

What's New in Obstetric Anesthesia Publications from 2015

Philip Hess, MD

What's new in OB anesthesia?

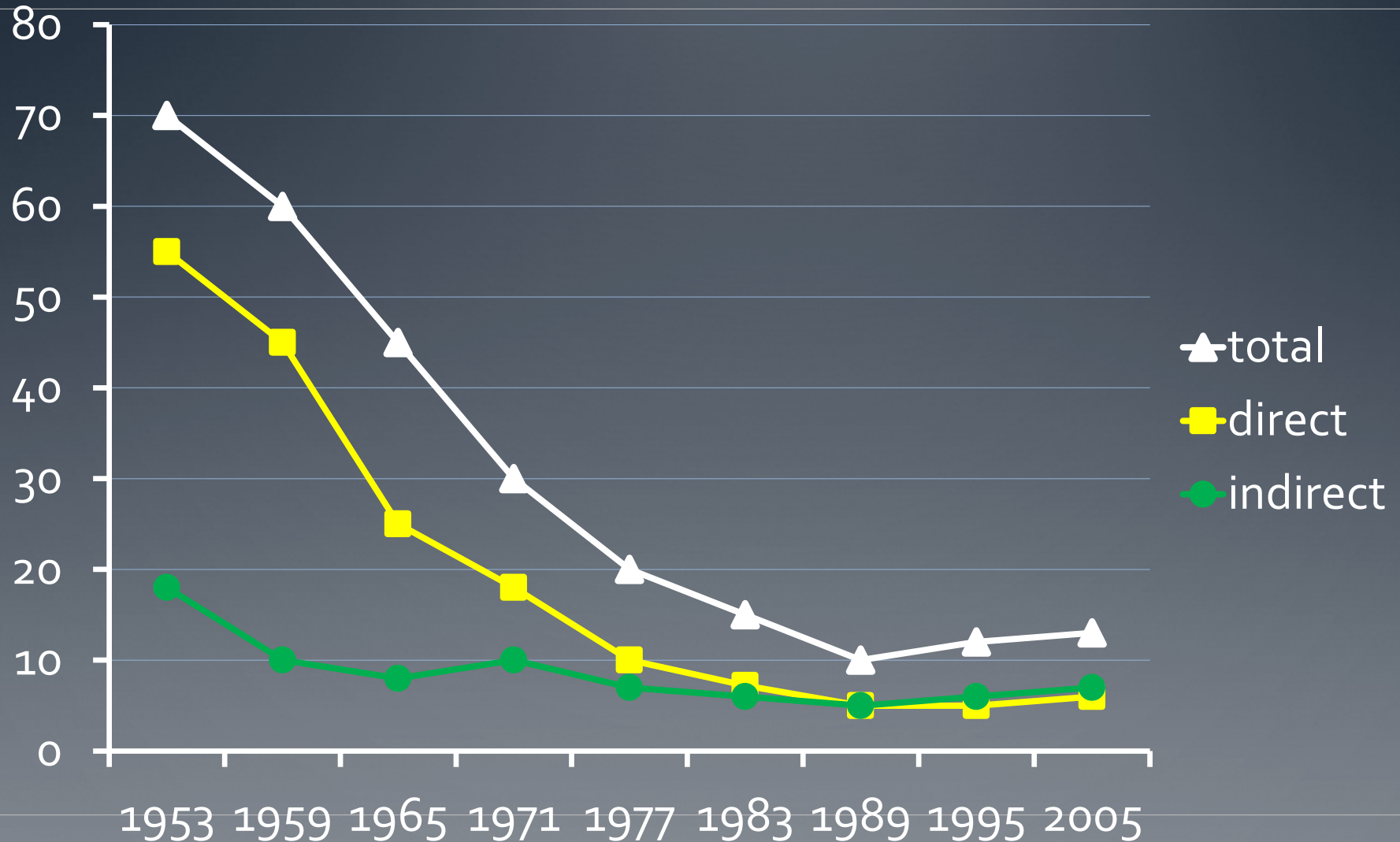
- Mortality and Morbidity
- Cesarean Delivery
- Effects of Anesthesia



Patient Safety

Mortality and Morbidity

Trends US Maternal Mortality



Maternal Mortality

Creanga AA, Berg CJ, Syverson C, et al.
Pregnancy-Related Mortality in the United States, 2006-2010.
Obstet Gynecol 2015;125:5-12

Maternal Mortality

CDC's Pregnancy Mortality Surveillance System

Maternal deaths within one (1) year

10 category Cause-of-death coding

- ACOG and the CDC Maternal Mortality Study Group

Maternal Mortality

20,959,533 live births during 2006–2010

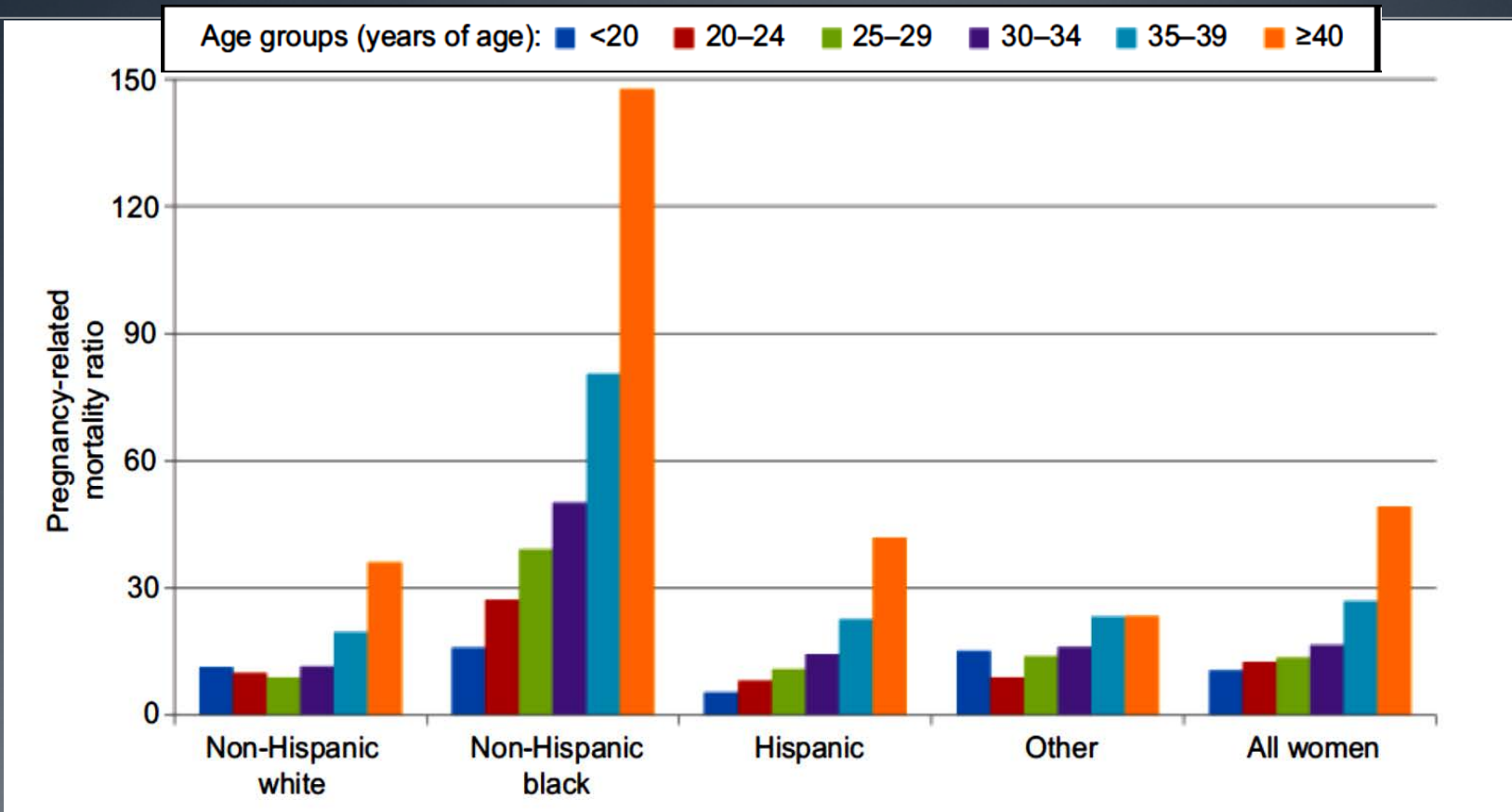
3,358 pregnancy-related (8,645 total deaths)

16.0 deaths per 100,000 live births

- 86.5% within 42 days (13.6 per 100,000)
- 2009: 17.8 deaths per 100,000 live births
 - Obstet Gynecol 2015;126:486-90
 - Increased influenza – related deaths in pregnancy
 - 12 % of all pregnancy-related deaths

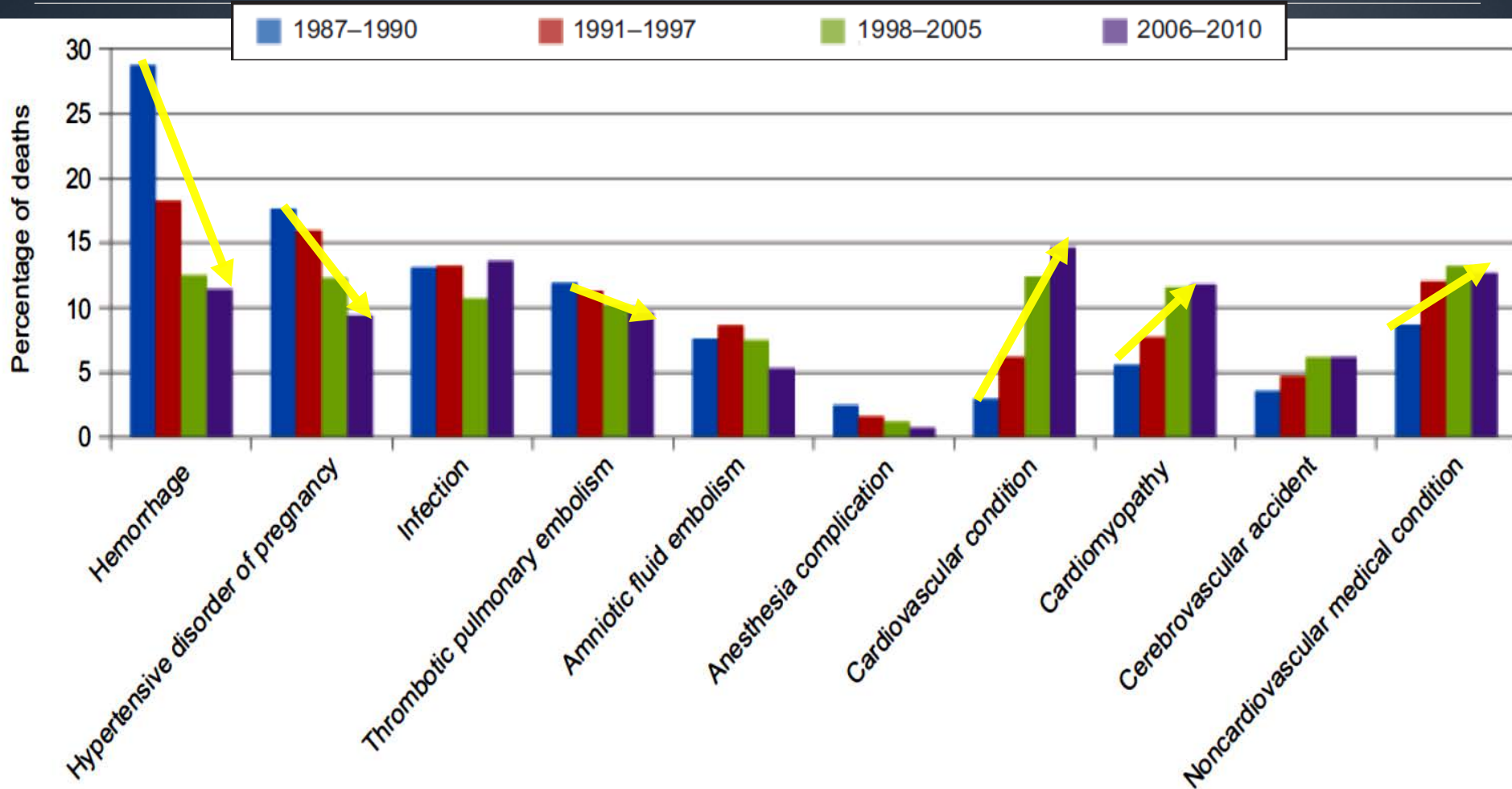
Maternal Mortality

Age



Advanced maternal age (≥ 35 yr): 27.4%

Maternal Mortality



Maternal Mortality

1987 – 1990

- Hemorrhage
- Hypertensive disorders
- Infection
- Embolic

2006 – 2010

- Cardiovascular
- Infection
- Cardiomyopathy
- Medical comorbidity

Preexisting

Acquired

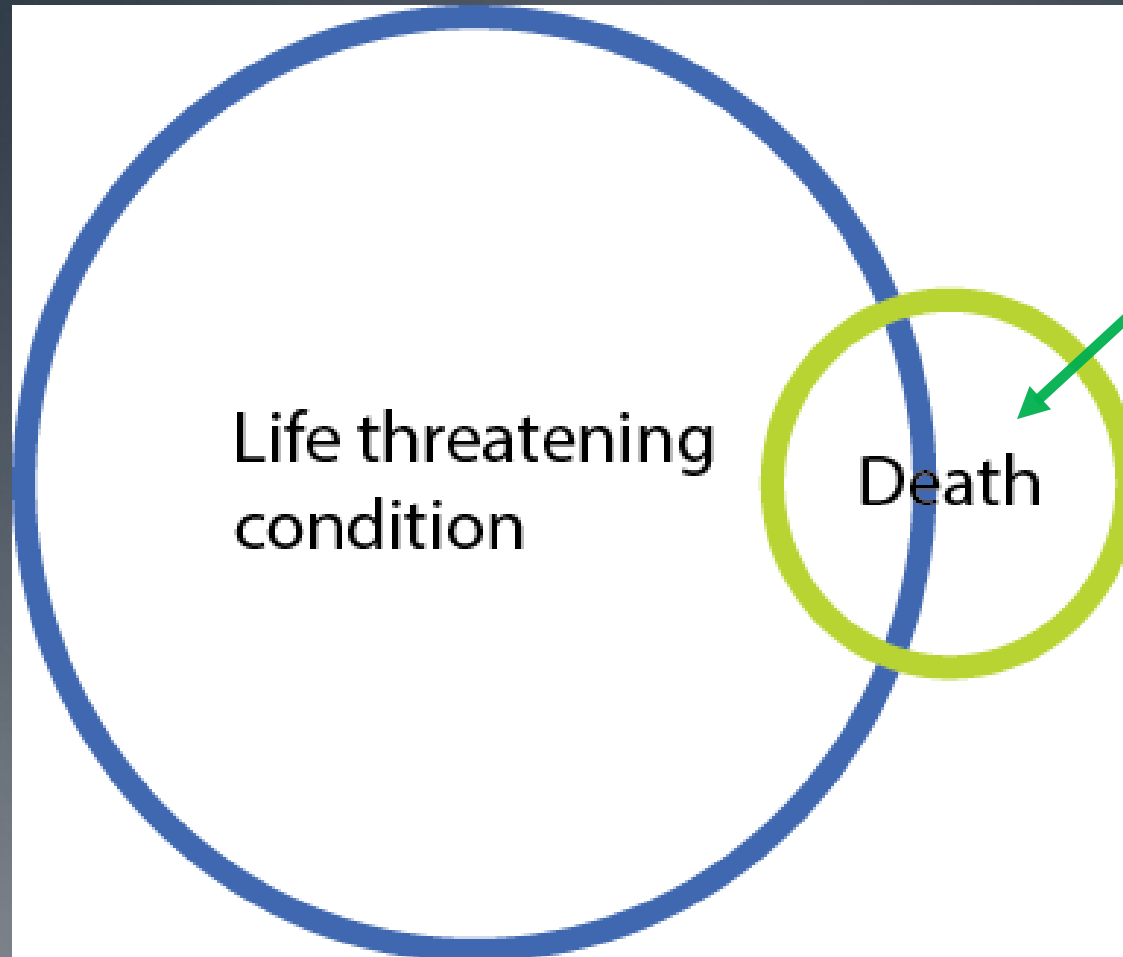
Maternal Mortality – UK

Nair M, Kurinczuk J, Brocklehurst P, et al.

*Factors Associated with Maternal Death from Direct
Pregnancy Complications: A UK National Case-Control Study.*

BJOG 2015;122:653–662

Maternal Mortality – UK



Maternal Mortality – UK

- Unmatched, case-control, retrospective analysis
- Mortality data - MBRRACE-UK database (2009 to 2012)
 - (n=135)
- Life-threatening complications data - UK Obstetric Surveillance System (UKOSS) (2005–2013)
 - (n=1661)

Maternal Mortality – UK

Table 3. Population-attributable fractions (PAFs) for specific associated factors

Risk factors	PAF (%)	95% CI
'Risk factors' score	69.8	66.1–73.0
Specific factors		
Medical comorbidities	48.9	40.5–56.2
Previous pregnancy problems	21.1	11.7–29.5
Hypertensive disorders of pregnancy	12.0	7.7–16.1
Inadequate use of antenatal care	10.5	9.7–11.4
Indian ethnicity	2.9	0.3–5.5
Substance misuse	1	0.03–1.4

Maternal Comorbidity

- Thompson JL, et al. *Medical and Obstetric Outcomes among Pregnant Women with Congenital Heart Disease*. *Obstet Gynecol* 2015;126:346-54
 - 6% Cardiovascular outcome
-

Maternal Comorbidity

- McNamara DM, et al. *Clinical Outcomes for Peripartum Cardiomyopathy in North America*. J Am Coll Cardiol 2015;66:905-14
 - 6% major events (mortality, LVAD, transplant)
 - Burchill LJ, et al. *Pregnancy Risks in Women with Pre-Existing Coronary Artery Disease, or Following Acute Coronary Syndrome*. Heart 2015;101:525-9
 - 10% adverse maternal events (2% mortality)
 - 50% adverse fetal outcomes
-

Maternal Mortality

Main EK, McCain CL, Morton CH, et al.

Pregnancy-Related Mortality in California: Causes, Characteristics, and Improvement Opportunities.

Obstet Gynecol 2015;125:938-47

Maternal Mortality

Preventable?

41% of deaths 'Good to Strong'

- Hemorrhage (70%)
- Preeclampsia (60%)
- Cardiovasc (29%)
- AFE (0%)

Obstetric Anesthesia

Parturients are older and have more complex medical histories.

Challenge:

How do we improve care?

ICU Admissions

Chantry AA, Deneux-Tharoux C, Bonnet MP, et al.
Pregnancy-Related ICU Admissions in France: Trends in Rate and Severity, 2006-2009.
Crit Care Med 2015;43:78-86

ICU Admissions

- French hospital discharge database
 - (Programme de Médicalisation des Systèmes d'Information)
- 11,824 pregnancy-related ICU admissions in France from 2006 to 2009
 - 3.62 per 1,000 deliveries

ICU Admissions

Diagnosis		% of admissions	Rate / 100,000 deliveries
Hemorrhage		34.2	1.24
Hypertensive DO		22.3	0.81
Cardiovascular		8.0	0.29
Infectious	*	3.6	0.13
Thromboembolic		2.8	0.10
Anesthesia	*	0.6	0.02
AFE	*	0.4	0.02

Sepsis

Bauer ME, Lorenz RP, Bauer ST, et al.
*Maternal Deaths Due to Sepsis in the State of Michigan,
1999-2006.*
Obstet Gynecol 2015;126:747-52

Sepsis

- Maternal Mortality Surveillance records from the Michigan Department of Community Health
- Sepsis identified by:
 - Death certificate cause of death,
 - Maternal Mortality Medical Surveillance Committee, or
 - Specific source of infection leading to organ failure

Sepsis

558 maternal deaths

- 14 per 100,000 live births

Sepsis:

- 15% of pregnancy – related mortality
- 2.1 deaths/100,000 live births

Sepsis

- Inadequate care:
 - Delayed identification
 - Delayed treatment
 - Inadequate antibiotic coverage

Cesarean Delivery

Cesarean and Mortality

“There is no justification for any region to have a cesarean delivery rate higher than 10-15%”

World Health Organization

Lancet. 1985;2(8452):436-437

Cesarean and Mortality

Molina G, Weiser TG, Lipsitz SR, et al.

Relationship between Cesarean Delivery Rate and Maternal and Neonatal Mortality.

JAMA 2015;314:2263-70

Cesarean and Mortality

194 WHO member states

- 54 countries with published rates
- 118 countries with estimated from previous
- 22 countries calculated from economic / social factors

2012:

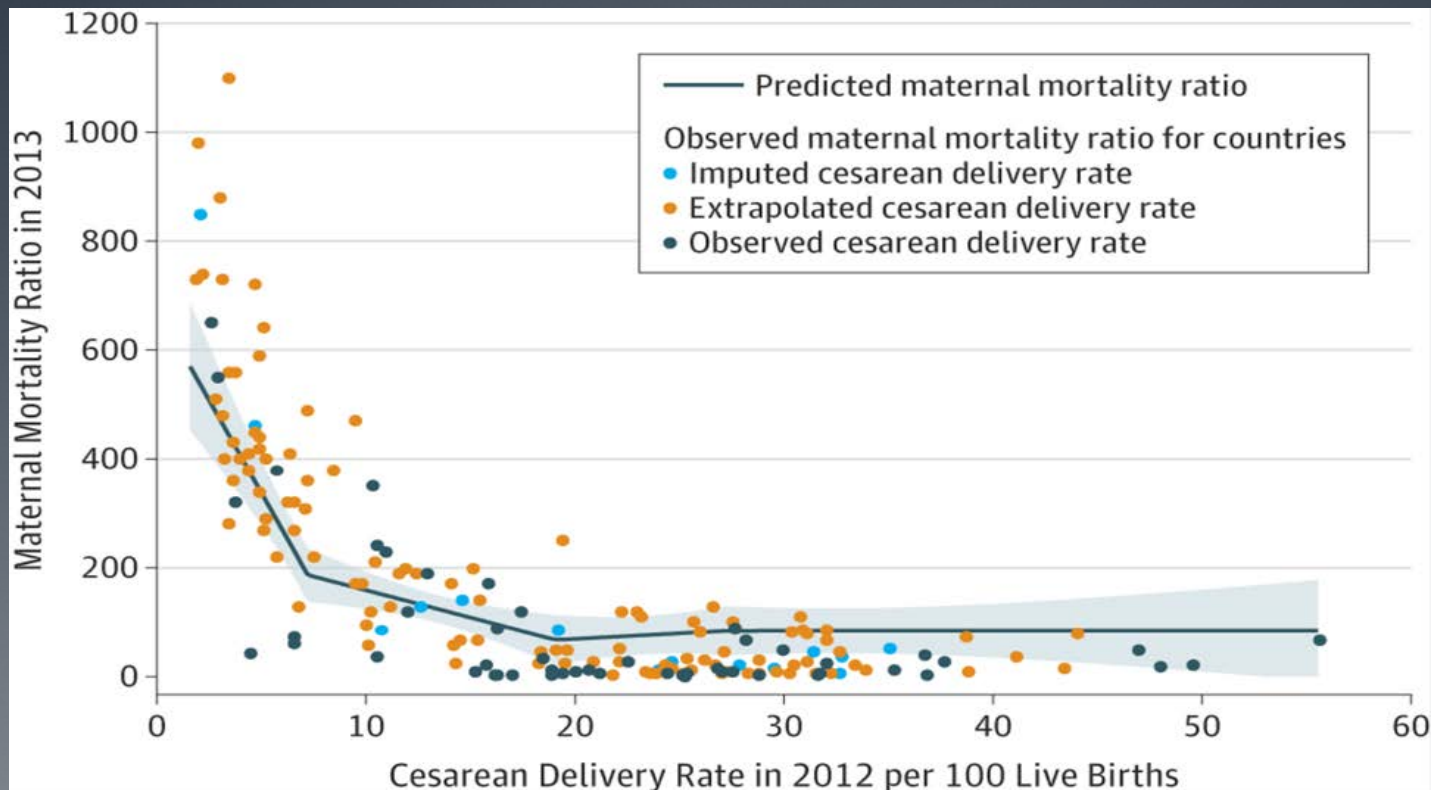
- 22,900,000 cesarean deliveries (est)

Cesarean and Mortality

Maternal Mortality Rate

$\geq 19.1\%$ (95% CI, 16.3% to 21.9%)

$\geq 20\%$ when only high quality data used

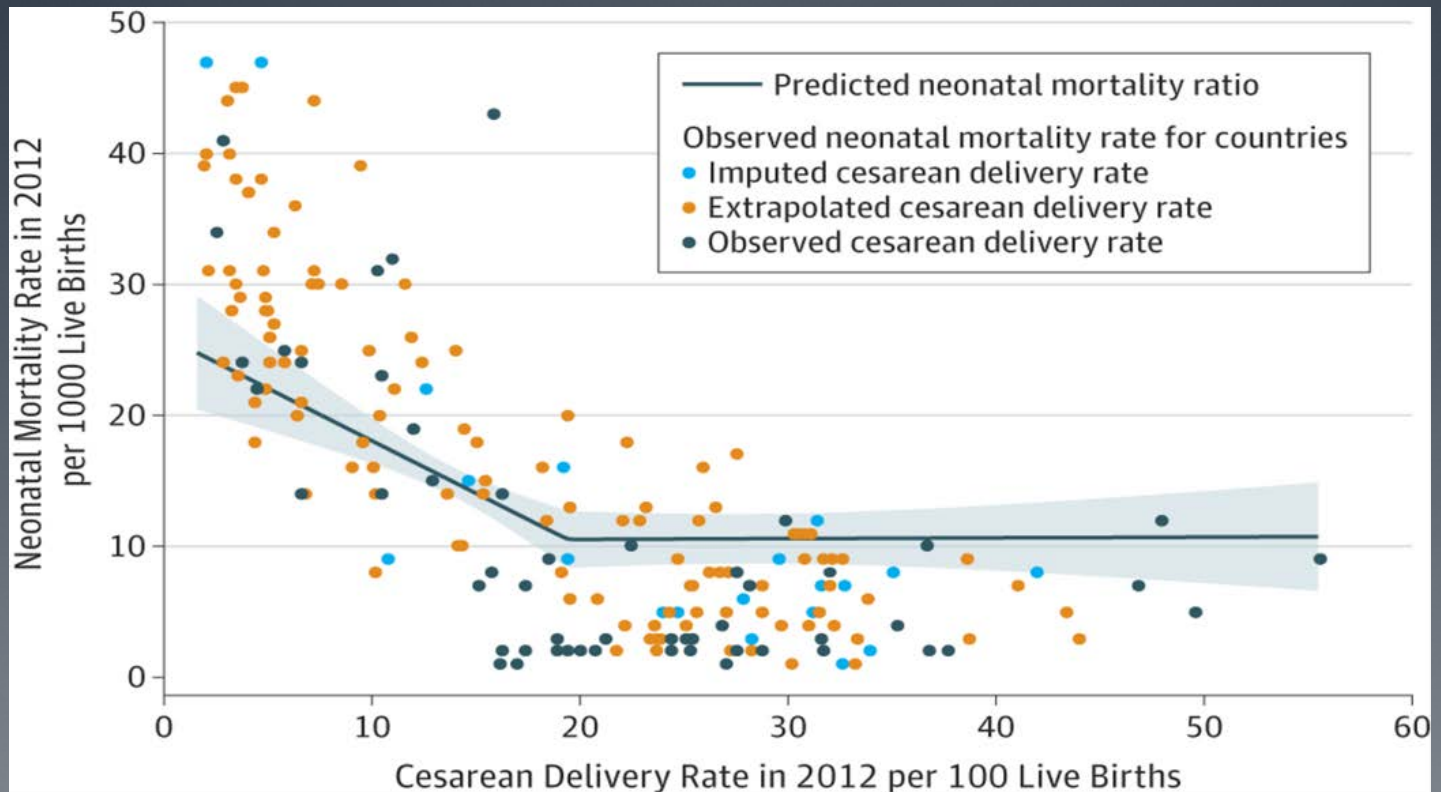


Cesarean and Mortality

Neonatal Mortality Rate

$\geq 19.4\%$ (95% CI, 18.6% to 20.3%)

$\geq 24\%$ when only high quality data used



Cesarean Anesthesia

Conversion to GA

86% of anesthesia-associated mortality during cesarean

- Hawkins JL, et al. *Obstet Gynecol.* 2011;117:69-74.

Failed airway ~ 1 / 250 parturients

- Kinsella SM, et al. *IJOA.* 2015;24:356-74

Mortality from anesthesia has decreased

? Improved practice and equipment ?

Cesarean Anesthesia

Conversion to GA

Regional >> General

- Mortality
 - Side effects
 - Participation
-

Cesarean Anesthesia

Conversion to GA

Aiken CE, Aiken AR, Cole JC, et al.

Maternal and Fetal Outcomes Following Unplanned Conversion to General Anesthetic at Elective Cesarean Section.

J Perinatol 2015;35:695-9

Cesarean Anesthesia

Conversion to GA

4337 deliveries from 2008 to 2013

- Single center
- Non-emergent

Identified conversion to general
anesthesia

Cesarean Anesthesia

Conversion to GA

Rate of general anesthesia: 3.8%

Type of Anesthesia	Number planned	Convert to GA	Percentage
Epidural	132	15	11.4%
Spinal	3831	67	1.74%
CSE	291	0	0%

General anesthesia associated with

- Delayed neonatal respiration
- Maternal blood loss

Patient Safety Minute

Obstetric Airway

Guidelines

Obstetric Airway

Mushambi MC, Kinsella SM, Popat M, et al.

Obstetric Anaesthetists' Association and Difficult Airway Society Guidelines for the Management of Difficult and Failed Tracheal Intubation in Obstetrics.

Anaesth 2015;70:1286-306

Guidelines

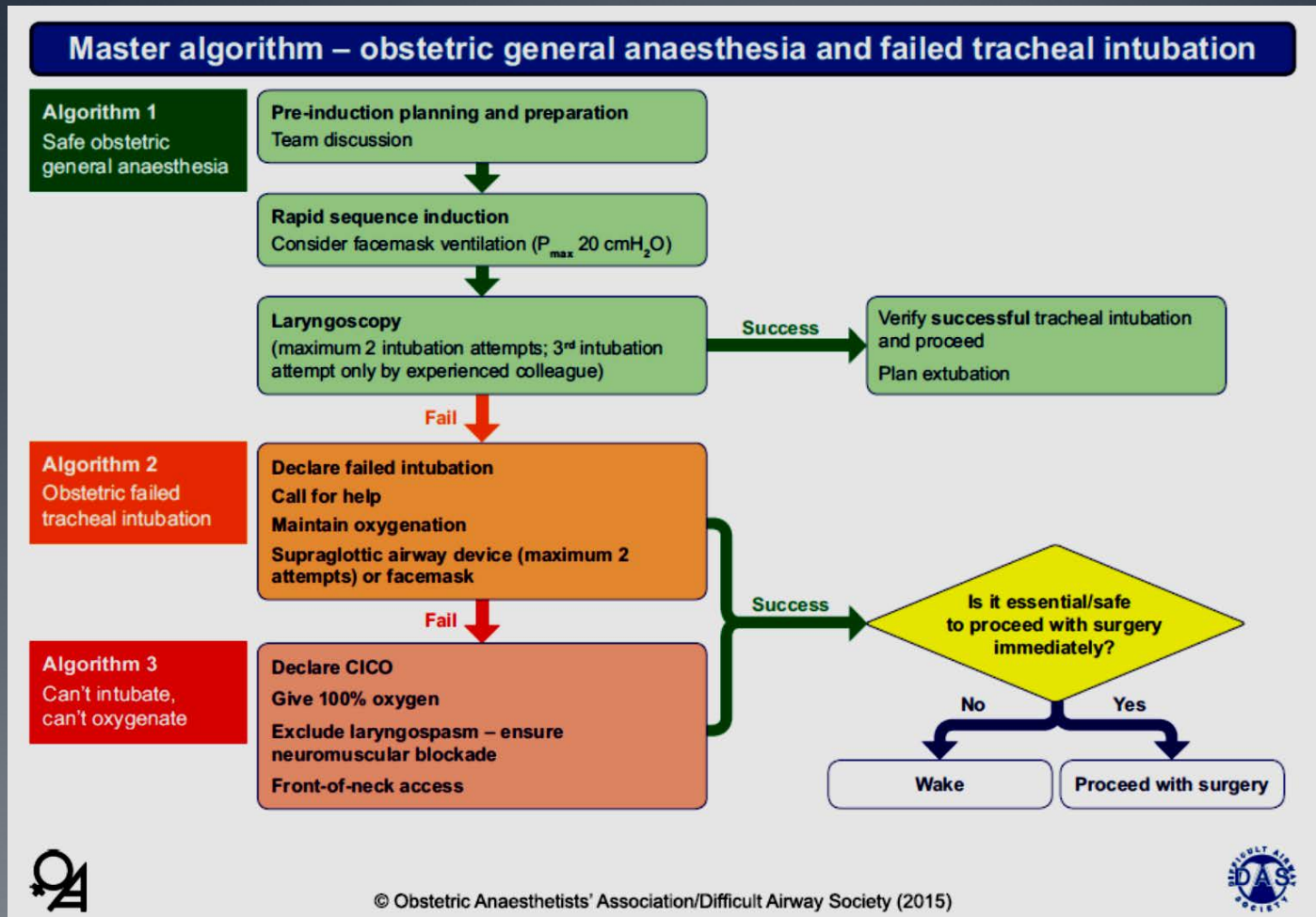
Obstetric Airway

Three Algorithms:

1. Safe Obstetric General anesthesia
Planning and preparation, up to second failed attempt
2. Obstetric Failed Tracheal Intubation
3. 'Can't Intubate, Can't Oxygenate'

5 valuable charts to aid decision-making

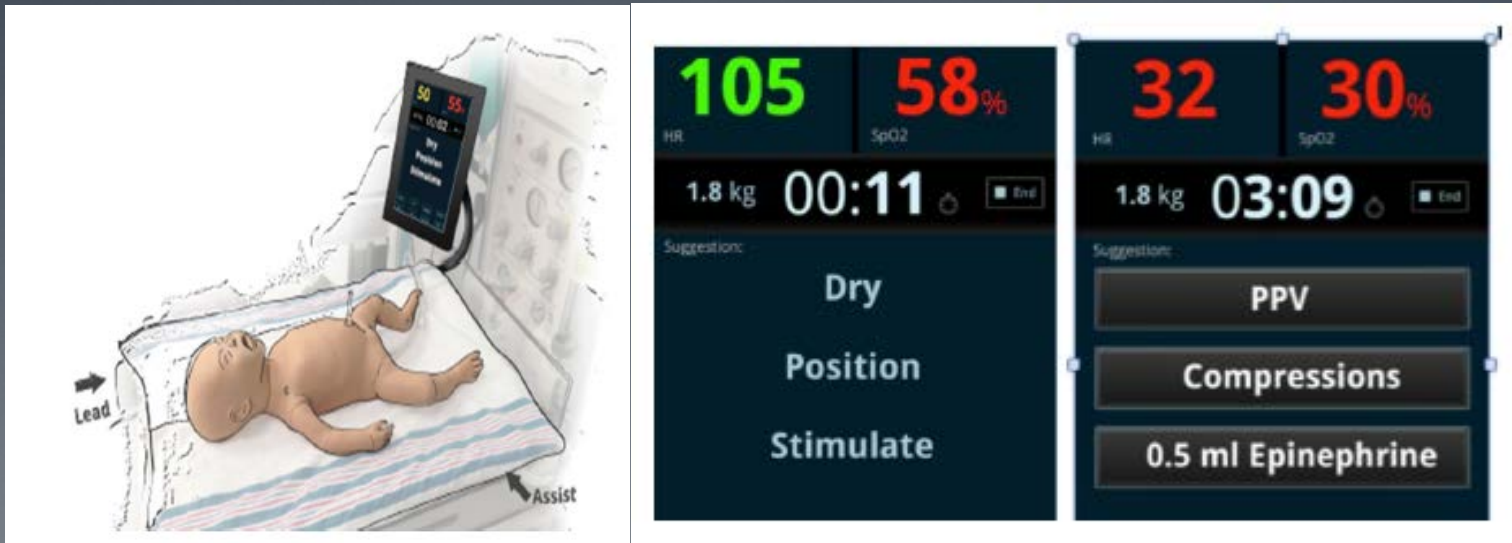
Poster-ready format



Patient Safety

Visual Aids

Fuerch JH, Yamada NK, Coelho PR, et al.
Impact of a Novel Decision Support Tool on Adherence to Neonatal Resuscitation Program Algorithm.
Resusc 2015;88:52-6



Cesarean Delivery

Adverse Events

Guglielminotti J, Wong CA, Landau R, et al.
*Temporal Trends in Anesthesia-Related Adverse Events in
Cesarean Deliveries, New York State, 2003-2012.*
Anesthesiol 2015;123:1013-23

Cesarean Delivery

Adverse Events

2003 to 2012

Hospital discharge records

785,000 cesarean deliveries

Cesarean Delivery

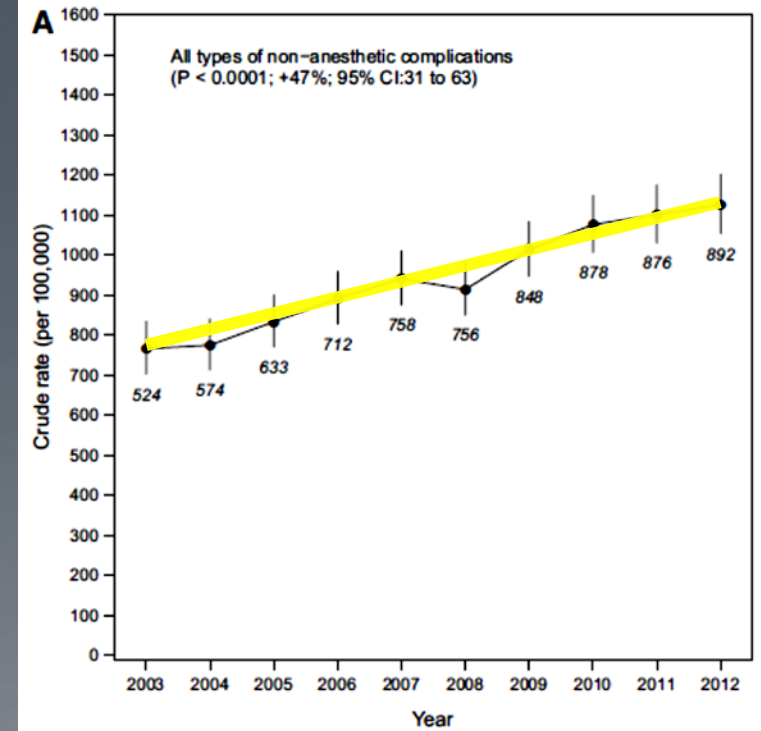
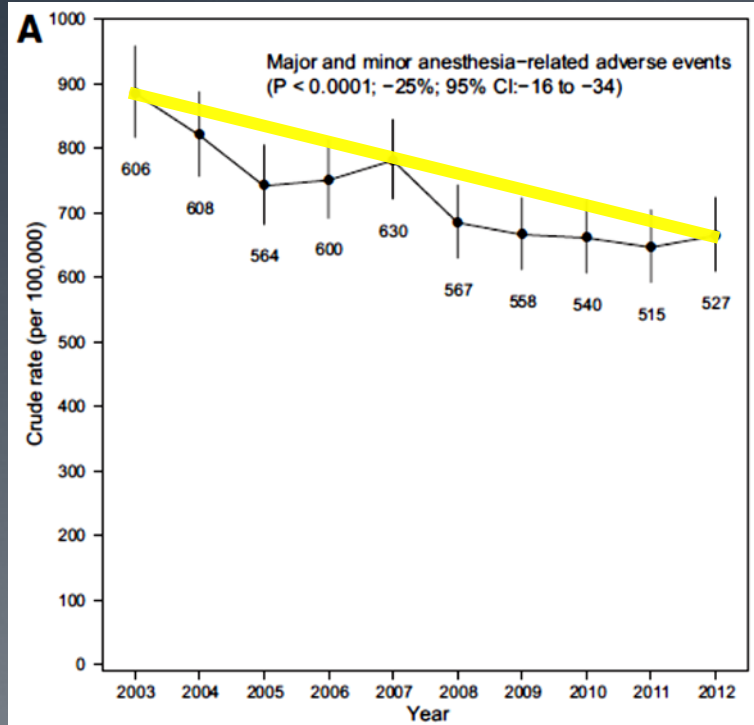
Adverse Events

Anesthesia events

Rate = 730 / 100,000

Non-anesthesia events

Rate = 890 / 100,000



Cesarean Delivery

Adverse Events

Anesthesia events

- Minor – 94% of events
 - Dural puncture headache
- Major ($\geq 1\%$ risk of death)

Non-anesthesia events

- Myocardial infarction
- Heart failure
- Respiratory failure
- PE / DVT
- DIC
- Renal failure
- Sepsis
- Stroke

Cesarean Anesthesia

Hypotension

Aortocaval compression

- Supine hypotension syndrome
- Fetal perfusion decrease

Foundation for lateral tilt

How much tilt is required?

Cesarean Anesthesia

Hypotension

Higuchi H, Takagi S, Zhang K, et al.

Effect of Lateral Tilt Angle on the Volume of the Abdominal Aorta and Inferior Vena Cava in Pregnant and Nonpregnant Women Determined by Magnetic Resonance Imaging.
Anesthesiol 2015;122:286-93

Cesarean Anesthesia

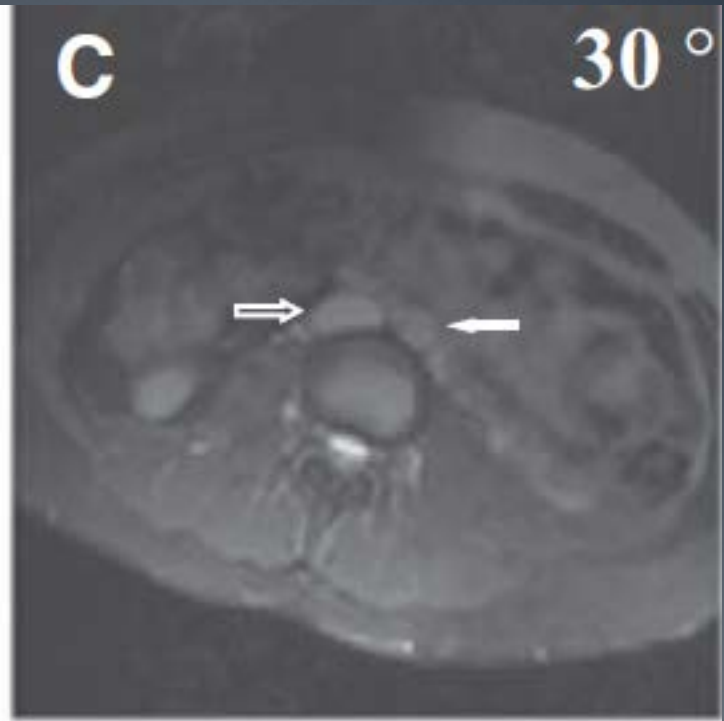
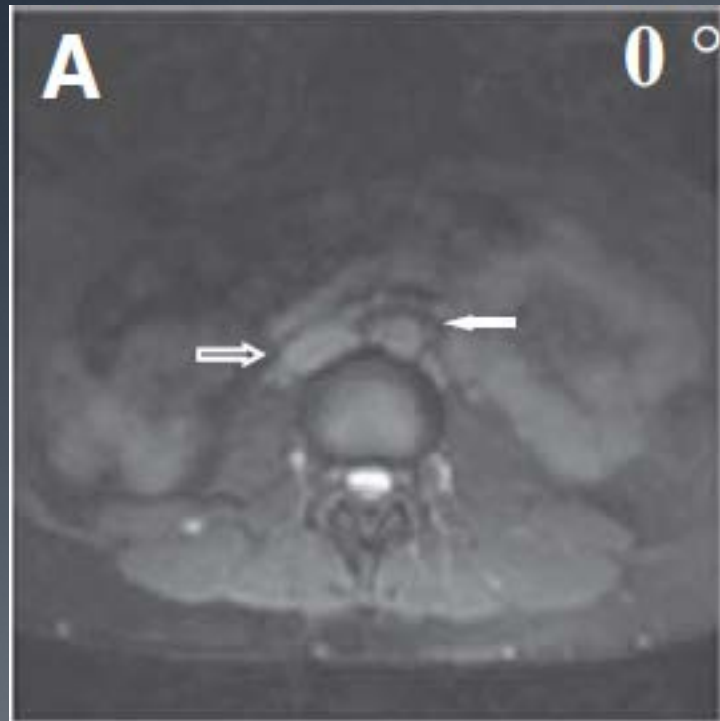
Hypotension

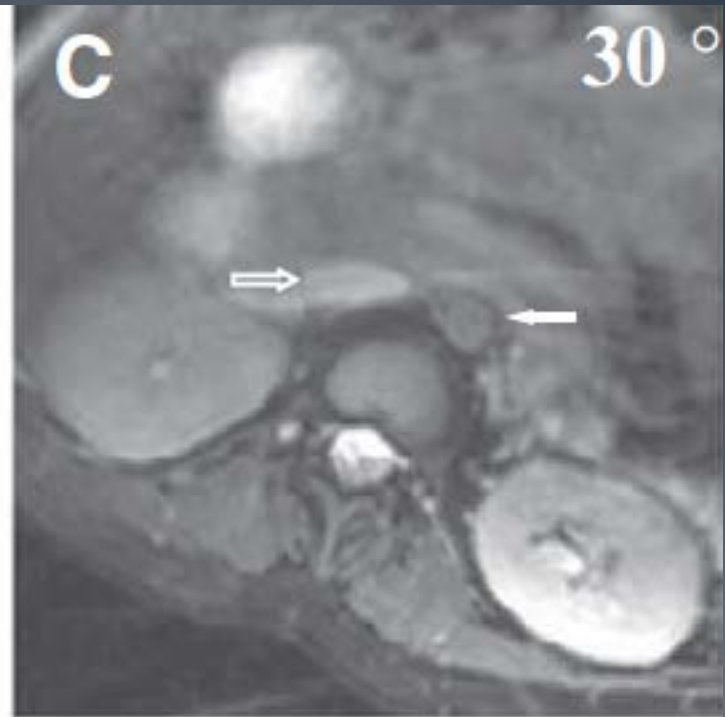
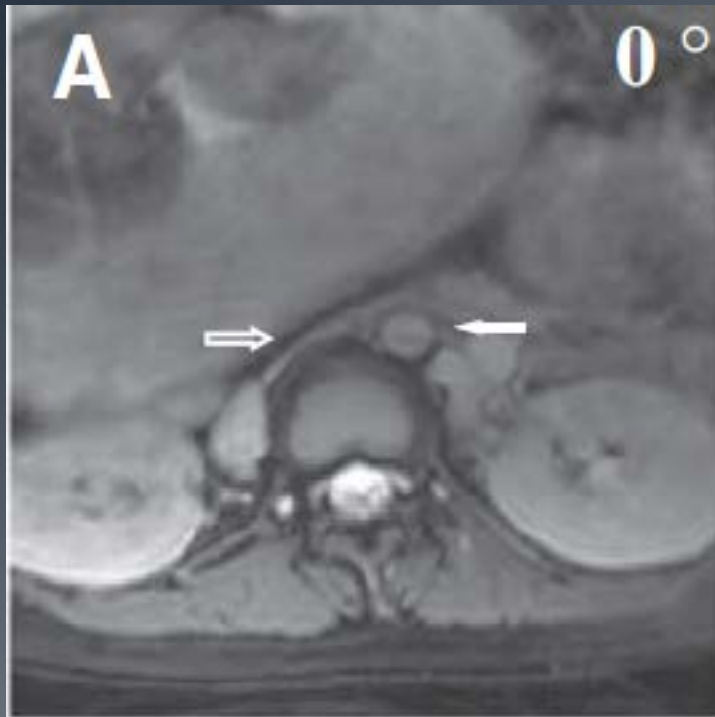
10 healthy pregnant women (37 – 39 wks)

10 healthy volunteers

MRI performed at 4 positions of tilt

Aortic and vena cava volumes measured
(L2-3 and L3-4)





Cesarean Anesthesia

Hypotension

	Pregnant (n=10)	Nonpregnant (n=10)
Cardiac output (l/min)		
0°	5.4 ± 0.9	4.6 ± 0.8
15°	5.6 ± 0.9	4.7 ± 0.7
30°	5.3 ± 0.9	4.5 ± 0.6
45°	5.4 ± 1.1	4.5 ± 0.6
Mean arterial pressure (mmHg)		
0°	77 ± 8	76 ± 8
15°	80 ± 8	77 ± 5
30°	78 ± 9	76 ± 5
45°	80 ± 10	75 ± 6
Heart rate (beats/min)		
0°	81 ± 14	72 ± 4
15°	79 ± 13	73 ± 7
30°	79 ± 14	69 ± 5
45°	81 ± 14	71 ± 6

Cesarean Anesthesia

Hypotension

Hypotension is potentially bad

- Fluids: Ineffective
 - Ephedrine: Tachycardia
Fetal acidosis
 - Phenylephrine: Bradycardia
Decreased cardiac output
-

Cesarean Anesthesia

Hypotension

Ngan Kee WD, Lee SW, Ng FF, et al.

Randomized Double-Blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure During Spinal Anesthesia for Cesarean Delivery.

Anesthesiol 2015;122:736-45

Cesarean Anesthesia

Hypotension

104 parturients

- Scheduled cesarean delivery
- ASA 1 or 2
- Singleton
- Term

Spinal anesthesia

- 11mg bupivacaine (hypobaric) / 15 μ g fentanyl
- 2 liter IV fluid cohydration
- Hip wedge

Cesarean Anesthesia

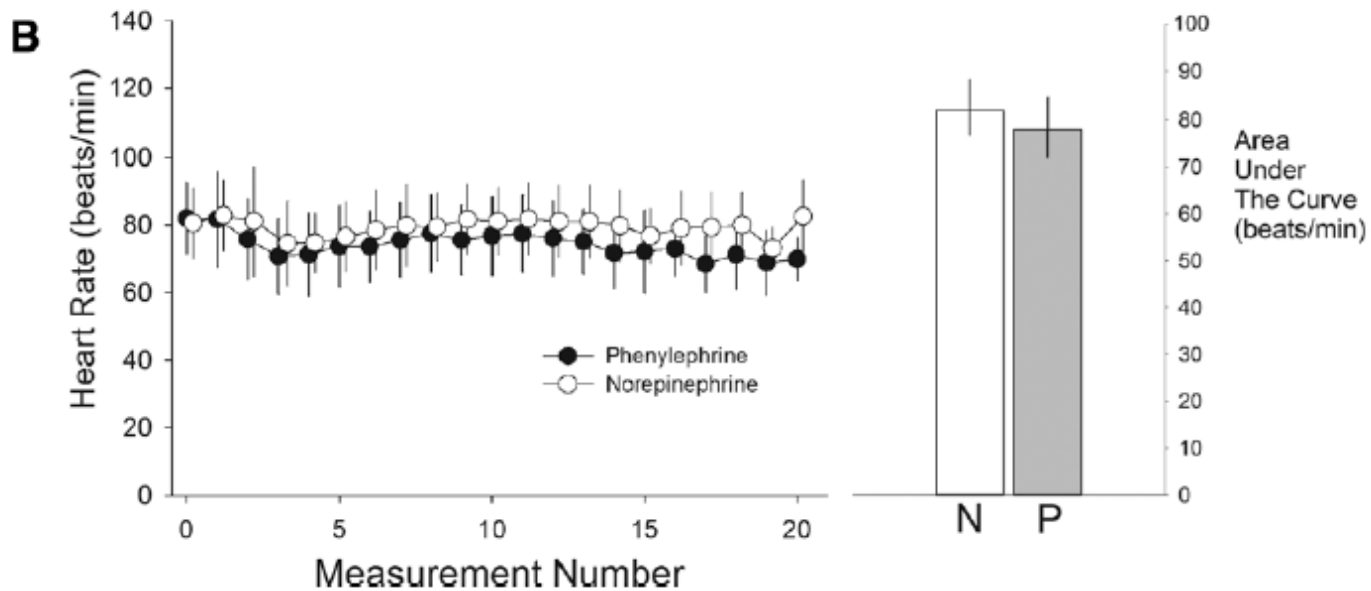
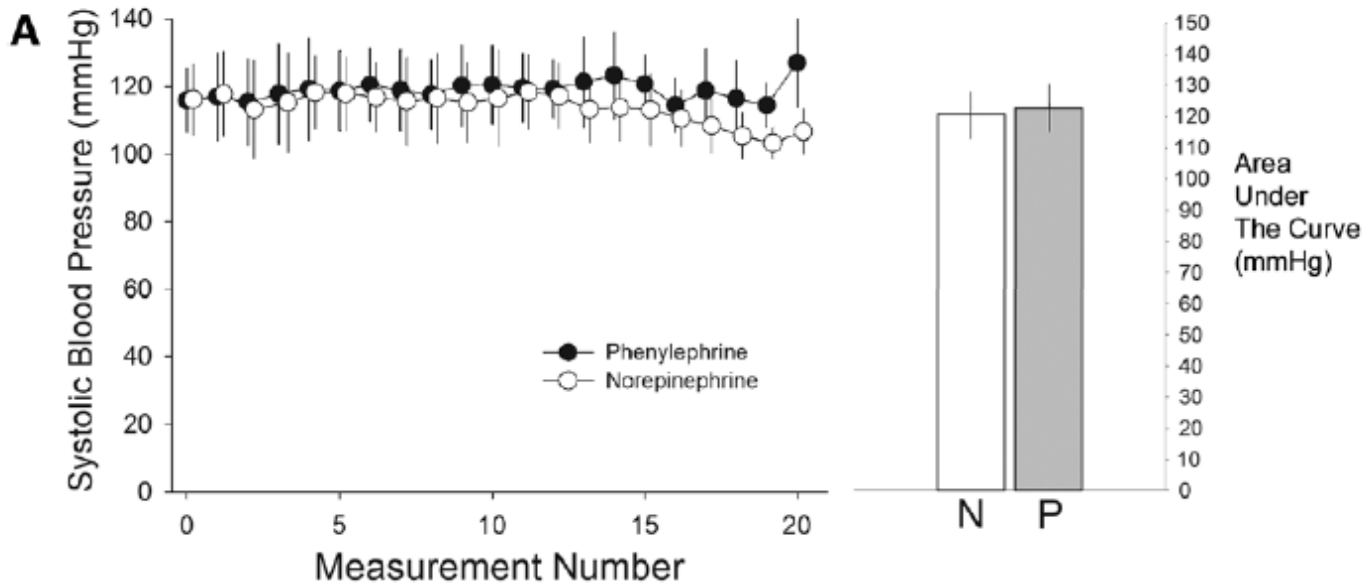
Hypotension

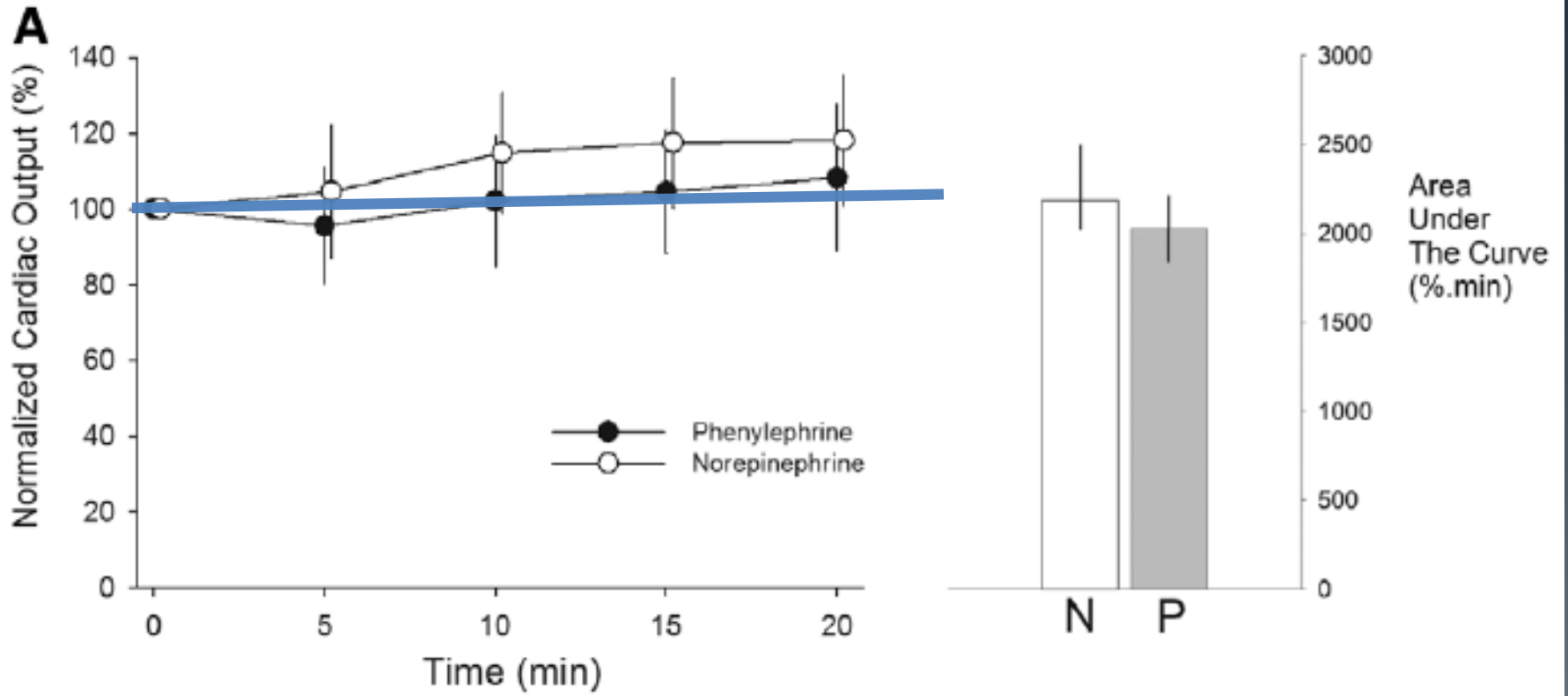
Randomized to infusion of:

- Norepinephrine
- Phenylephrine

Infusion maintained by computer-controlled, closed-loop feedback system.

Primary outcome: Cardiac Output





Postpartum Care

Zaremba S, Mueller N, Heisig AM, et al.

Elevated Upper Body Position Improves Pregnancy-Related OSA without Impairing Sleep Quality or Sleep Architecture Early after Delivery.

Chest 2015;148:936-44

Postpartum Care

Body position alters obstructive sleep apnea (OSA)

~ 5% of parturients

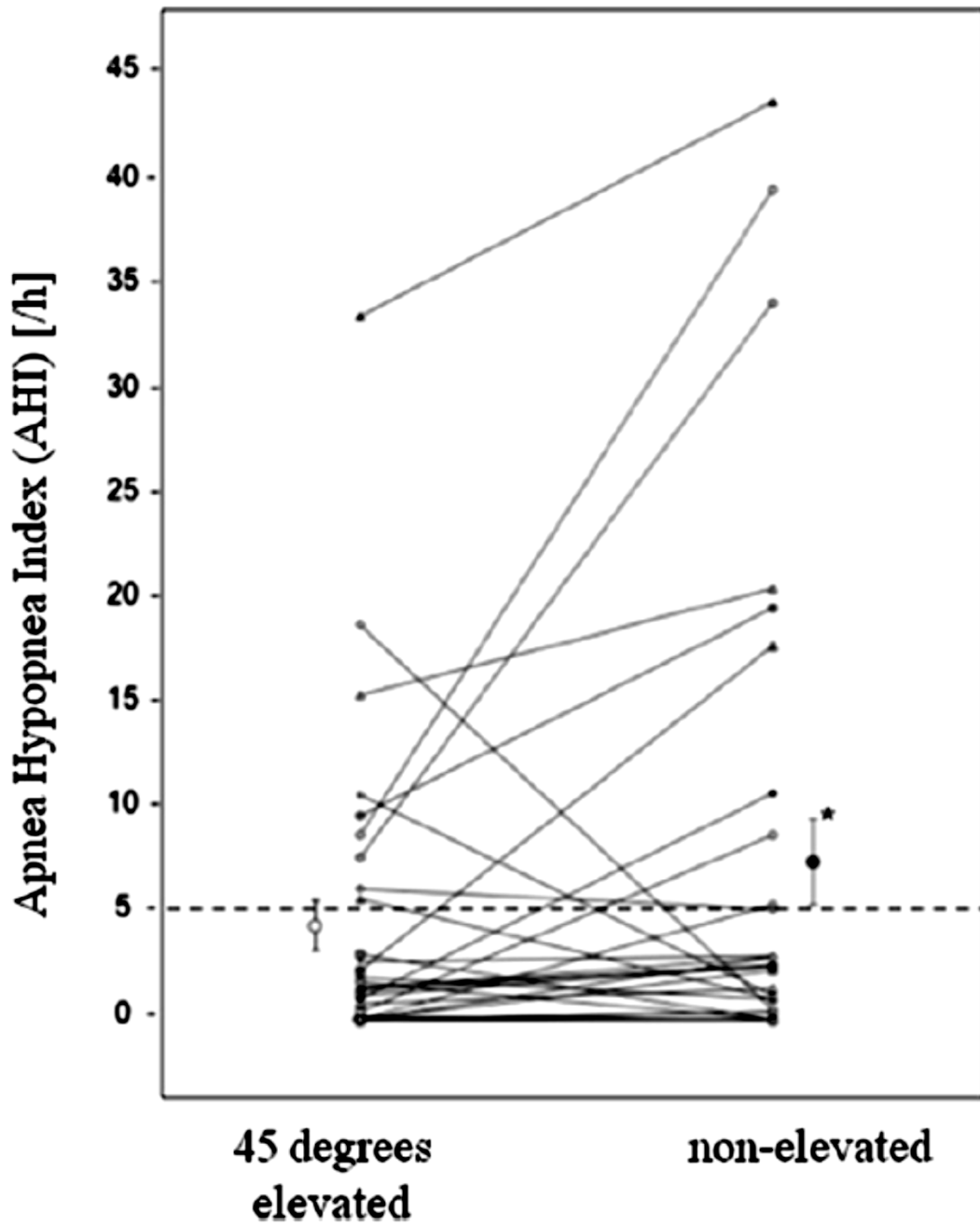
30 postpartum women (day 2)

- Polysomnography (sleep study)
- Crossover design
 - Horizontal vs. 45° incline

Postpartum Care

Horizontal	45 Degree Incline	P-value
	Apnea Hypopnea Index	
7.7 ± 2.2 / hr	4.5 ± 1.4 / hr	0.03

No differences in sleep quality parameters



Postpartum Care

Wrench IJ, Allison A, Galimberti A, et al.

Introduction of Enhanced Recovery for Elective Caesarean Section Enabling Next Day Discharge: A Tertiary Centre Experience.

IJOA 2015;24:124-30

Postpartum Care

Enhanced recovery / fast tracking

- Cardiac surgery
- Colorectal
- Orthopedic
- Gynecologic
- Urology

Reduced morbidity, faster recovery

Postpartum Care

- Select patient population
- Education!
- Sports drink 2h preop
- Active warming in OR
- Spinal anesthesia with diamorph
- Early feeding
- Early mobilization

Postpartum Care

Day of discharge	Number discharged n (%)	Readmissions n (%)
Day 1	114 (15 ⁰ %)	5 (4 ⁰ %)
Day 2	375 (49 ⁰ %)	21 (6%)
Day 3+	271 (36 ⁰ %)	35 (13 ⁰ %)

Patient Safety Minute

Protocols and Guidelines

Protocols and Guidelines

Bailit JL, Grobman WA, Mcgee P, et al.

Does the Presence of a Condition-Specific Obstetric Protocol Lead to Detectable Improvements in Pregnancy Outcomes?

Am J Obstet Gynecol 2015;213:86 e1-6

Protocols and Guidelines

NICHD / MFMU

25 hospitals – 4 years – 115,502 patients

Protocols:

- Hemorrhage
- Shoulder dystocia
- Preeclampsia

Protocols and Guidelines

No change in outcomes

No change in morbidity

Guidelines

Dahlke JD, Mendez-Figueroa H, Maggio L, et al.
*Prevention and Management of Postpartum Hemorrhage: A
Comparison of 4 National Guidelines.*
Am J Obstet Gynecol 2015;213:76 e1-10

Guidelines

- American College of Obstetricians and Gynecologists (2013)
- Royal College of Obstetrician and Gynaecologists (2011)
- Society of Obstetricians and Gynaecologists of Canada (2009)
- Royal Australian and New Zealand College of Obstetricians and Gynaecologists (2014)

Guidelines

References # range from 12 to 110

Minimal review of RCT and meta-analyses

- ACOG: NONE!

Few points of agreement

Points of Agreement

- Definition: Clinical markers > visual EBL
- Active management of 3rd stage
 - Medications in agreement
- Surgical or interventional radiology
 - 2nd line after medications
- Units should have resuscitative equipment
- Internal iliac balloons are +/- in accreta

Placenta Accreta

Creanga AA, Bateman BT, Butwick AJ, et al.

Morbidity Associated with Cesarean Delivery in the United States: Is Placenta Accreta an Increasingly Important Contributor?

Am J Obstet Gynecol 2015;213:384 e1-11

Placenta Accreta

Nationwide Inpatient Sample

- 2000-2011 data
- Discharges from 1000 hospitals
- 20% sample of the US

Trends in primary and repeat cesarean delivery: Nationwide Inpatient Sample, United States, 2000-2011

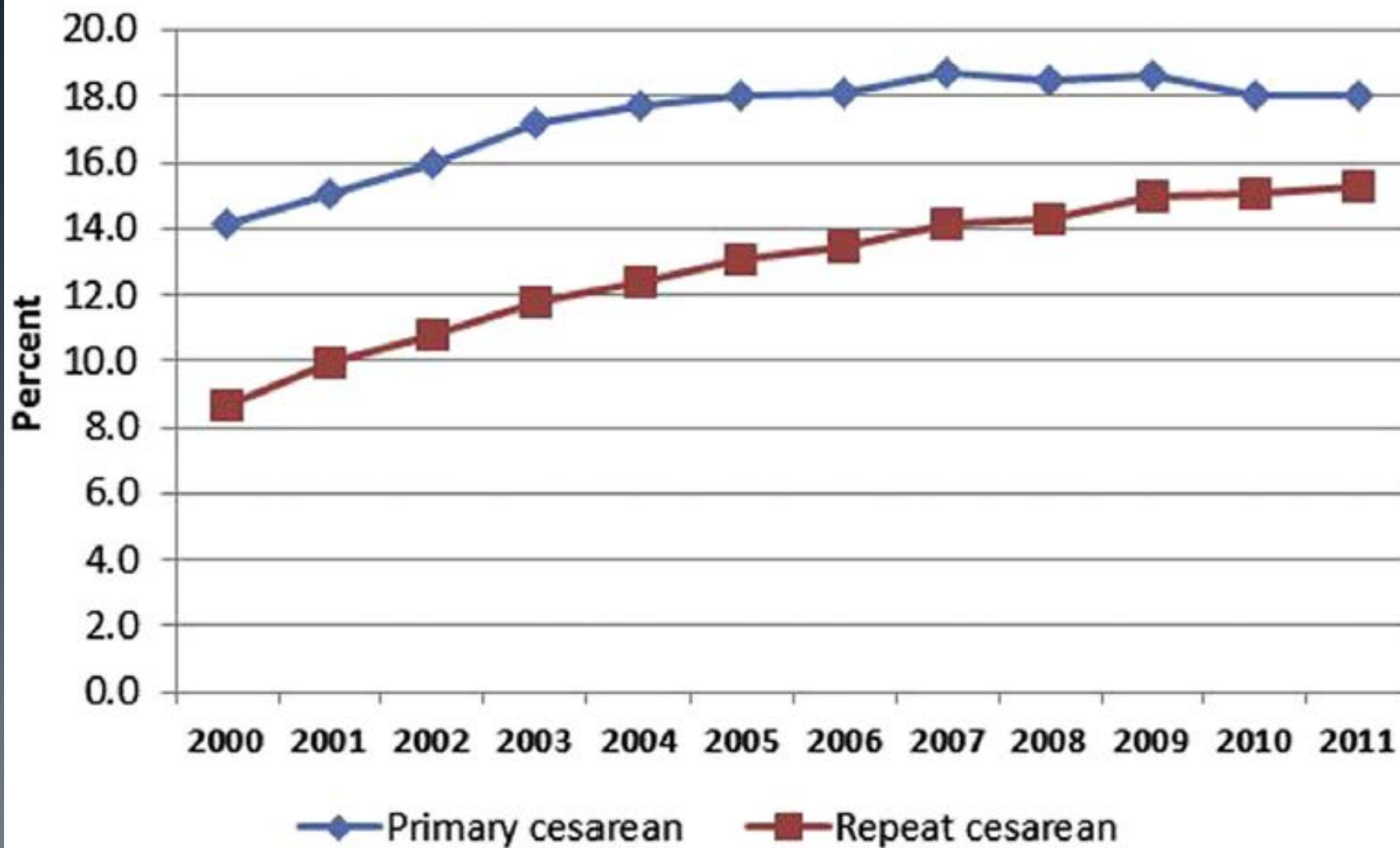
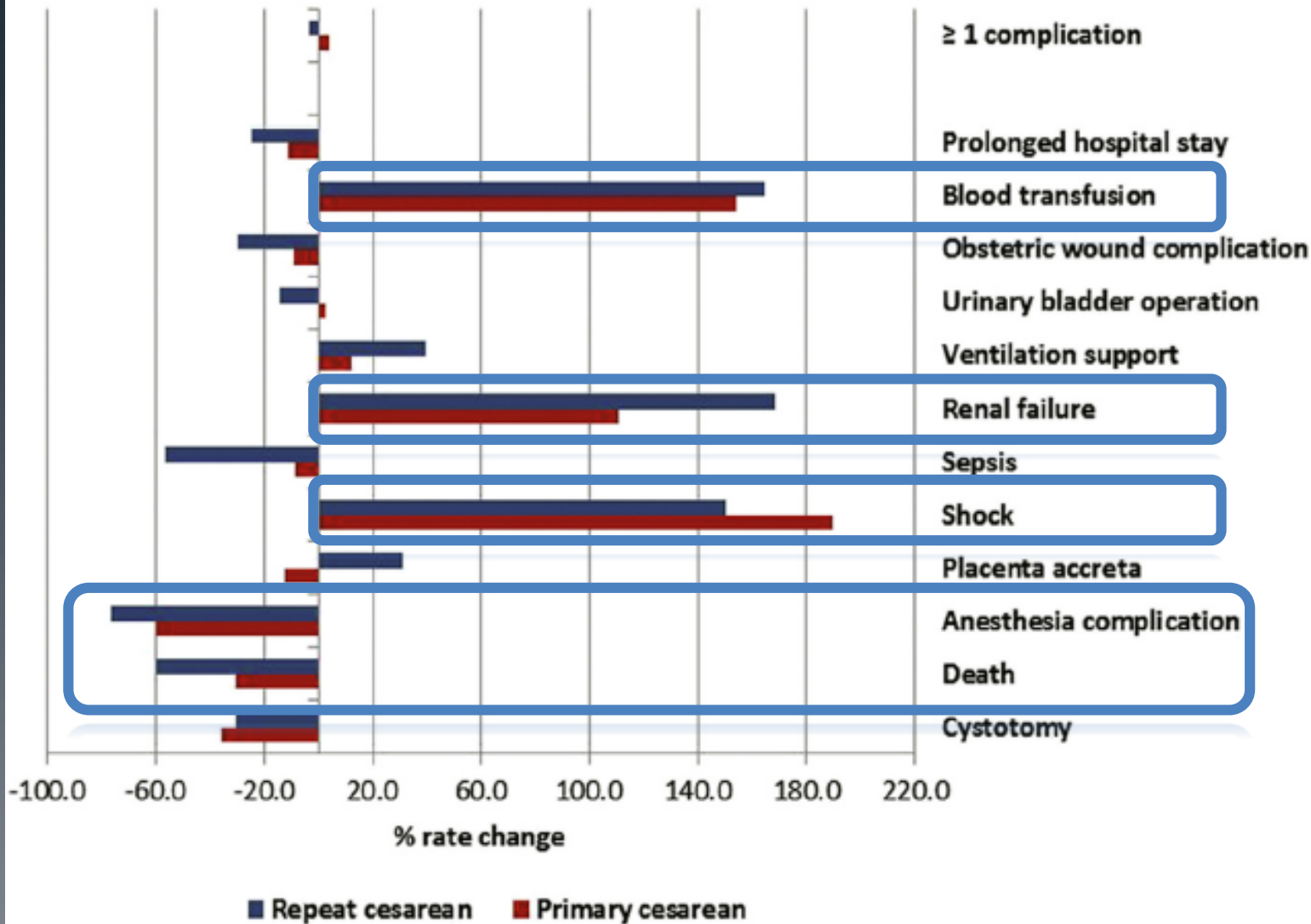
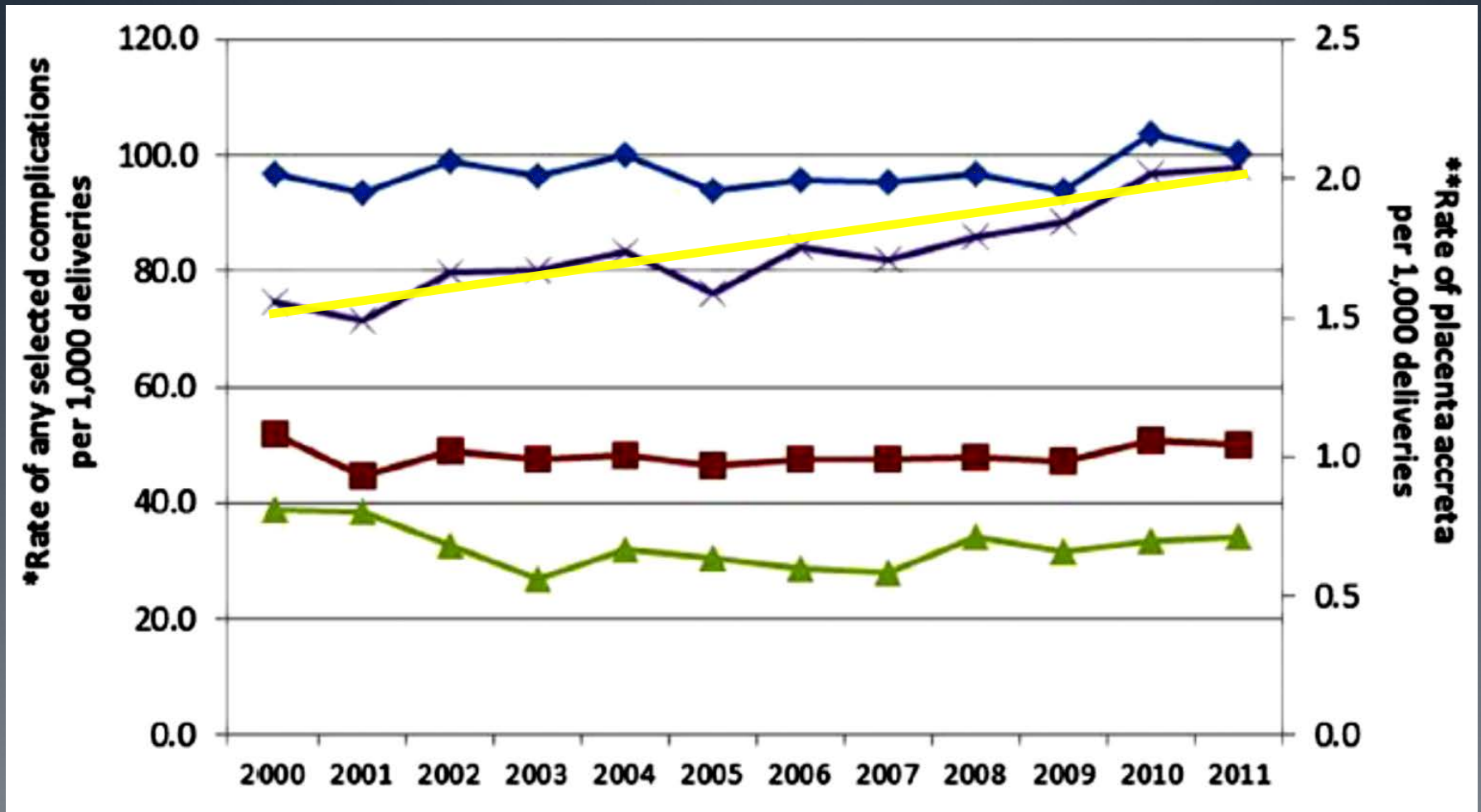


FIGURE 2

Percentage rate changes in morbidity associated with cesarean delivery complications: United States, 2000-2011



Placenta Accreta



The Effects of Anesthesia Associations or Causality?

$A \neq B$

Anesthesia and The Developing Brain

Spann MN, Serino D, Bansal R, et al.

*Morphological Features of the Neonatal Brain Following
Exposure to Regional Anesthesia During Labor and Delivery.*

Mag Res Imag 2015;33:213-21

Anesthesia and The Developing Brain

37 healthy infants

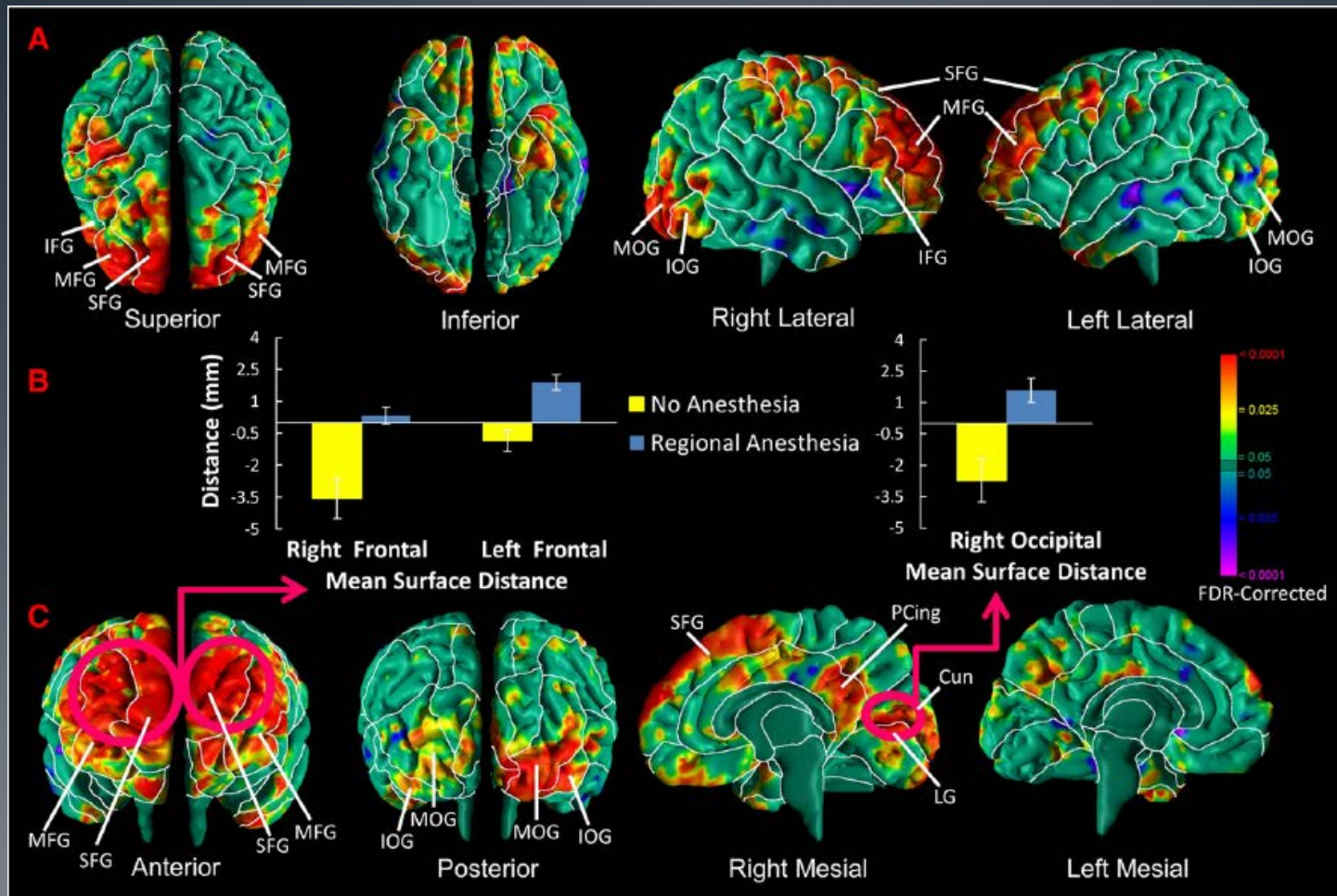
- MRI two weeks post delivery

Anesthesia

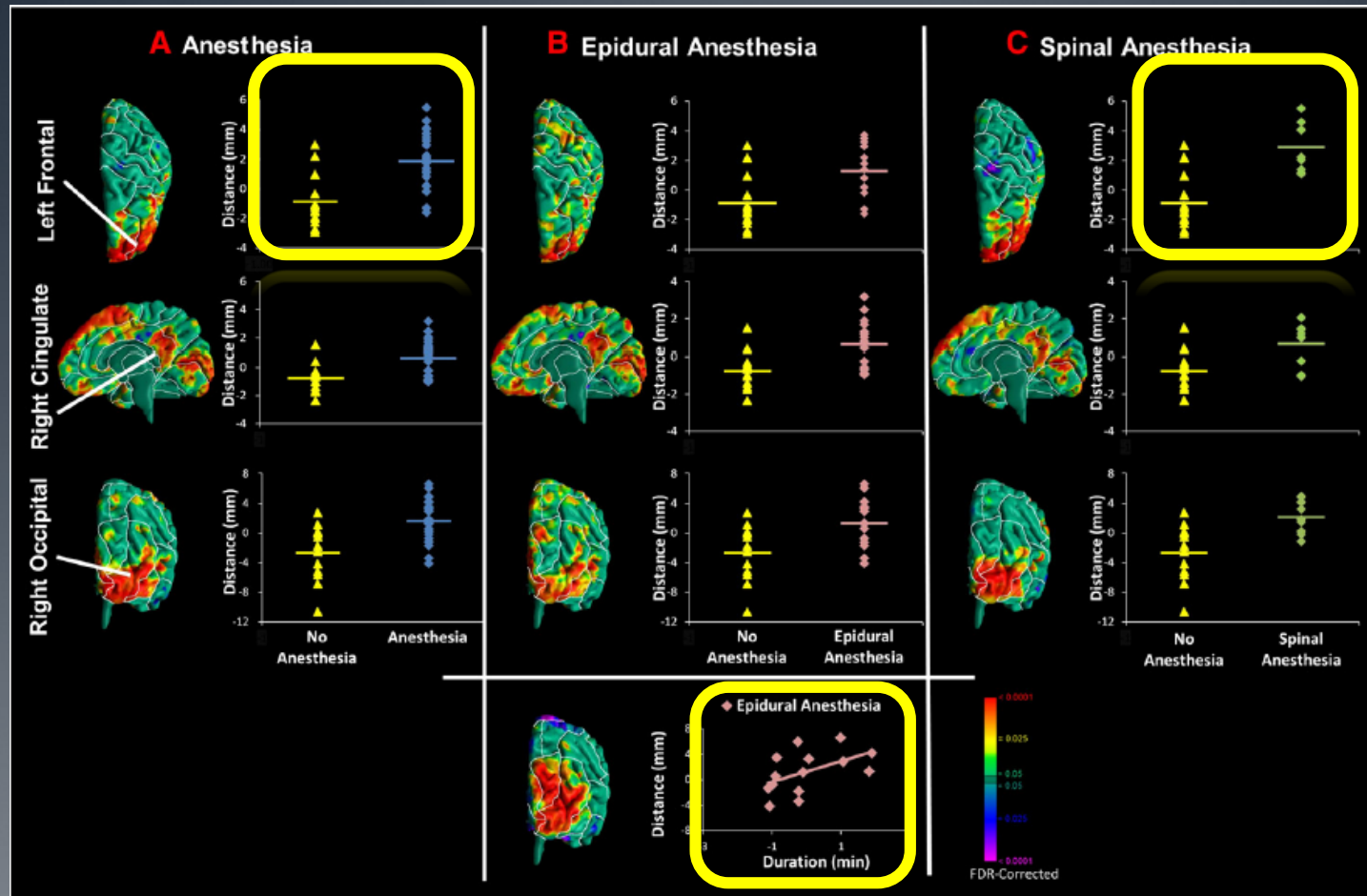
- None n=13
- Spinal anesthesia n=12
- Epidural analgesia n=12

Behavioral testing 12 months

Anesthesia and The Developing Brain



Anesthesia and The Developing Brain



Anesthesia and The Developing Brain

Analgesia

≠

Un-medicated

Cesarean

≠

Vaginal

Anesthesia and The Developing Brain

Chung W, et al. Paed Anaesth 2015;25:1033-45

- Sevoflurane (mice) Long-term learning impairment

Popic J, et al. Int J Dev Neurosci 2015;44:22-32

- Propofol (rats) TNF- α in the cortex and thalamus

Steinhorn R, et al. J Pediatr. 2015;166:1200-1207

- Morphine (human) behavioral up to 2 years
-

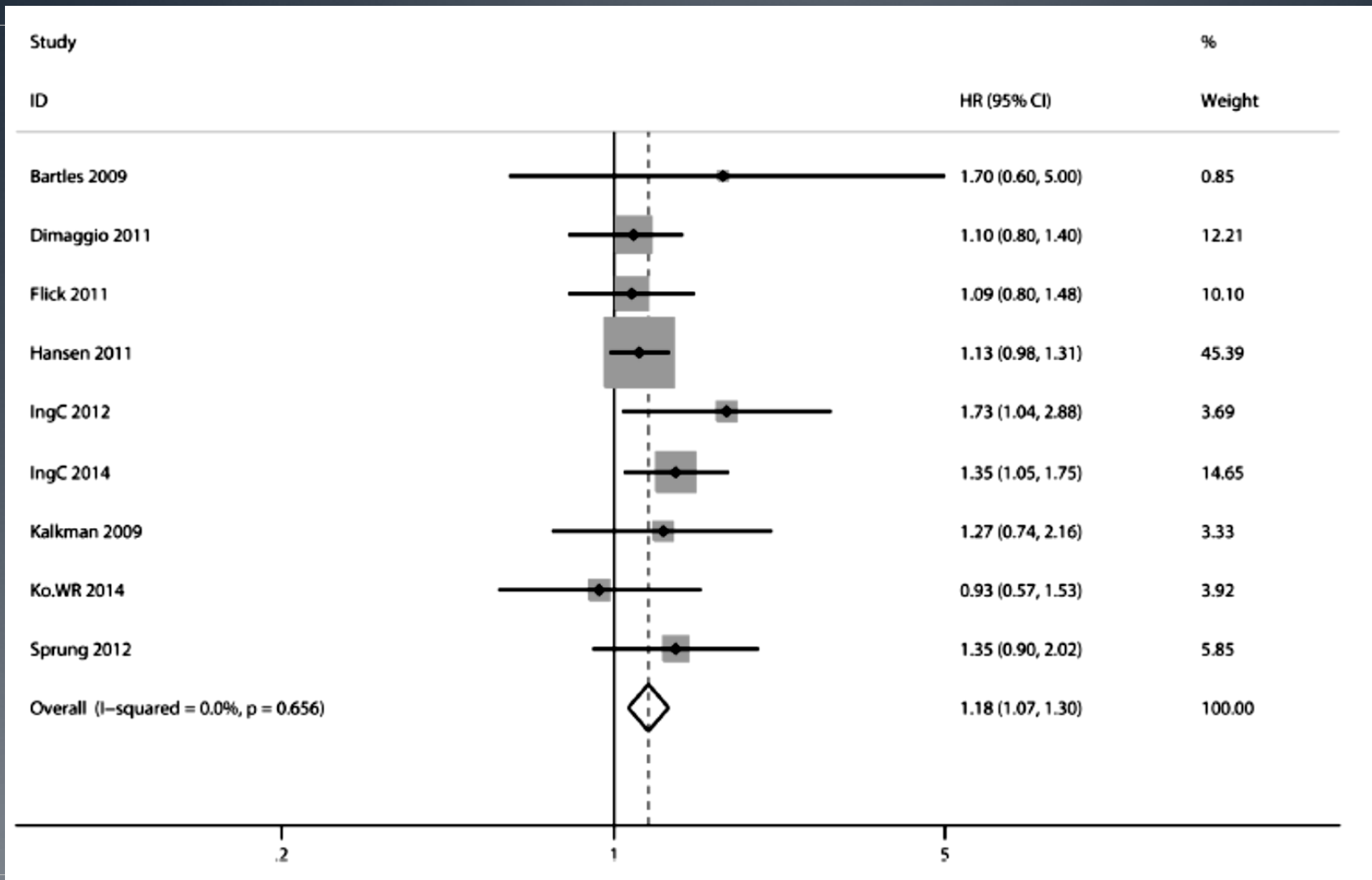
Anesthesia and The Developing Brain

Zhang H, Du L, Du Z, et al.

Association between Childhood Exposure to Single General Anesthesia and Neurodevelopment: A Systematic Review and Meta-Analysis of Cohort Study.

J Anesth 2015;29:749-57

Anesthesia and The Developing Brain



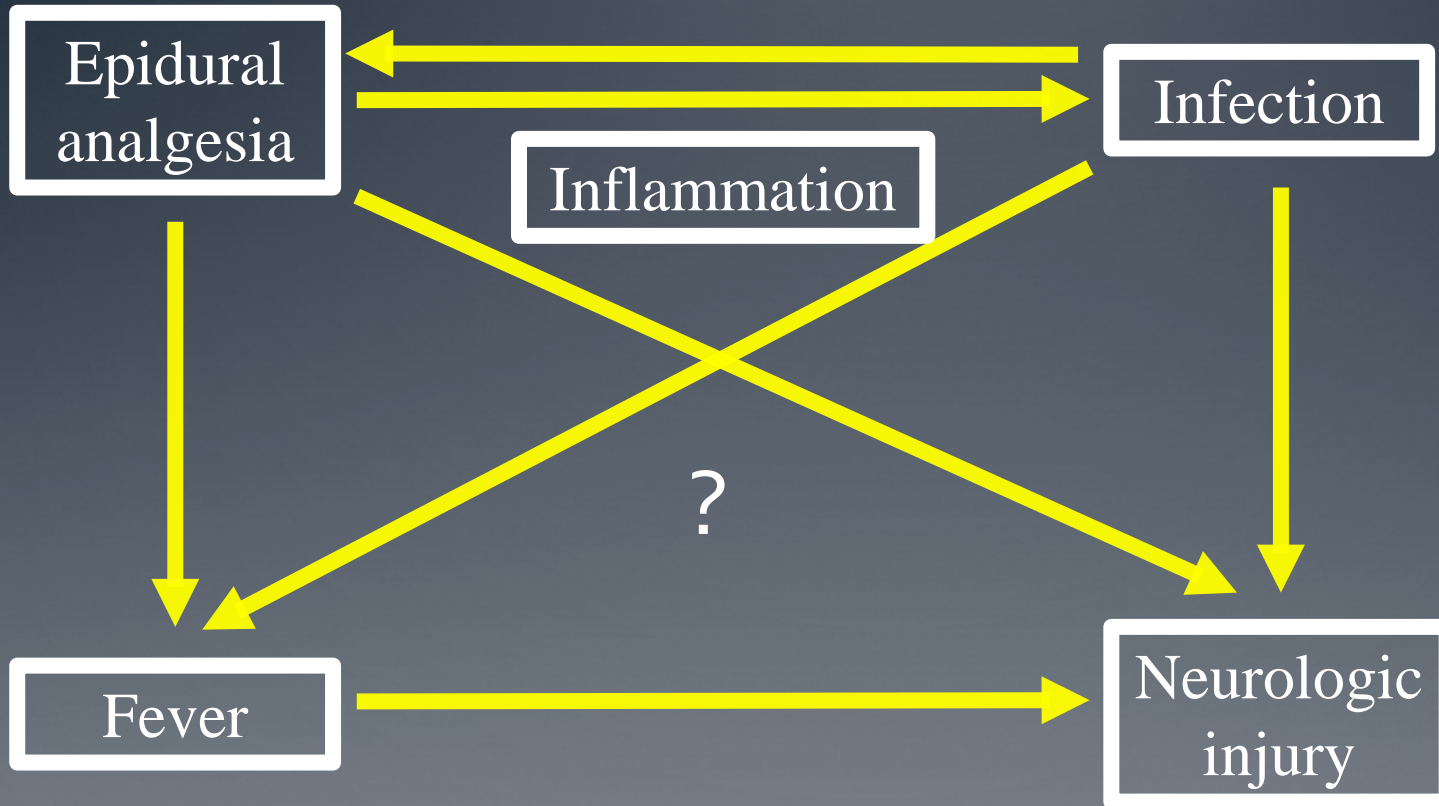
Anesthesia and The Developing Brain

Kids who
need surgery

≠

Kids who
don't

Epidural "Fever"



Epidural "Fever"

Neal JL, Lamp JM, Lowe NK, et al.

Differences in Inflammatory Markers between Nulliparous Women Admitted to Hospitals in Preactive Vs Active Labor.

Am J Obstet Gynecol 2015;212:68 e1-8

Inflammatory biomarkers = active labor

Epidural "Fever"

Armstrong-Wells J, Donnelly M, Post MD, et al.
*Inflammatory Predictors of Neurologic Disability after
Preterm Premature Rupture of Membranes.*
Am J Obstet Gynecol 2015;212:212 e1-941

Inflammatory biomarkers in mom = no injury
Inflammation in fetus = neurologic injury

Epidural "Fever"

Yamada N, Sato Y, Moriguchi-Goto S, et al.

Histological Severity of Fetal Inflammation Is Useful in Predicting Neonatal Outcome.

Placenta 2015;36:1490-3

Chorionic (maternal) inflammation

= no neurologic injury

Funisitis (fetal) inflammation

= neurologic injury

Placenta 2015;36:1490-3

Stages of ascending intraamniotic infection



Stage I



Stage II



Stage III



Stage IV

Epidural "Fever"

Tornell S, Ekeus C, Hultin M, et al.

Low Apgar Score, Neonatal Encephalopathy and Epidural Analgesia During Labour: A Swedish Registry-Based Study.

Acta Anaesth Scand 2015;59:486-95.

Epidural "Fever"

Swedish Birth Registry

- 300,000 deliveries
- 10 years
- Nulliparous women with singleton pregnancies at term
- Spontaneous onset of delivery

Epidural analgesia: 44%

Epidural "Fever"

Women who received Epidural Analgesia

- Shorter
- Higher BMI
- Larger fetus

Epidural "Fever"

Women who received Epidural Analgesia

- Dystocia and prolonged labor
- Instrumental delivery
- Chorioamnionitis or other infections

- 6 – fold higher rate of fever
(1.4% vs. 0.24%)

Epidural "Fever"

Multivariate analysis:

Epidural

No neurologic sequela

Fever

Convulsions

Neonatal cerebral ischemia

Epidural "Fever"

Epidural fever \neq Funisitis $=$ Neurologic Injury

Labor Analgesia

Second Stage

Craig MG, Grant EN, Tao W, et al.

A Randomized Control Trial of Bupivacaine and Fentanyl Versus Fentanyl-Only for Epidural Analgesia During the Second Stage of Labor.

Anesthesiol 2015;122:172-7

Labor Analgesia

Second Stage

310 nulliparous laboring women

Second stage epidural infusion

- Bupivacaine/fentanyl
- Fentanyl

Second stage: 75 min vs. 73 min

No difference in labor outcomes

Labor Analgesia

Second Stage

Weak legs \neq Weak Uterus

Thank you!