIGHT INFECTION
15
SECOND HANDWASH
PRIMON
PRIMON
TRANSWARMER
TRANSWARMER
Kimberly-Clark
Kimberly-Clark
Kimberly-Clark
Pampers
swaddlers
PDI
CLEAN AREA
DIRTY AREA
DO NOT STORE
ANYTHING UNDER SINK
DR 1

FUTURE DIRECTIONS

- Delayed cord clamping / milking
- Neurodevelopmental care in the DR
- Documentation of resuscitation
- Ethics – periviability

Thank you!
QUESTIONS?