Postpartum Hemorrhage:

Diagnosis, Treatment and The Michigan Approach

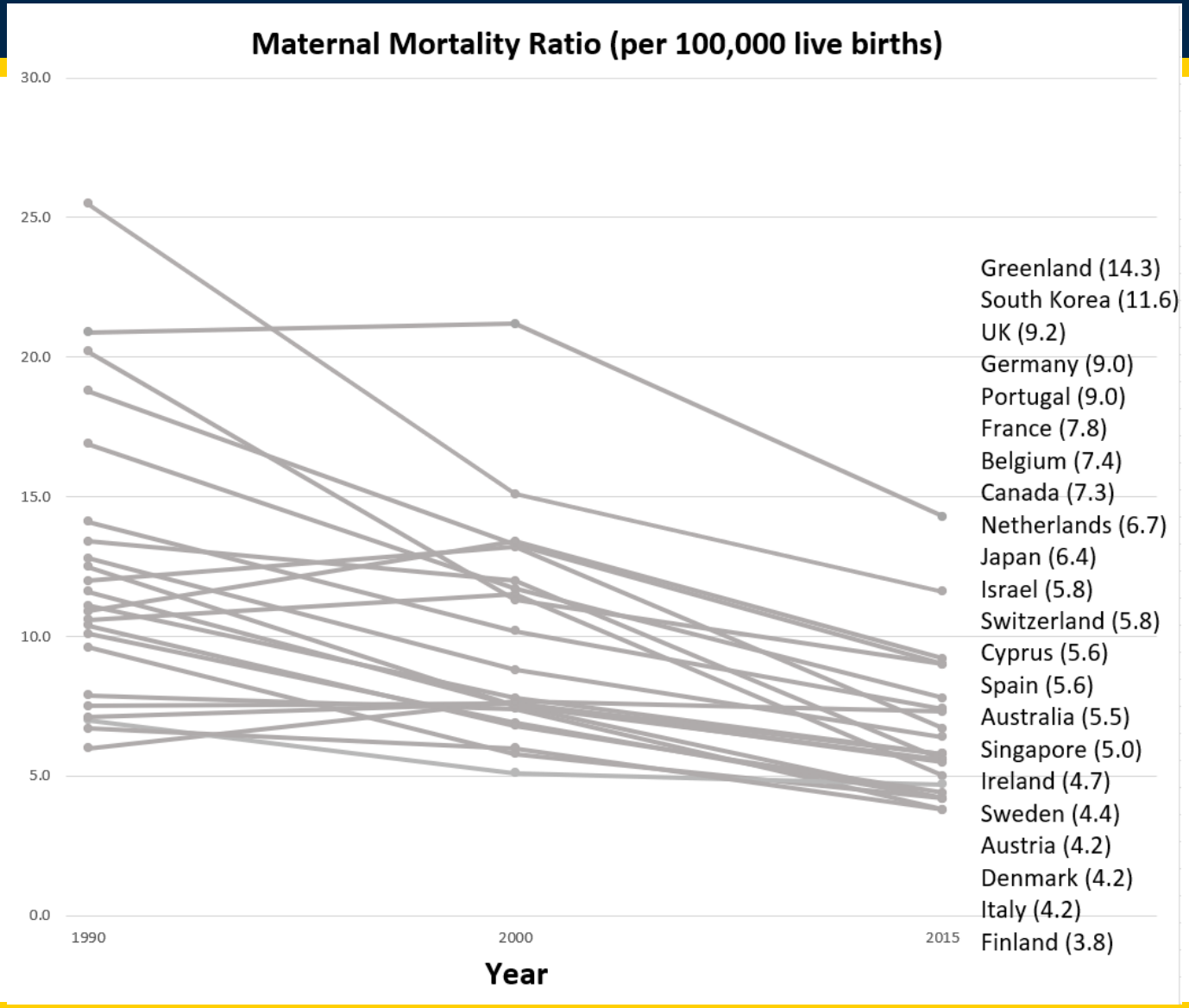
July 2021

Conflicts of Interest

I have no conflicts of interest to disclose.

Tom Klumpner, MD
Clinical Assistant Professor
Anesthesiology and Obstetrics and Gynecology
Assistant Director, Informatics and Systems Improvement

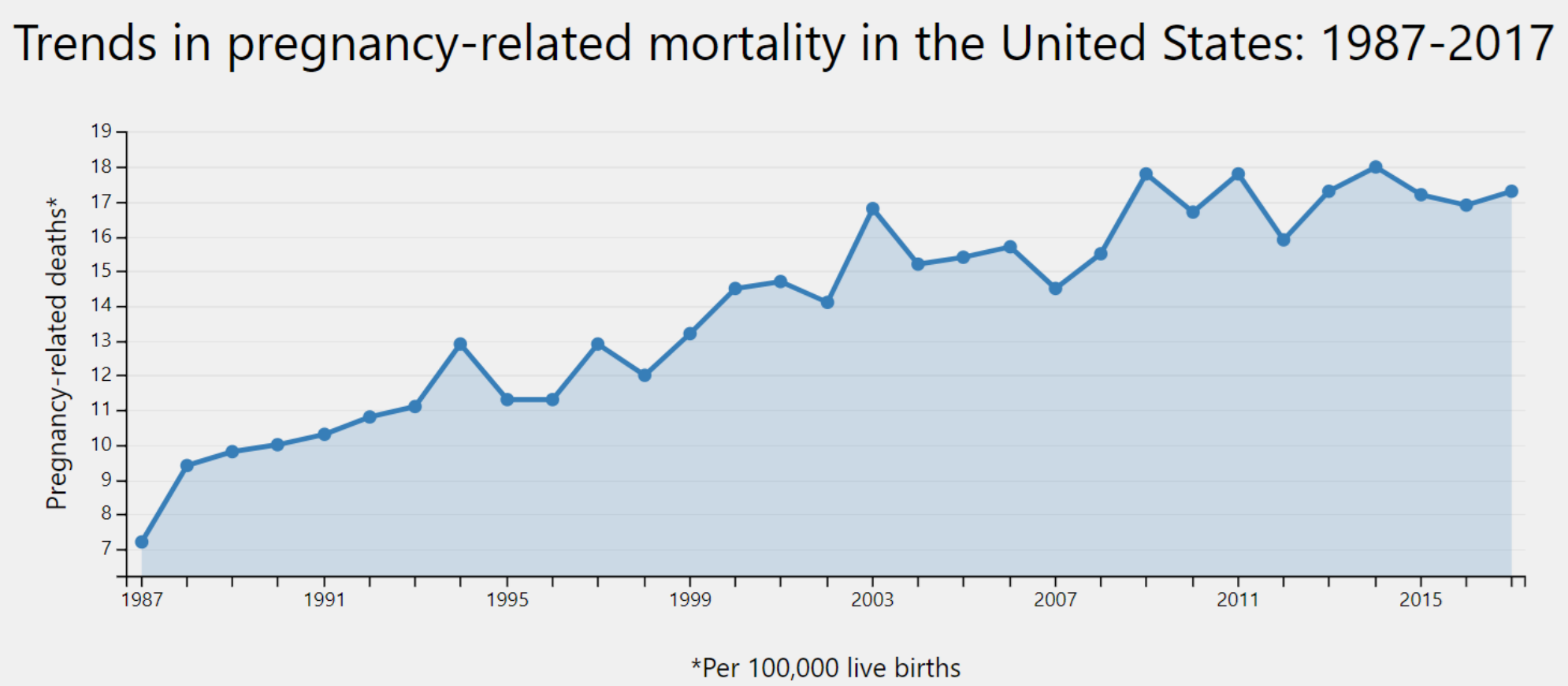
Maternal Mortality Rates Per 100,000 Live Births



GBD 2015 Maternal Mortality Collaborators. Global, regional, and national levels of maternal mortality, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 388, 1775–1812 (2016)

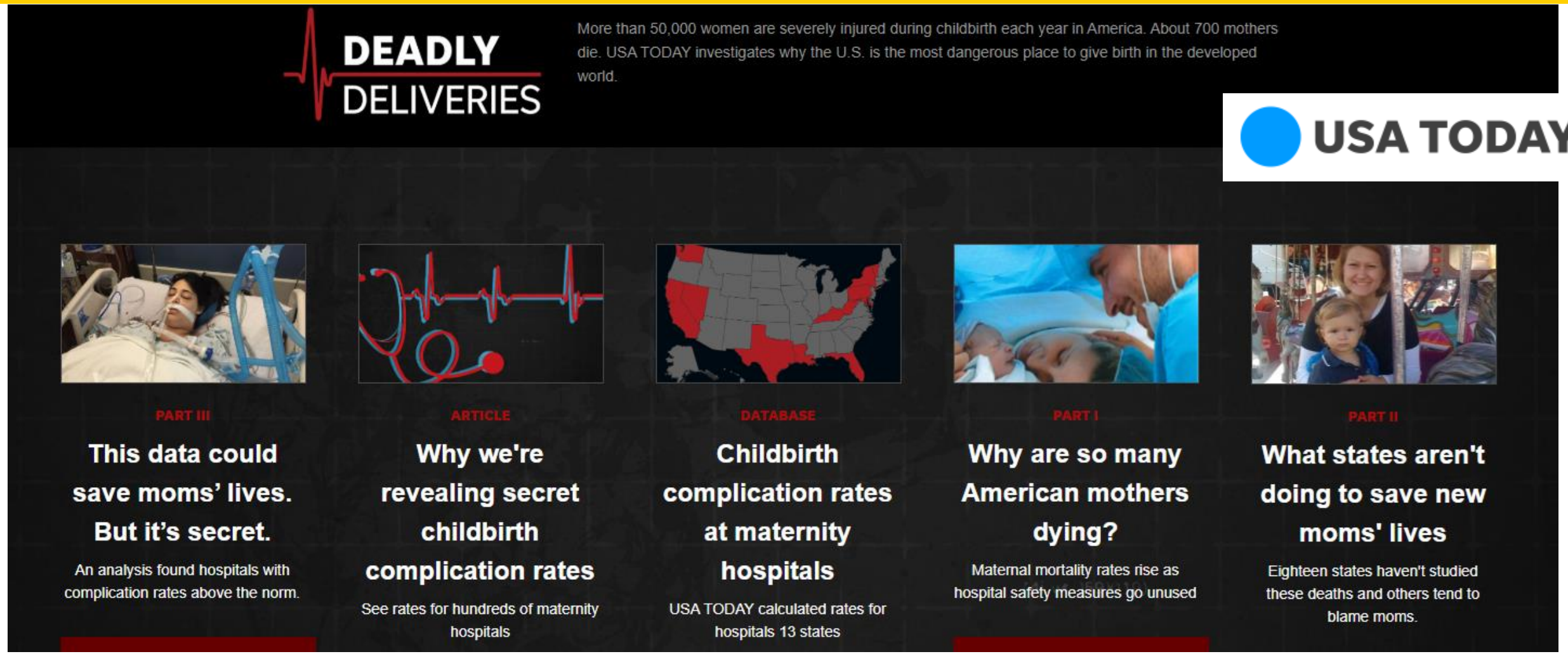
Figure adapted from NPR.org. https://www.npr.org/2017/05/12/528098789/u-s-has-the-worst-rate-of-maternal-deaths-in-the-developed-world Accessed: July 31, 2019

Maternal Mortality Rates Per 100,000 Live Births



CDC. Pregnancy Mortality Surveillance System. https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm Accessed: June 15, 2021

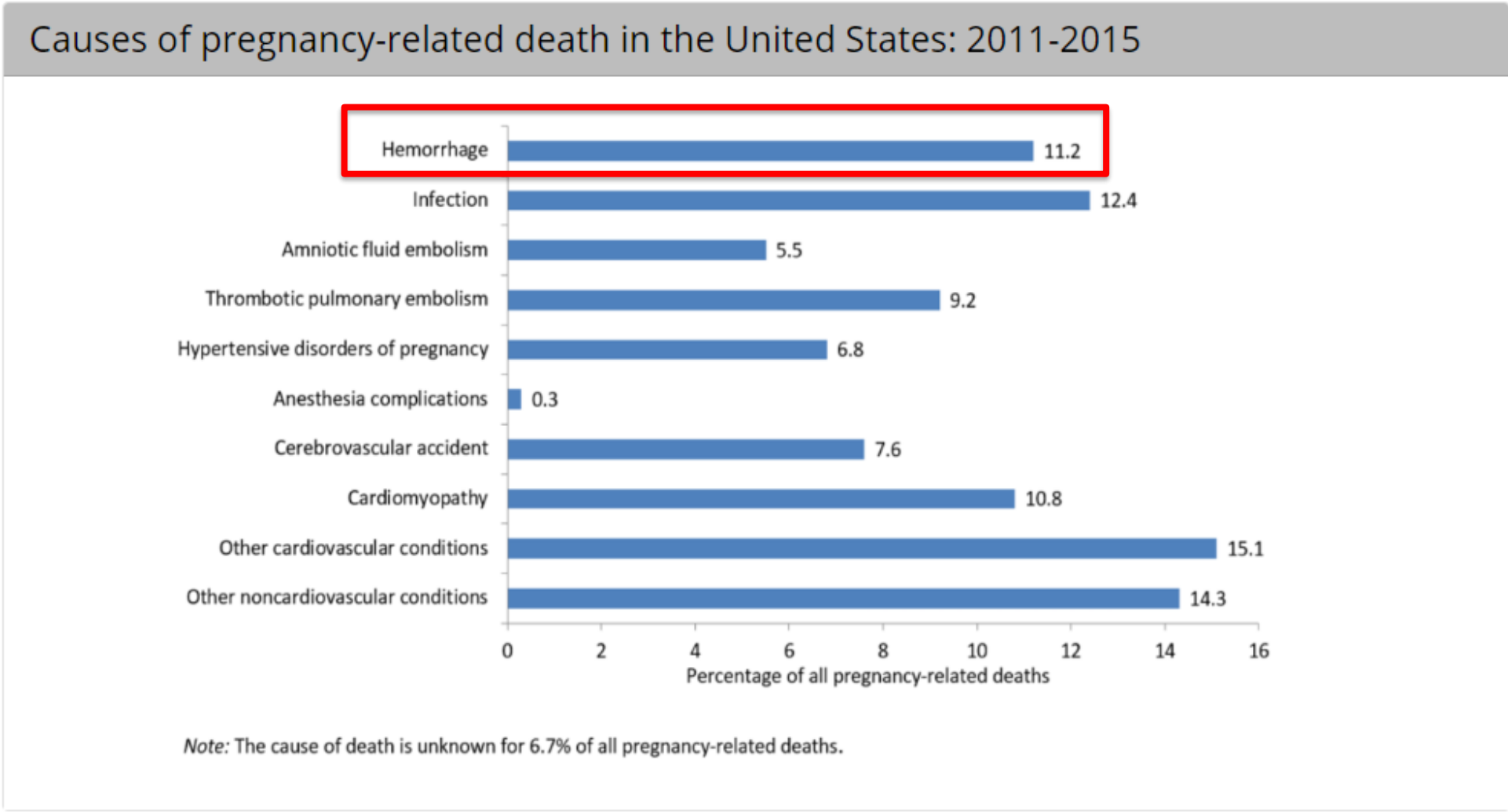
Maternal Mortality Rates Per 100,000 Live Births



Deadly Deliveries. USA Today. Accessed: July 2019

Maternal Mortality

- Postpartum hemorrhage (PPH) is a leading cause of maternal death

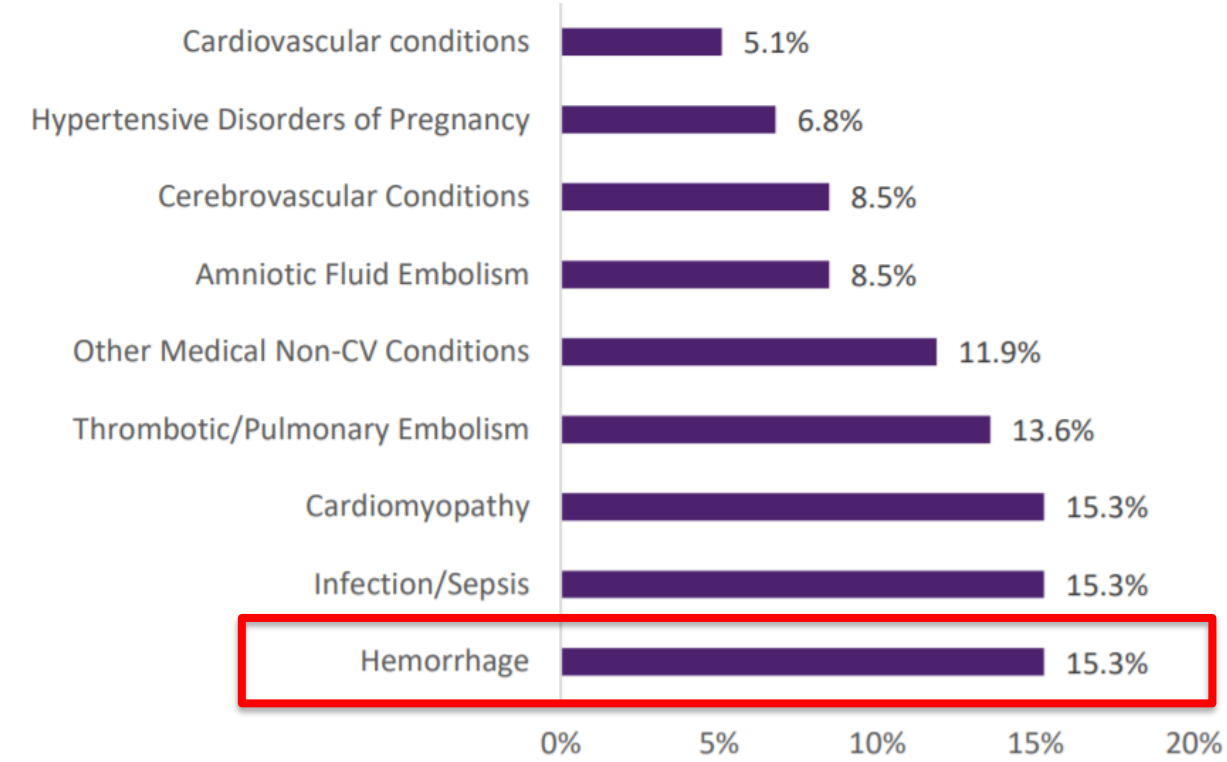


cdc.gov
https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-mortality-surveillance-system.htm

Maternal Mortality

- Postpartum hemorrhage (PPH) is a leading cause of maternal death in Michigan

Figure 2. Causes of Pregnancy-Related Deaths in Michigan, 2012-2016

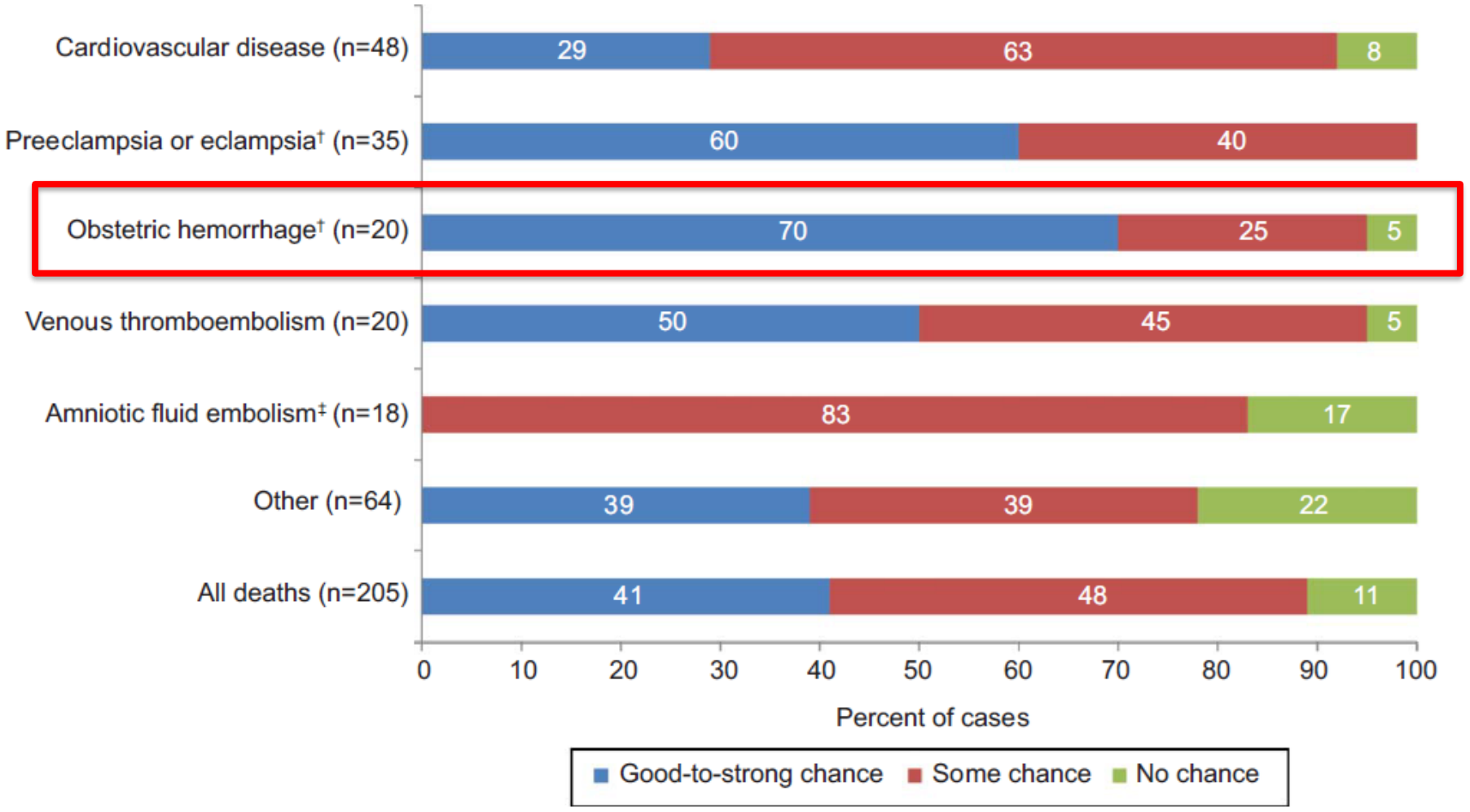


Date Sources: Michigan Department of Health and Human Services, Michigan Maternal Mortality Surveillance Program, 2012-2016; Michigan Department of Health and Human Services, Division for Vital Records and Health Statistics, Resident Death Files, 2012-2016

https://www.michigan.gov/documents/mdhhs/MMMS_2012-2016_Fact_Sheet_1.23.2020_679478_7.pdf

Preventable Maternal Mortality

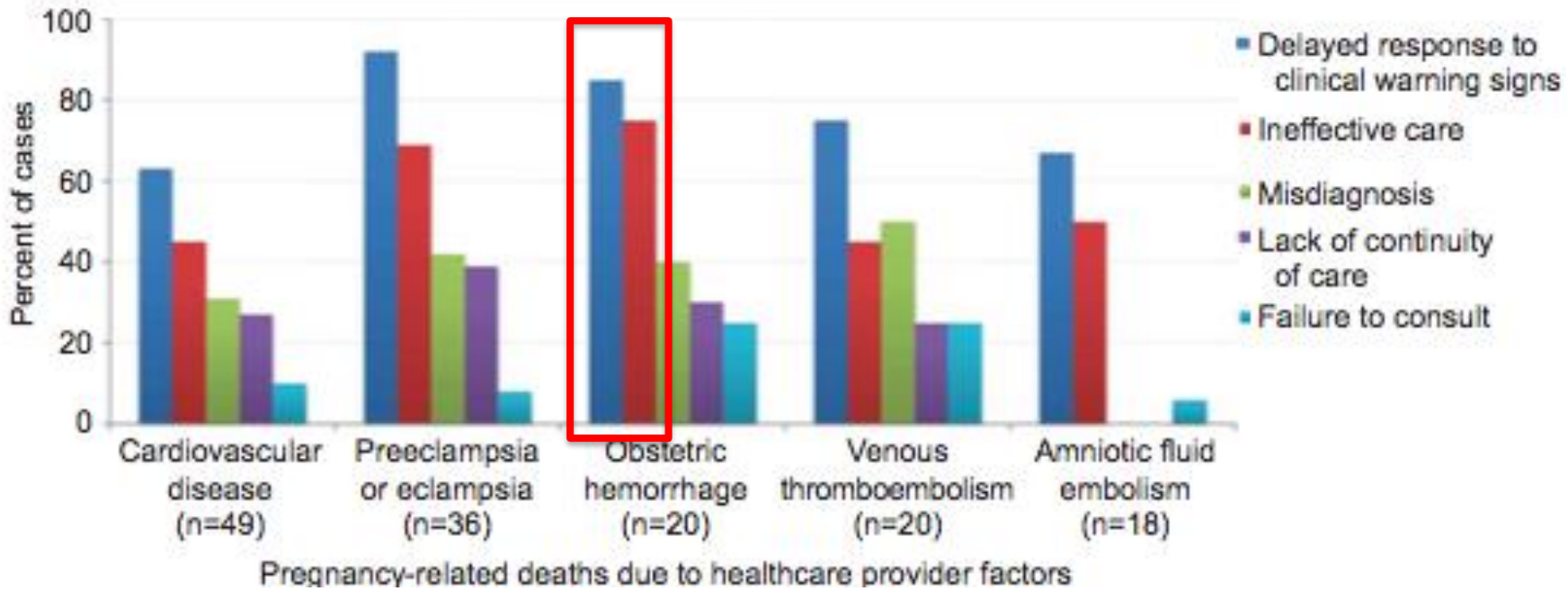
- Death from postpartum hemorrhage is often **preventable**



Main, E. et al. Pregnancy-Related Mortality in California: Causes, Characteristics, and Improvement Opportunities. Obstetrics & Gynecology. 125(4):938–947, Apr 2015

Preventable Maternal Mortality

- Death from postpartum hemorrhage is often **preventable** and is often related to delayed and ineffective care.



Main, E. et al. Pregnancy-Related Mortality in California: Causes, Characteristics, and Improvement Opportunities. Obstetrics & Gynecology. 125(4):938–947, Apr 2015

We are at a turning point.

Outline

- Epidemiology and definition
  - Risk Factors
- Diagnosis
  - Early Identification
- Pathogenesis
- Treatment
  - Transfusion Management
- Preparation

Health.mil

Incidence

- In the US: 3%
- Worldwide: 6-11%

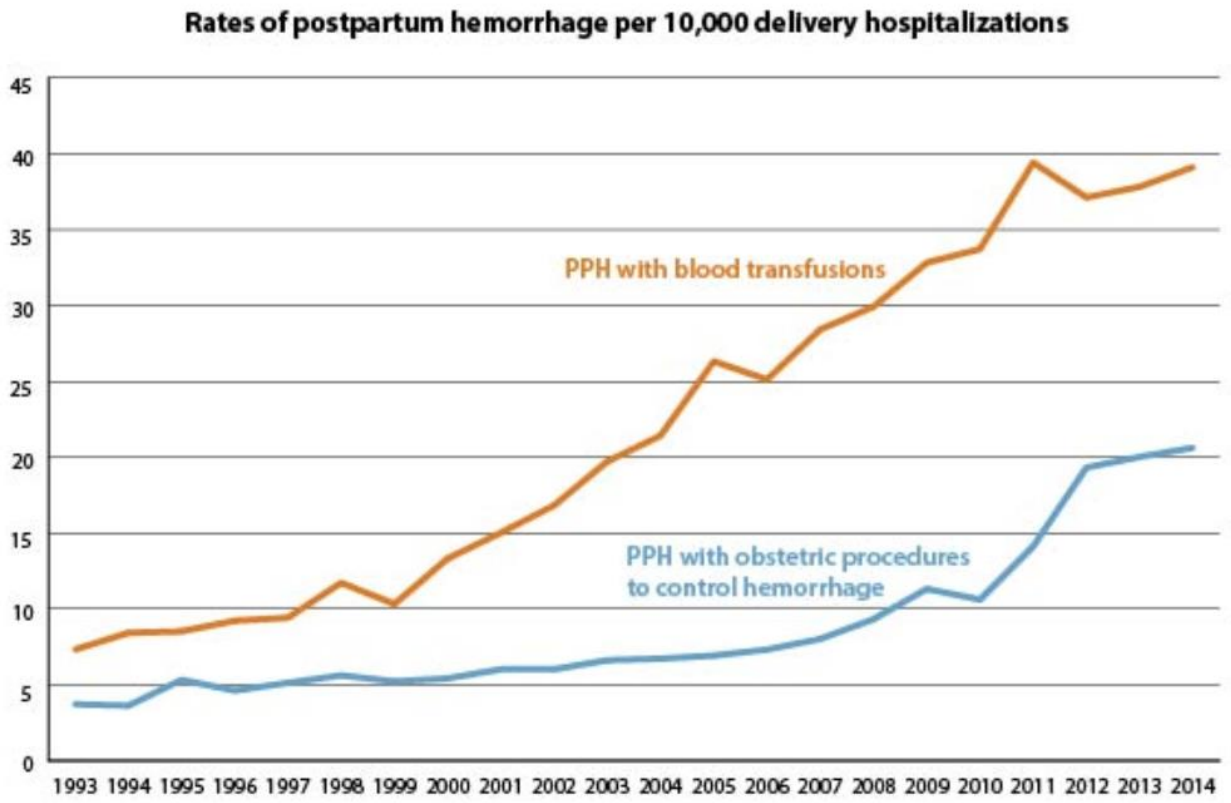
Marshall, A.L. et. al. The impact of postpartum hemorrhage on hospital length of stay and inpatient mortality: a National Inpatient Sample-based analysis. Am J Obstet Gynecol. 2017 Sep;217(3):344.e1-344.e6

John M. Eisenberg Center for Clinical Decisions and Communications Science. Comparative Effectiveness Review Summary Guides for Clinicians [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2007-. AHRQ Comparative Effectiveness Reviews. 2016 Jul 12.

Incidence

- In the US: 3%
- Worldwide: 6-11%

- Incidence is increasing
  - 26% increase in US between 1994-2006
  - Severity is also increasing



John M. Eisenberg Center for Clinical Decisions and Communications Science. Comparative Effectiveness Review Summary Guides for Clinicians [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2007-. AHRQ Comparative Effectiveness Reviews. 2016 Jul 12.

CDC. Data on Selected Pregnancy Complications in the United States. https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-complications-data.htm Accessed: July 2019

Risk Factors

Before Pregnancy

- Maternal Age <19
- Maternal Age >35
- Grand Multiparity (≥ 5 births)
- Prior Cesarean Delivery

Antepartum

- Hypertensive Disease of Pregnancy
- Diabetes
- Polyhydramnios
- Infection
- Placenta Previa/Abruption
- Multiple Gestation
- Macrosomia (>4,000g)
- Fibroids

Intra/Post-partum

- Medical Induction of Labor
- Instrumental Vaginal Delivery
- Cesarean Delivery

M.S. Kramer, C. Berg, H. Abenhaim, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol, 209 (2013), pp. 449.e1-449.e7

Risk Factors

- Not all risk factors are equal

TABLE 1
Associations between studied risk factors and severe PPH

Characteristic	% of total cohort	Confirmed cases, n (rate per 1000)	Crude OR (95% CI)	Adjusted OR (95% CI)
BEFORE INDEX PREGNANCY				
Maternal age				
≤19	10.7	2973 (3.2)	1.2 (1.1–1.3)	1.2 (1.2–1.3)
20-34	75.0	17,375 (2.7)	1.0 (Reference)	1.0 (Reference)
≥35	14.3	5134 (4.2)	1.6 (1.5–1.6)	1.5 (1.5–1.6)
Eldery primigravidity	1.3	555 (5.1)	1.7 (1.6–1.9)	1.3 (1.2–1.4)
Grand multiparity	0.5	216 (4.7)	1.6 (1.4–1.8)	1.4 (1.2–1.7)
Prior cesarean delivery	13.8	4273 (3.6)	1.3 (1.2–1.3)	1.3 (1.2–1.3)
DURING PREGNANCY BUT BEFORE LABOR AND DELIVERY				
Hypertension				
None	93.3	21,306 (2.7)	1.0 (Reference)	1.0 (Reference)
Preeclampsia	3.2	2680 (9.7)	3.7 (3.4–3.9)	3.1 (2.9–3.3)
Eclampsia	0.1	113 (15.6)	6.0 (5.0–7.2)	5.1 (4.3–6.2)
Other	3.4	1385 (4.7)	1.7 (1.6–1.9)	1.7 (1.6–1.8)
Diabetes	6.4	1989 (3.6)	1.3 (1.2–1.3)	1.0 (1.0–1.1)
Polyhydramnios	0.6	249 (4.7)	1.6 (1.4–1.9)	1.3 (1.2–1.5)
Amnionitis	1.8	1415 (9.3)	3.3 (2.9–3.8)	2.9 (2.5–3.4)
Placenta previa or abruption	1.8	3099 (19.9)	7.6 (7.3–8.0)	7.0 (6.6–7.3)
Multiple pregnancy	1.2	1095 (11.1)	3.9 (3.6–4.2)	2.8 (2.6–3.0)
Fetal macrosomia	2.9	929 (3.7)	1.3 (1.2–1.4)	1.4 (1.3–1.5)
Noncephalic presentation	7.4	2815 (4.4)	1.6 (1.5–1.6)	1.2 (1.1–1.2)
Fibroids	0.9	626 (8.3)	2.9 (2.6–3.2)	2.0 (1.8–2.2)
DURING LABOR AND DELIVERY				
Induction of labor				
Medical	15.4	4329 (3.3)	1.1 (1.1–1.2)	1.1 (1.04–1.1)
Surgical	3.7	859 (2.7)	0.9 (0.8–1.0)	0.9 (0.8–0.99)
Mode of delivery				
Spontaneous vaginal	64.5	12,471 (2.3)	1.0 (Reference)	1.0 (Reference)
Instrumental vaginal	7.1	2472 (4.1)	1.8 (1.7–1.9)	1.5 (1.4–1.6)
Cesarean	28.4	10,541 (4.3)	1.9 (1.8– 2.0)	1.4 (1.3–1.5)
Cervical laceration	0.2	3309 (187.8)	88.4 (82.4–94.7)	94.0 (87.3–101.2)
Uterine rupture	0.1	381 (64.5)	23.1 (20.4–26.2)	11.6 (9.7–13.8)

CI, confidence interval; *OR*, odds ratio; *PPH*, postpartum hemorrhage.

Kramer. Temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013.

M.S. Kramer, C. Berg, H. Abenhaim, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol, 209 (2013), pp. 449.e1-449.e7

Risk Factors

- Not all risk factors are equal
  - Multiple Gestation – OR 2.8 (2.6 - 3.0)
  - Amnionitis – OR 2.9 (2.5 - 3.4)
  - Preeclampsia – OR 3.1 (2.9 - 3.3)
  - Eclampsia – OR 5.1 (4.3 - 6.2)

TABLE 1
Associations between studied risk factors and severe PPH

Characteristic	% of total cohort	Confirmed cases, n (rate per 1000)	Crude OR (95% CI)	Adjusted OR (95% CI)
BEFORE INDEX PREGNANCY				
Maternal age				
≤19	10.7	2973 (3.2)	1.2 (1.1–1.3)	1.2 (1.2–1.3)
20-34	75.0	17,375 (2.7)	1.0 (Reference)	1.0 (Reference)
≥35	14.3	5134 (4.2)	1.6 (1.5–1.6)	1.5 (1.5–1.6)
Eldery primigravidity	1.3	555 (5.1)	1.7 (1.6–1.9)	1.3 (1.2–1.4)
Grand multiparity	0.5	216 (4.7)	1.6 (1.4–1.8)	1.4 (1.2–1.7)
Prior cesarean delivery	13.8	4273 (3.6)	1.3 (1.2–1.3)	1.3 (1.2–1.3)
DURING PREGNANCY BUT BEFORE LABOR AND DELIVERY				
Hypertension				
None	93.3	21,306 (2.7)	1.0 (Reference)	1.0 (Reference)
Preeclampsia	3.2	2680 (9.7)	3.7 (3.4–3.9)	3.1 (2.9–3.3)
Eclampsia	0.1	113 (15.6)	6.0 (5.0–7.2)	5.1 (4.3–6.2)
Other	3.4	1385 (4.7)	1.7 (1.6–1.9)	1.7 (1.6–1.8)
Diabetes	6.4	1989 (3.6)	1.3 (1.2–1.3)	1.0 (1.0–1.1)
Polyhydramnios	0.6	249 (4.7)	1.6 (1.4–1.9)	1.3 (1.2–1.5)
Amnionitis	1.8	1415 (9.3)	3.3 (2.9–3.8)	2.9 (2.5–3.4)
Placenta previa or abruption	1.8	3099 (19.9)	7.6 (7.3–8.0)	7.0 (6.6–7.3)
Multiple pregnancy	1.2	1095 (11.1)	3.9 (3.6–4.2)	2.8 (2.6–3.0)
Fetal macrosomia	2.9	929 (3.7)	1.3 (1.2–1.4)	1.4 (1.3–1.5)
Noncephalic presentation	7.4	2815 (4.4)	1.6 (1.5–1.6)	1.2 (1.1–1.2)
Fibroids	0.9	626 (8.3)	2.9 (2.6–3.2)	2.0 (1.8–2.2)
DURING LABOR AND DELIVERY				
Induction of labor				
Medical	15.4	4329 (3.3)	1.1 (1.1–1.2)	1.1 (1.04–1.1)
Surgical	3.7	859 (2.7)	0.9 (0.8–1.0)	0.9 (0.8–0.99)
Mode of delivery				
Spontaneous vaginal	64.5	12,471 (2.3)	1.0 (Reference)	1.0 (Reference)
Instrumental vaginal	7.1	2472 (4.1)	1.8 (1.7–1.9)	1.5 (1.4–1.6)
Cesarean	28.4	10,541 (4.3)	1.9 (1.8– 2.0)	1.4 (1.3–1.5)
Cervical laceration	0.2	3309 (187.8)	88.4 (82.4–94.7)	94.0 (87.3–101.2)
Uterine rupture	0.1	381 (64.5)	23.1 (20.4–26.2)	11.6 (9.7–13.8)

CI, confidence interval; *OR*, odds ratio; *PPH*, postpartum hemorrhage.

Kramer. Temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013.

M.S. Kramer, C. Berg, H. Abenhaim, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol, 209 (2013), pp. 449.e1-449.e7

Risk Factors

- Risk factors are not completely predictive

TABLE 1
Associations between studied risk factors and severe PPH

Characteristic	% of total cohort	Confirmed cases, n (rate per 1000)	Crude OR (95% CI)	Adjusted OR (95% CI)
BEFORE INDEX PREGNANCY				
Maternal age				
≤19	10.7	2973 (3.2)	1.2 (1.1–1.3)	1.2 (1.2–1.3)
20-34	75.0	17,375 (2.7)	1.0 (Reference)	1.0 (Reference)
≥35	14.3	5134 (4.2)	1.6 (1.5–1.6)	1.5 (1.5–1.6)
Eldery primigravidity	1.3	555 (5.1)	1.7 (1.6–1.9)	1.3 (1.2–1.4)
Grand multiparity	0.5	216 (4.7)	1.6 (1.4–1.8)	1.4 (1.2–1.7)
Prior cesarean delivery	13.8	4273 (3.6)	1.3 (1.2–1.3)	1.3 (1.2–1.3)
DURING PREGNANCY BUT BEFORE LABOR AND DELIVERY				
Hypertension				
None	93.3	21,306 (2.7)	1.0 (Reference)	1.0 (Reference)
Preeclampsia	3.2	2680 (9.7)	3.7 (3.4–3.9)	3.1 (2.9–3.3)
Eclampsia	0.1	113 (15.6)	6.0 (5.0–7.2)	5.1 (4.3–6.2)
Other	3.4	1385 (4.7)	1.7 (1.6–1.9)	1.7 (1.6–1.8)
Diabetes	6.4	1989 (3.6)	1.3 (1.2–1.3)	1.0 (1.0–1.1)
Polyhydramnios	0.6	249 (4.7)	1.6 (1.4–1.9)	1.3 (1.2–1.5)
Amnionitis	1.8	1415 (9.3)	3.3 (2.9–3.8)	2.9 (2.5–3.4)
Placenta previa or abruption	1.8	3099 (19.9)	7.6 (7.3–8.0)	7.0 (6.6–7.3)
Multiple pregnancy	1.2	1095 (11.1)	3.9 (3.6–4.2)	2.8 (2.6–3.0)
Fetal macrosomia	2.9	929 (3.7)	1.3 (1.2–1.4)	1.4 (1.3–1.5)
Noncephalic presentation	7.4	2815 (4.4)	1.6 (1.5–1.6)	1.2 (1.1–1.2)
Fibroids	0.9	626 (8.3)	2.9 (2.6–3.2)	2.0 (1.8–2.2)
DURING LABOR AND DELIVERY				
Induction of labor				
Medical	15.4	4329 (3.3)	1.1 (1.1–1.2)	1.1 (1.04–1.1)
Surgical	3.7	859 (2.7)	0.9 (0.8–1.0)	0.9 (0.8–0.99)
Mode of delivery				
Spontaneous vaginal	64.5	12,471 (2.3)	1.0 (Reference)	1.0 (Reference)
Instrumental vaginal	7.1	2472 (4.1)	1.8 (1.7–1.9)	1.5 (1.4–1.6)
Cesarean	28.4	10,541 (4.3)	1.9 (1.8– 2.0)	1.4 (1.3–1.5)
Cervical laceration	0.2	3309 (187.8)	88.4 (82.4–94.7)	94.0 (87.3–101.2)
Uterine rupture	0.1	381 (64.5)	23.1 (20.4–26.2)	11.6 (9.7–13.8)

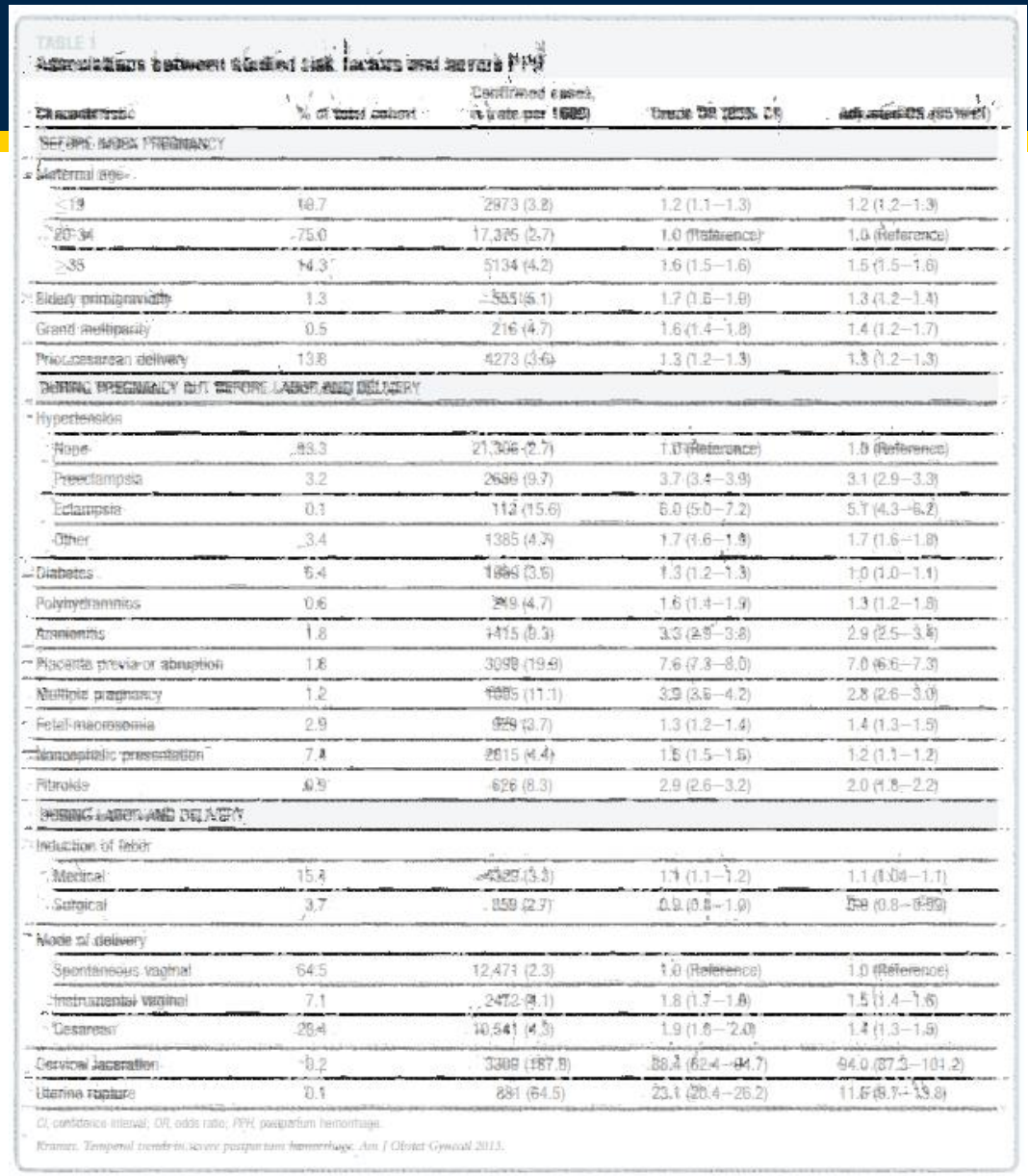
CI, confidence interval; *OR*, odds ratio; *PPH*, postpartum hemorrhage.

Kramer. Temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013.

M.S. Kramer, C. Berg, H. Abenhaim, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol, 209 (2013), pp. 449.e1-449.e7

Risk Factors

- Risk factors are not completely predictive
  - 40% of PPH occurs in low risk women



Characteristic	% of total cohort	Confirmed cases, n (rate per 1000)	Crude OR (95% CI)	Adjusted OR (95% CI)
BEFORE MOST PREGNANCY				
Maternal age				
<19	10.7	2973 (3.8)	1.2 (1.1–1.3)	1.2 (1.2–1.3)
20–34	75.0	17,376 (2.7)	1.0 (Reference)	1.0 (Reference)
≥35	14.3	5134 (4.2)	1.6 (1.5–1.6)	1.5 (1.5–1.6)
Elderly primigravidity	1.3	555 (5.1)	1.7 (1.6–1.9)	1.3 (1.2–1.4)
Grand multiparity	0.5	216 (4.7)	1.6 (1.4–1.8)	1.4 (1.2–1.7)
Precesarean delivery	13.8	4273 (3.6)	1.3 (1.2–1.3)	1.3 (1.2–1.3)
DURING PREGNANCY BUT BEFORE LABOR AND DELIVERY				
Hypertension				
None	83.3	21,306 (2.7)	1.0 (Reference)	1.0 (Reference)
Preeclampsia	3.2	2696 (9.7)	3.7 (3.4–3.9)	3.1 (2.9–3.3)
Eclampsia	0.1	112 (15.6)	6.0 (5.0–7.2)	5.7 (4.3–6.2)
Other	3.4	1385 (4.3)	1.7 (1.6–1.8)	1.7 (1.6–1.8)
Diabetes	6.4	1895 (3.5)	1.3 (1.2–1.3)	1.0 (1.0–1.1)
Polyhydramnios	0.6	289 (4.7)	1.6 (1.4–1.9)	1.3 (1.2–1.5)
Anemia	1.8	1415 (9.3)	3.3 (2.9–3.8)	2.9 (2.5–3.4)
Placenta previa or abruption	1.8	3098 (19.9)	7.6 (7.3–8.0)	7.0 (6.6–7.3)
Multiple pregnancy	1.2	1685 (11.1)	3.9 (3.6–4.2)	2.8 (2.6–3.0)
Fetal macrosomia	2.9	999 (3.7)	1.3 (1.2–1.4)	1.4 (1.3–1.5)
Nonvertex presentation	7.8	2615 (4.4)	1.5 (1.5–1.6)	1.2 (1.1–1.2)
Fibroids	0.9	626 (8.3)	2.9 (2.6–3.2)	2.0 (1.8–2.2)
DURING LABOR AND DELIVERY				
Induction of labor				
Medical	15.4	4329 (3.3)	1.1 (1.1–1.2)	1.1 (1.0–1.1)
Surgical	3.7	859 (2.7)	0.9 (0.8–1.0)	0.9 (0.8–0.99)
Mode of delivery				
Spontaneous vaginal	64.5	12,471 (2.3)	1.0 (Reference)	1.0 (Reference)
Instrumental vaginal	7.1	2472 (5.1)	1.8 (1.7–1.9)	1.5 (1.4–1.6)
Cesarean	28.4	10,541 (4.3)	1.9 (1.8–2.0)	1.4 (1.3–1.5)
Cervical laceration	0.2	3399 (187.8)	88.4 (82.4–94.7)	94.0 (87.9–101.2)
Uterine rupture	0.1	881 (64.5)	23.1 (20.4–26.2)	11.6 (9.7–13.8)

CI, confidence interval; OR, odds ratio; PPH, postpartum hemorrhage.

Kramer. Temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013.

Main, Elliott K. MD; Goffman, Dena MD; Scavone, Barbara M. MD; Low, Lisa Kane PhD, CNM; Bingham, Debra DrPH, RN; Fontaine, Patricia L. MD, MS; Gorlin, Jed B. MD; Lagrew, David C. MD; Levy, Barbara S. MD National Partnership for Maternal Safety, Obstetrics & Gynecology: July 2015 - Volume 126 - Issue 1 - p 155-162

Diagnosis

Definition

Maxpixel.net

- Traditionally:
  - Vaginal Delivery: 500cc of blood lost
  - Cesarean Delivery: 1000cc of blood lost
- Recently:
  - 1000cc blood lost

    OR
  - Blood loss accompanied by signs or symptoms of hypovolemia

Borovac-Pinheiro, A. et. al. Postpartum hemorrhage: new insights for definition and diagnosis. American Journal of Obstetrics & Gynecology, Volume 219, Issue 2, 162 – 168

Menard MK, Main EK, Currigan SM. Executive summary of the reVITALize initiative: standardizing obstetric data definitions. Obstet Gynecol 2014;124:150–3.

Diagnosis

Toledo et. al.

- Visual Estimation of Blood Loss
  - Most frequently practiced
  - Most people receive no formal training in estimating EBL
  - Training might not improve estimation
  - Often underestimates blood loss
  - Underestimation increases as blood loss increases
- Quantitative Methods
  - More sensitive
  - Not always rapidly available

Toledo P et al. The accuracy of blood loss estimation after simulated vaginal delivery. Anesth Analg. 2007 Dec;105(6):1736-40.
W Prasertcharoensuk, et. al. Accuracy of the blood loss estimation in the third stage of labor. Int J Gyn Obst. Vol 71. Iss 1. pg 69-70. Oct. 2000
Hancock A., et. al. Is accurate and reliable blood loss estimation the 'crucial step' in early detection of postpartum haemorrhage: an integrative review of the literature. BMC Pregnancy Childbirth. 2015; 15: 230.

Diagnosis

- Signs or symptoms of hypovolemia with blood loss
  - Increased blood volume in pregnancy limits sensitivity

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

R. Collis, E. Guasch. Managing major obstetric haemorrhage: Pharmacotherapy and transfusion. Best Practice & Research Clinical Anaesthesiology 31 (2017) 107-124

Diagnosis

- Signs or symptoms of hypovolemia with blood loss
  - Increased blood volume in pregnancy limits sensitivity

Estimated Blood Loss	Clinical Signs
<1000cc	--
>1000-1500cc	tachycardia, tachypnea, slight ↓ systolic blood pressure
>1500cc	↑ tachycardia, ↑ tachypnea, systolic blood pressure < 80 mmHg, altered mental status

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

R. Collis, E. Guasch. Managing major obstetric haemorrhage: Pharmacotherapy and transfusion. Best Practice & Research Clinical Anaesthesiology 31 (2017) 107-124

Diagnosis

- Signs or symptoms of hypovolemia with blood loss
  - Increased blood volume in pregnancy limits sensitivity
  - **Early recognition is key!**

Estimated Blood Loss	Clinical Signs
<1000cc	--
>1000-1500cc	tachycardia, tachypnea, slight ↓ systolic blood pressure
>1500cc	↑ tachycardia, ↑ tachypnea, systolic blood pressure < 80 mmHg, altered mental status

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

R. Collis, E. Guasch. Managing major obstetric haemorrhage: Pharmacotherapy and transfusion. Best Practice & Research Clinical Anaesthesiology 31 (2017) 107-124

Diagnosis

Table 1. The Maternal Early Warning Criteria

Systolic BP (mm Hg)	<90 or >160
Diastolic BP (mm Hg)	>100
Heart rate (beats per min)	<50 or >120
Respiratory rate (breaths per min)	<10 or >30
Oxygen saturation on room air, at sea level, %	<95
Oliguria, mL/hr for ≥2 hours	<35
Maternal agitation, confusion, or unresponsiveness; Patient with preeclampsia reporting a non-remitting headache or shortness of breath	

Mhyre J. et. al. The Maternal Early Warning Criteria A Proposal From the National Partnership for Maternal Safety. Obstet Gynecol 2014;124:782–6

Pathogenesis

Pathogenesis – The Four T's

Tone

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

Trauma

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

Trauma

Tissue

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

Trauma

Tissue

Thrombin

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

Trauma

Tissue

Thrombin

Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone	**Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis**
Trauma	**Genital Tract Laceration, Uterine Inversion, Surgical Misadventure**
Tissue	
Thrombin	

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone	**Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis**
Trauma	**Genital Tract Laceration, Uterine Inversion, Surgical Misadventure**
Tissue	**Retained Placenta, Invasive Placenta, Placental Abruption**
Thrombin	

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone	**Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis**
Trauma	**Genital Tract Laceration, Uterine Inversion, Surgical Misadventure**
Tissue	**Retained Placenta, Invasive Placenta, Placental Abruption**
Thrombin	**Placental Abruption, Pre-Eclampsia, Coagulopathy**

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists
Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis

E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Pathogenesis – The Four T's

Tone

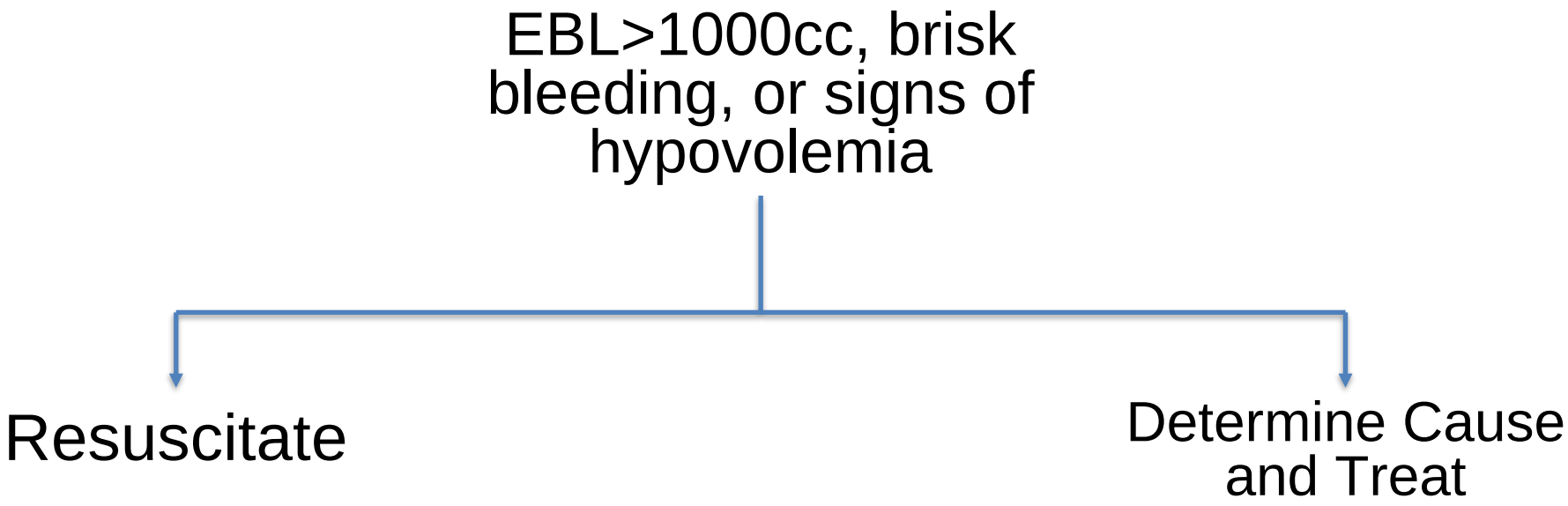
Uterine Atony: Overdistention, Muscle Fatigue, GA, Chorioamnionitis

Uterine atony causes 80% of PPH

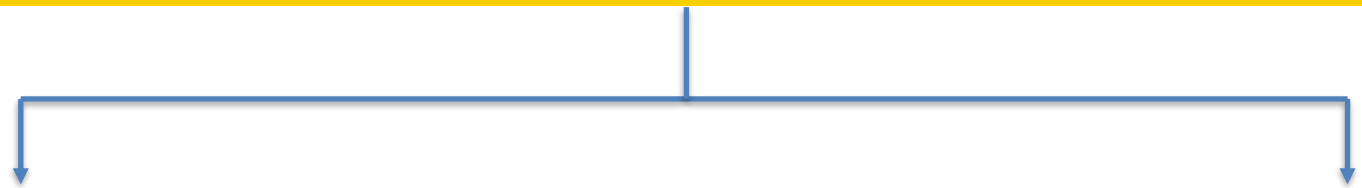
E. Mavrides, S. Allard, E. Chandraharan, et al., on behalf of the Royal College of Obstetricians and Gynaecologists Prevention and management of postpartum haemorrhage. BJOG (2016)

Treatment

Management of Postpartum Hemorrhage



Management of Postpartum Hemorrhage



Resuscitate

- Call for help
- Establish (multiple) large-bore IV access
- Obtain baseline laboratory studies: CBC, INR, fibrinogen, viscoelastometric testing (if available)
- Type and Screen/Type and Cross
- Correct hypovolemia
- Escalate monitoring
- Monitor urine output
- Move to the OR quickly
- Maintain normothermia, electrolyte management, etc

Determine Cause and Treat

Management of Postpartum Hemorrhage

Resuscitate

- Call for help
- Establish (multiple) large-bore IV access
- Obtain baseline laboratory studies: CBC, INR, fibrinogen, viscoelastometric testing (if available)
- Type and Screen/Type and Cross
- Correct hypovolemia
- Escalate monitoring
- Monitor urine output
- Move to the OR quickly
- Maintain normothermia, electrolyte management, etc

Determine Cause and Treat

Tone

Trauma

Tissue

Thrombin

Treatment

Wikimedia Commons

- Oxytocin
  - First line therapy
- Methylergonovine (Methergine)
  - Judicious use in patients with HTN
- Carboprost (Hemabate)
  - Judicious use in patients with reactive airway disease
- Misoprostol (Cytotec)

Determine Cause and Treat

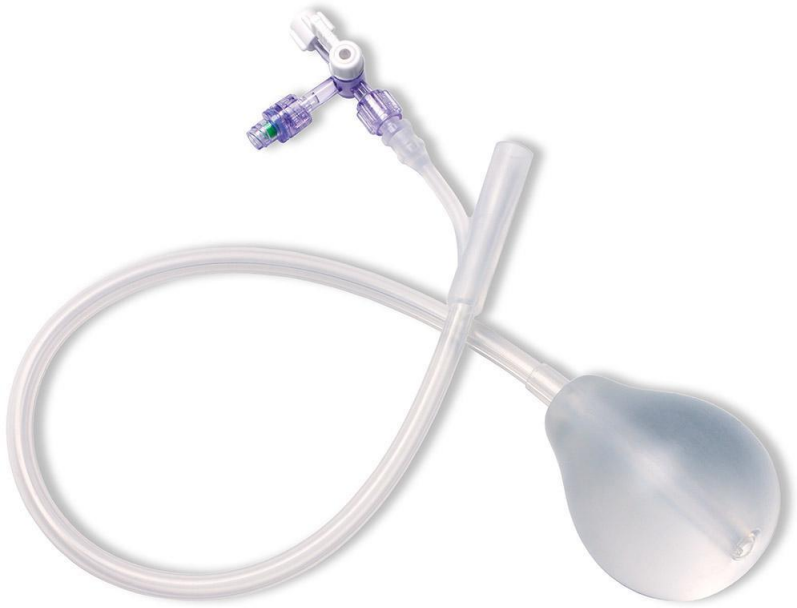
Tone

Trauma

Tissue

Thrombin

Treatment



utahmed.com

- Uterine massage
- Intrauterine balloon tamponade

- Uterine compression sutures

Determine Cause and Treat

Tone

Trauma

Tissue

Thrombin

Treatment

Wikimedia Commons

- Evaluation by obstetric team
- Laceration repair
- Uterine exploration
- Manual removal of placenta
- Curettage

Determine Cause and Treat

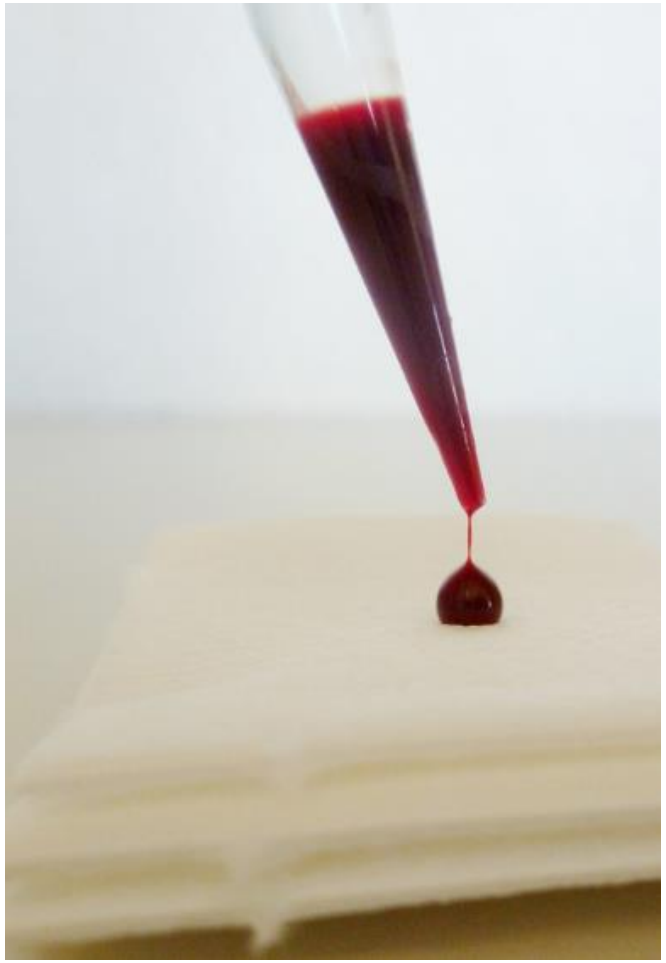
Tone

Trauma

Tissue

Thrombin

Treatment



Flickr

- Evaluation of clotting
- Replace clotting factors, platelets

- Hematology consult for congenital clotting disorders to target treatment

Determine Cause and Treat

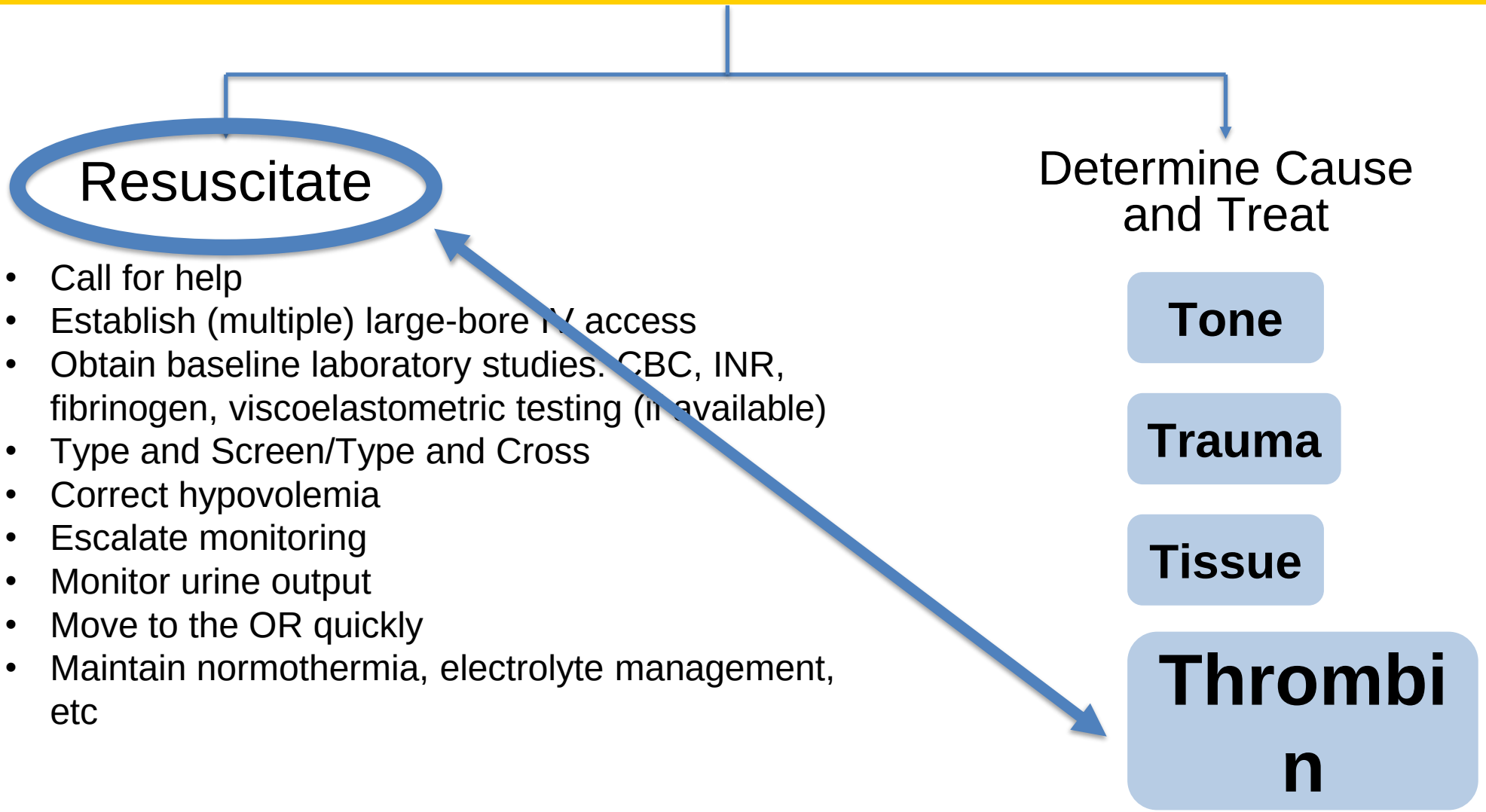
Tone

Trauma

Tissue

Thrombin

Management of Postpartum Hemorrhage



Transfusion Management

Transfusion Management

pRBC : FFP - Fixed ratio?

1:1?

Transfusion Management

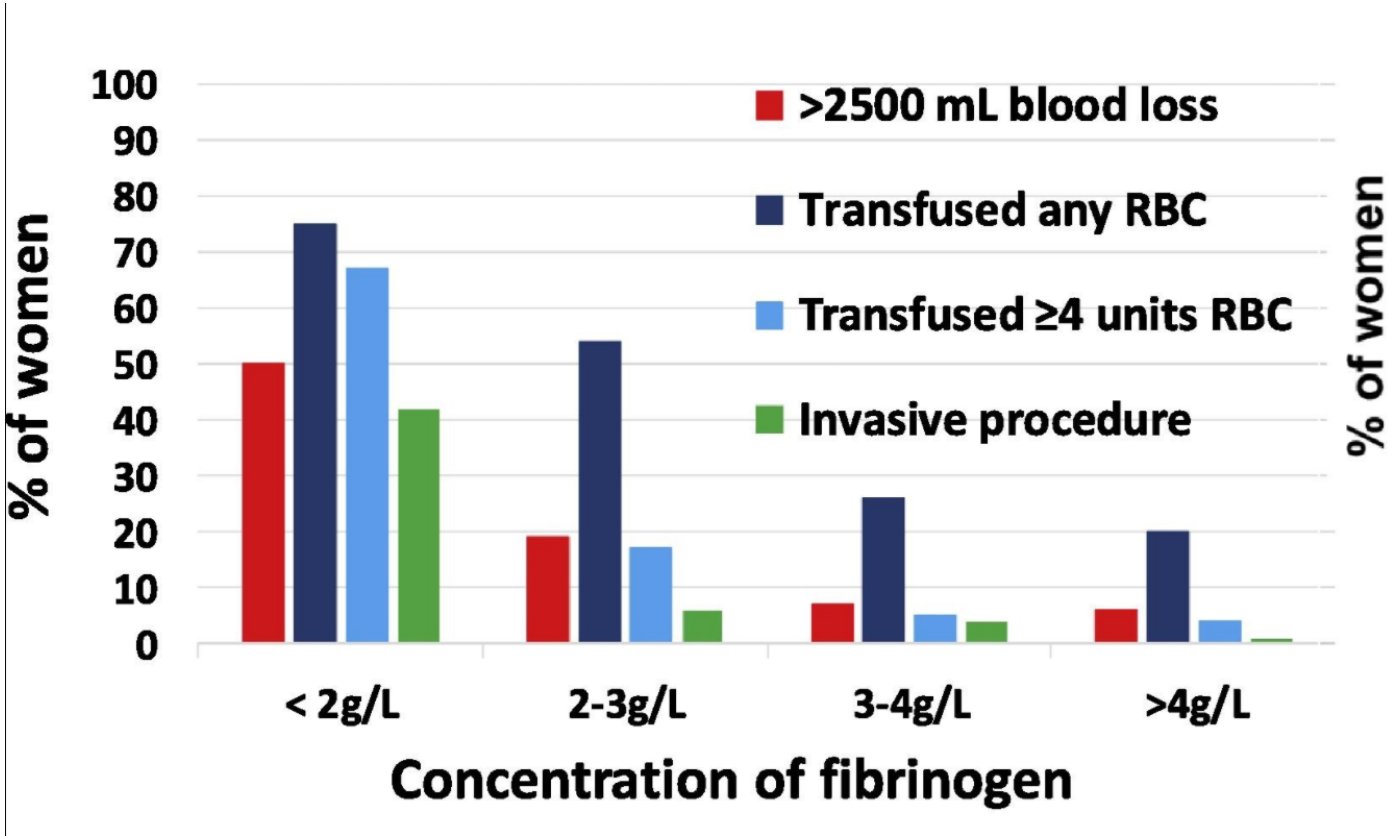
pRBC : FFP - Fixed ratio?

1:1?

More than 80% of institutions report using 1:1 ratio

Treml, A. et. al. Massive Transfusion Protocols: A Survey of Academic Medical Centers in the United States. Anesthesia & Analgesia 124 (1):277-281, January 2017.

Hypofibrinogenemia is associated with PPH



Collins PW, et. al. Management of postpartum haemorrhage: from research into practice, a narrative review of the literature and the Cardiff experience. Int J Obstet Anesth. 2019 Feb;37:106-117.

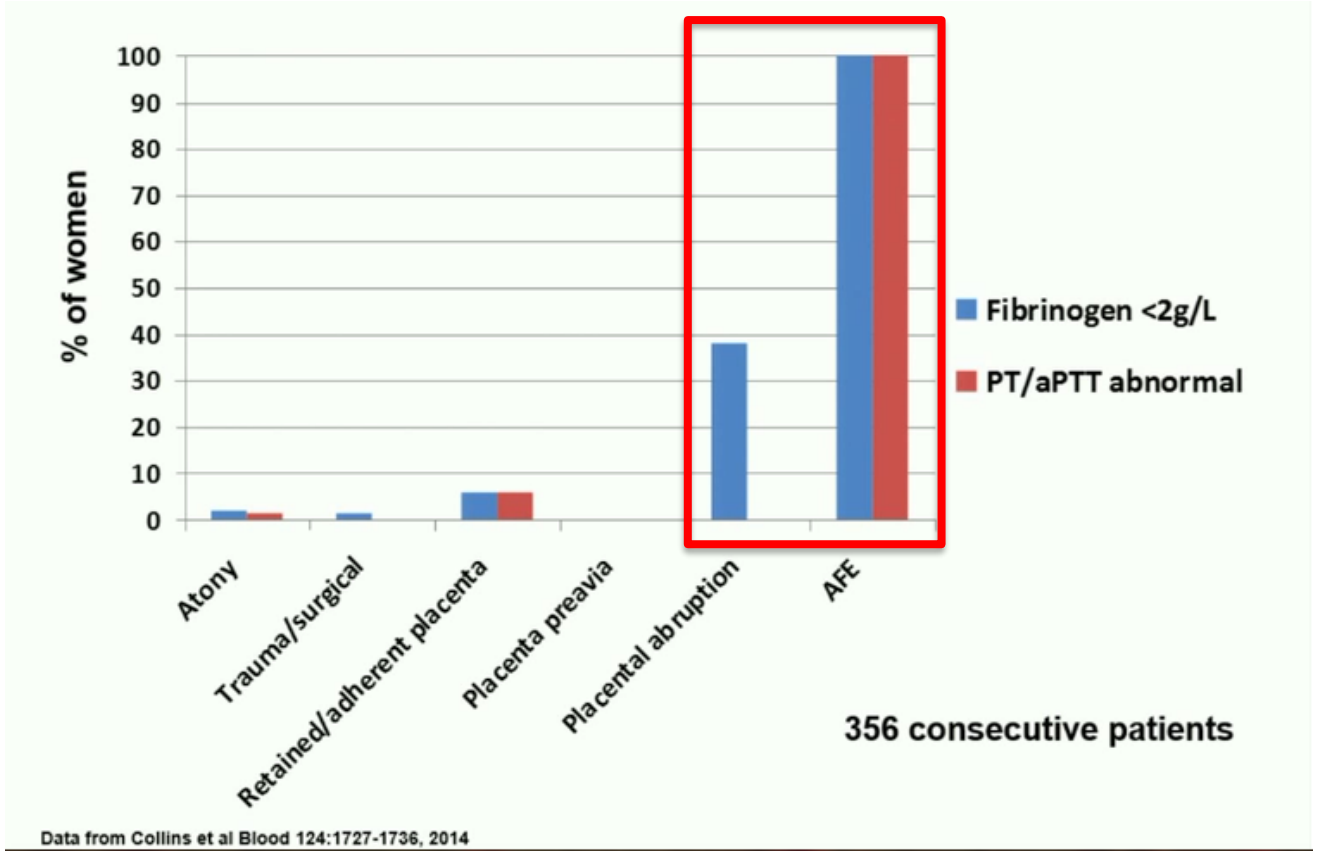
Transfusion Management

Table 1 Studies investigating the association between fibrinogen and progression of postpartum haemorrhage

Study	N	Study design			Fibrinogen g/L		
		Time of fibrinogen assay	Outcome defining progression of PPH	Descriptive statistic reported	No progression of PPH	Progression of PPH	ROC AUC (95% CI)
Charbit[31]	129	Infusion of uterotonic after manual exploration of uterus	Invasive procedure to control bleeding, fall in Hb ≥4 g/L or ≥4 units RBC	Median (IQR)	4.4 (3.7–5.1)	3.3 (2.5–4.2)	0.75 (CI NR) p <0.0001
Cortet[32]	738	Diagnosis of PPH	Invasive procedure to control bleeding, fall in Hb ≥4 g/L, ≥4 units RBC or admission to ITU	Mean (SD)	4.2 (1.2)	3.4 (0.9)	0.66 (0.64–0.68)
Poujade[55]	98	Variable time before embolisation	Success of radiological embolisation	Mean (SD)	2.9 (1.3)	1.8 (0.9)	NR
Gayat[34]	257	Variable time before procedure	Invasive procedure to control bleeding	Median (IQR)	2.7 (2.1–3.5)	1.8 (1.1–2.5)	0.83 (±0.03)*
de Lloyd[33]	240	First clinical concern during PPH	≥2500 mL blood loss	Mean (SD)	4.4 (1.1)	3.1 (1.0)	0.85 (0.78–0.93)
Collins[14]	346	1000–1500 mL blood loss	Transfusion of ≥8 units allogeneic blood products	Median (IQR)	3.9 (3.2–4.5)	2.1 (1.8–3.4)	0.82 (0.72–0.92)
Simon[35]	797	Before bleeding started	PPH requiring manual uterine exploration, RBC transfusion or fall in Hb ≥2 g/L	Mean (SD)	4.9 (1.0)	4.3 (1.3)	NR

Collins PW, et. al. Management of postpartum haemorrhage: from research into practice, a narrative review of the literature and the Cardiff experience. Int J Obstet Anesth. 2019 Feb;37:106-117.

Coagulation impairment after 1-2 liters blood loss



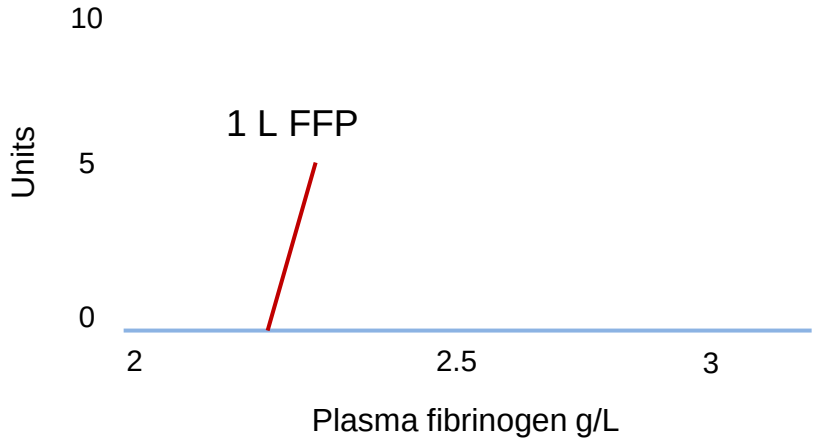
From Carlo Pancaro, MD, used with permission.

Effect of empiric FFP administration in PPH

Abruption

Fibrinogen <200 mg/dL

FFP contains about 200-250 mg/dL fibrinogen



*Normal fibrinogen (third trimester) = 373 - 619mg/dL

Collins et al Theoretical modeling of fibrinogen supplementation with therapeutic plasma, cryoprecipitate, or fibrinogen concentrate. BJA 113:585-95 2014.

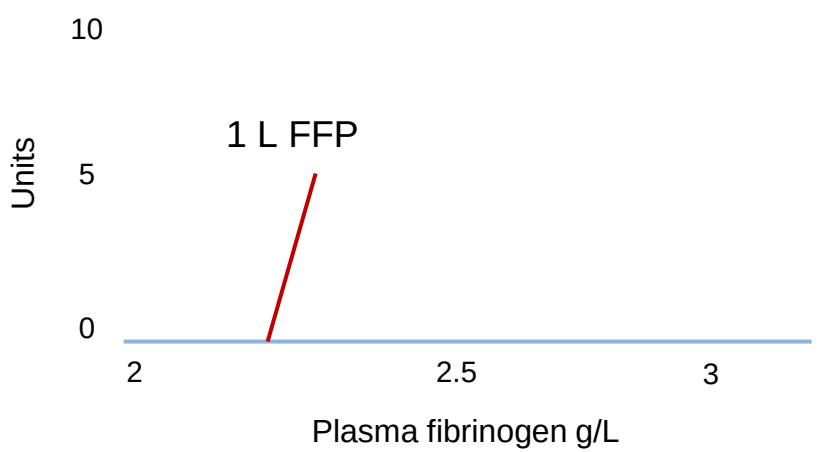
Abbassi-Ghanavati, M. et. al. Pregnancy and Laboratory Studies. Obstet Gynecol 2009;114:1326–31

Effect of empiric FFP administration in PPH

FFP contains about 200-250 mg/dL fibrinogen

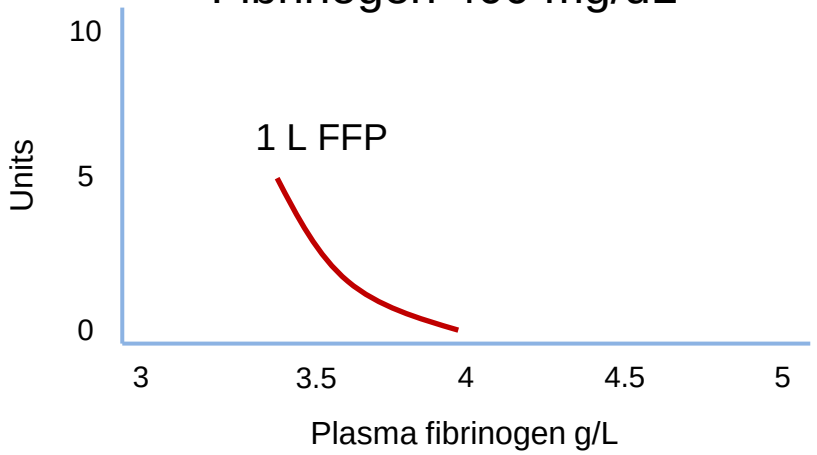
Abruption

Fibrinogen <200 mg/dL



Uterine Atony/Surgical Bleeding

Fibrinogen 400 mg/dL



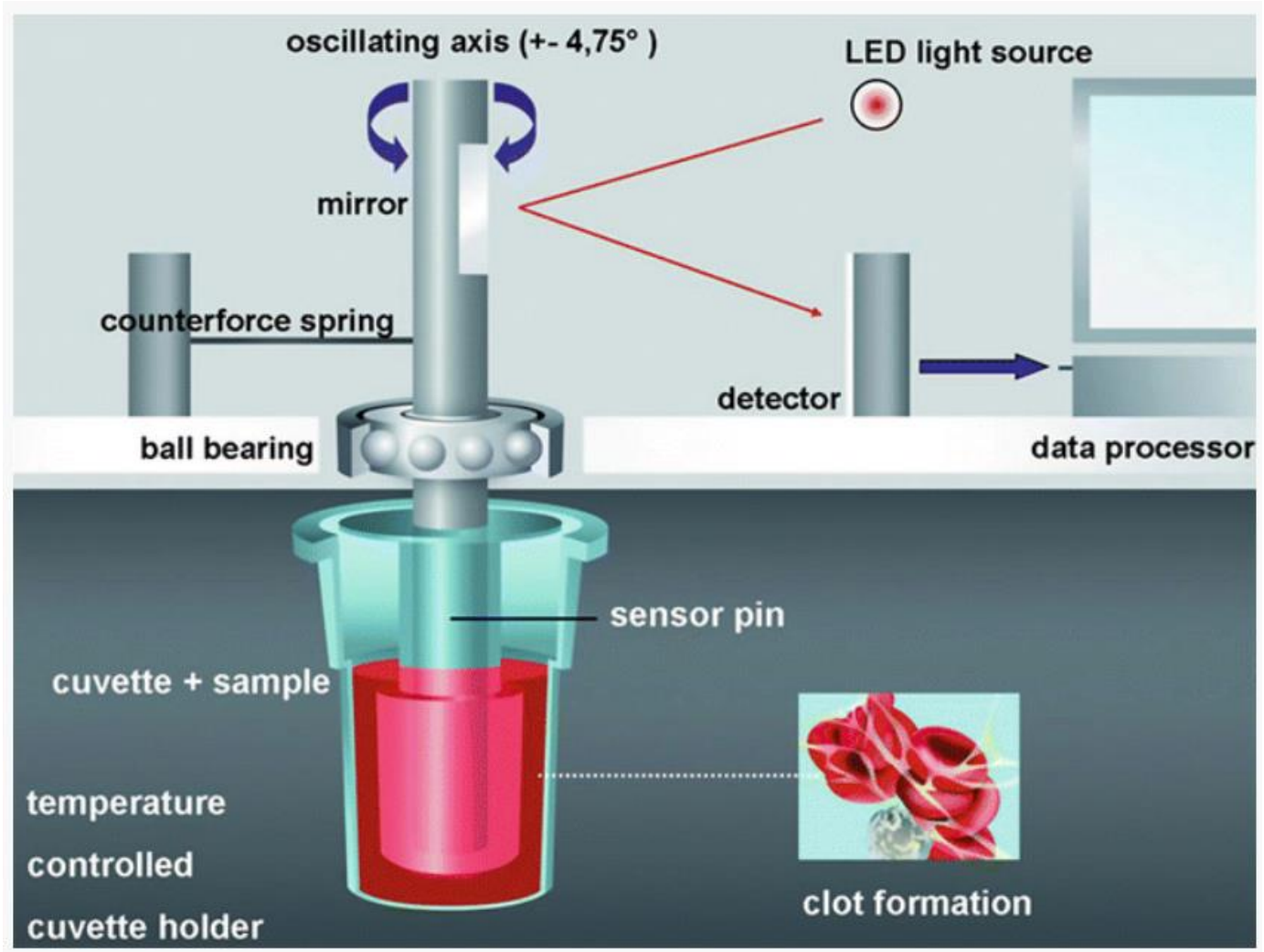
*Normal fibrinogen (third trimester) = 373 - 619mg/dL

Collins et al Theoretical modeling of fibrinogen supplementation with therapeutic plasma, cryoprecipitate, or fibrinogen concentrate. BJA 113:585-95 2014.

Abbassi-Ghanavati, M. et. al. Pregnancy and Laboratory Studies. Obstet Gynecol 2009;114:1326–31

Using Viscoelastometric Testing to Guide Transfusion Therapy

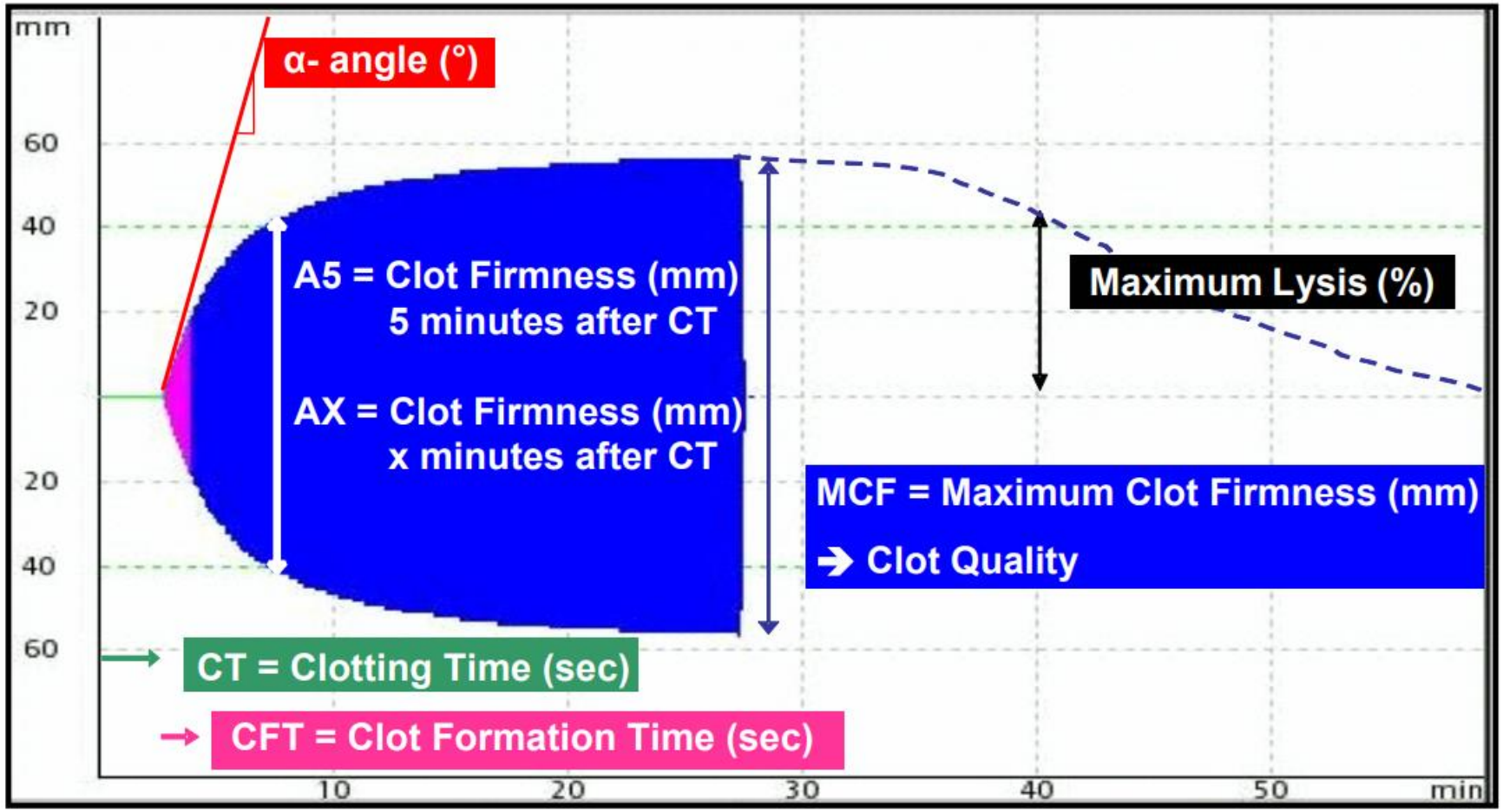
Viscoelastometric Testing



Görlinger K., Dirkmann D., Hanke A.A. (2016) Rotational Thromboelastometry (ROTEM®). In: Gonzalez E., Moore H., Moore E. (eds) Trauma Induced Coagulopathy. Springer, Cham

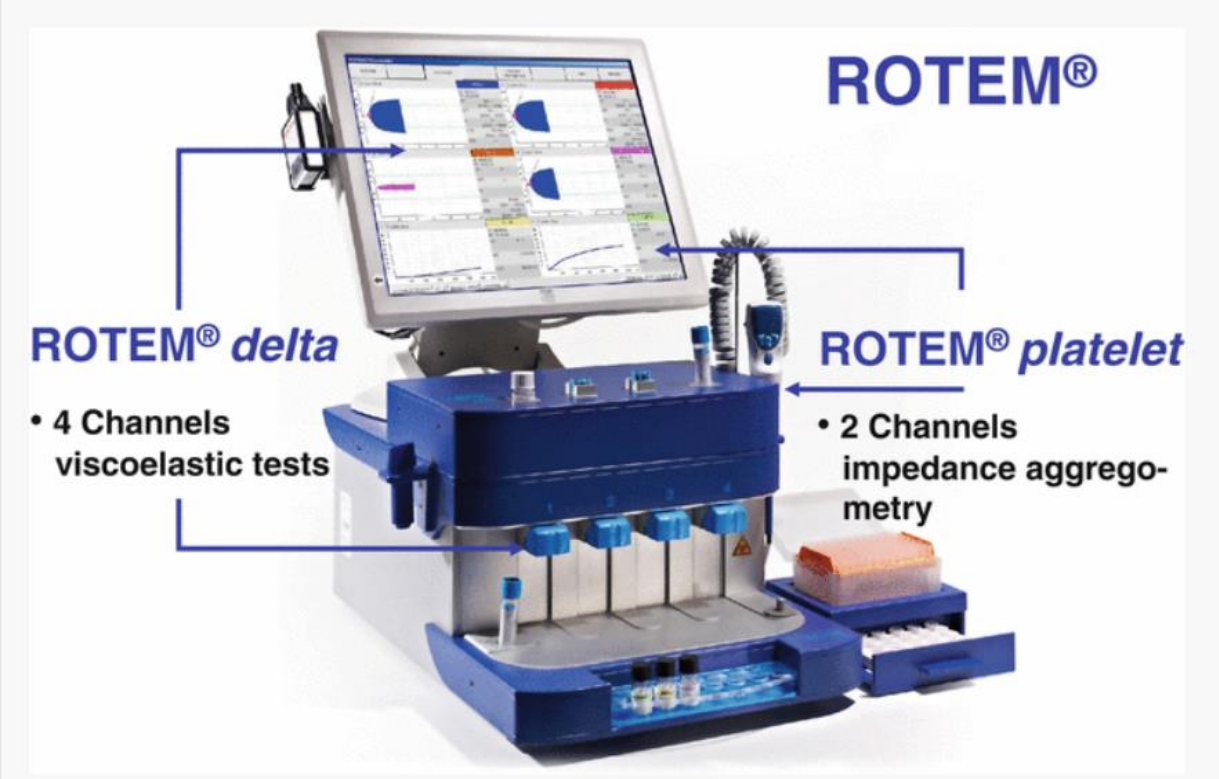
Viscoelastometric Testing

ROTEM® parameters



haemoview.com.au

Viscoelastometric Testing



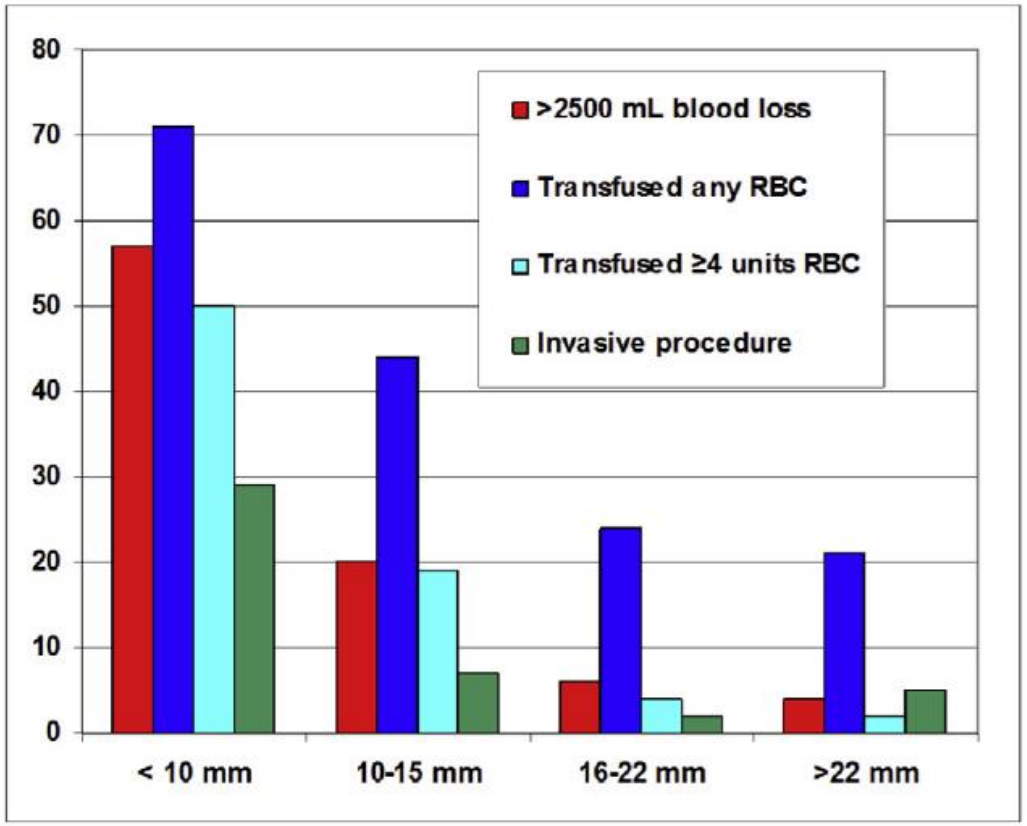
link.springer.com

- INTEM
  - Intrinsic system screening test
- EXTEM
  - Extrinsic system screening test
- FIBTEM
  - Isolated fibrinogen contribution to clot firmness

Görlinger K., Dirkmann D., Hanke A.A. (2016) Rotational Thromboelastometry (ROTEM®). In: Gonzalez E., Moore H., Moore E. (eds) Trauma Induced Coagulopathy. Springer, Cham

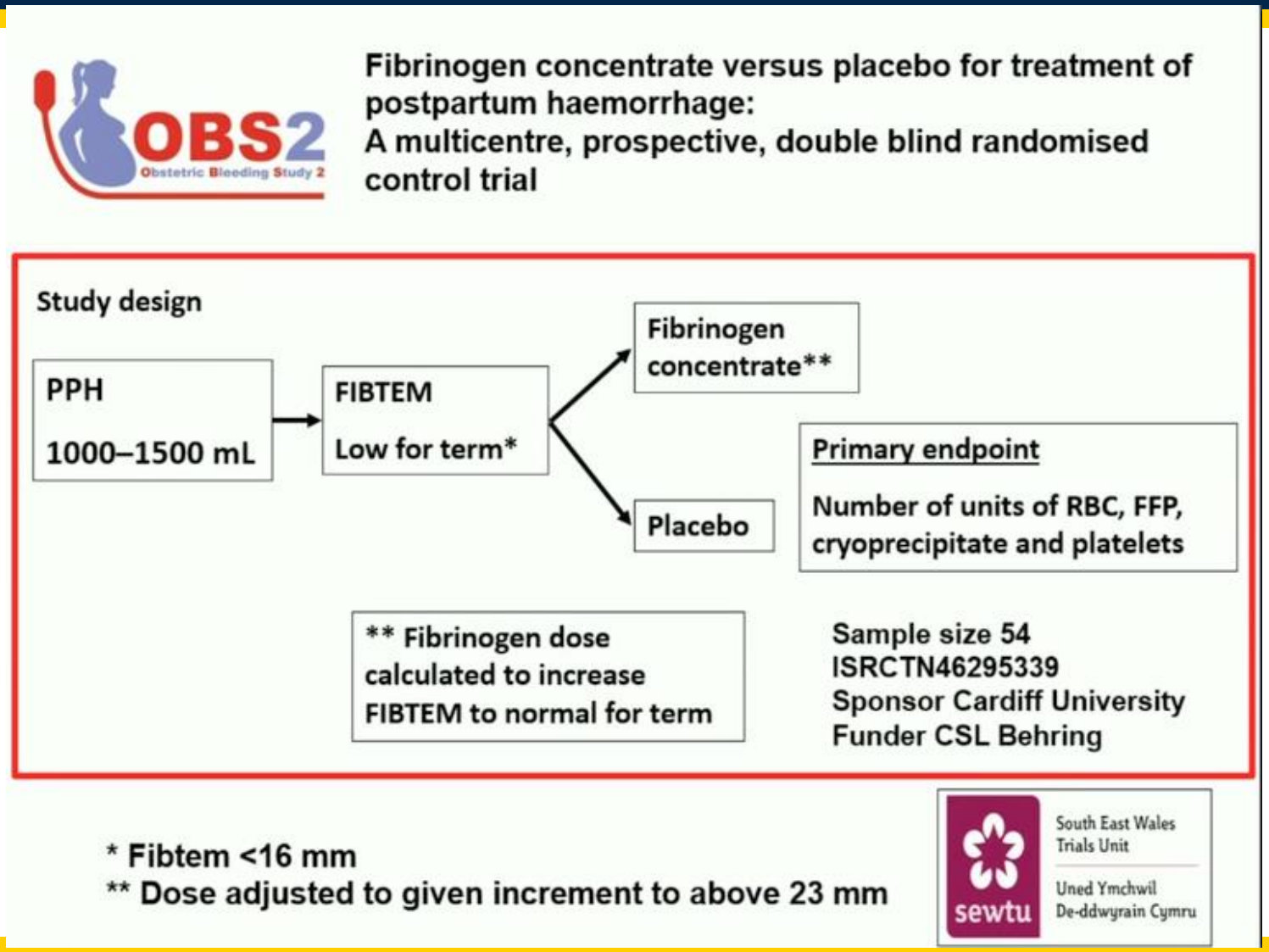
Transfusion Management

Viscoelastic fibrinogen testing correlates with severity of PPH



Collins PW, et. al. Management of postpartum haemorrhage: from research into practice, a narrative review of the literature and the Cardiff experience. Int J Obstet Anesth. 2019 Feb;37:106-117.

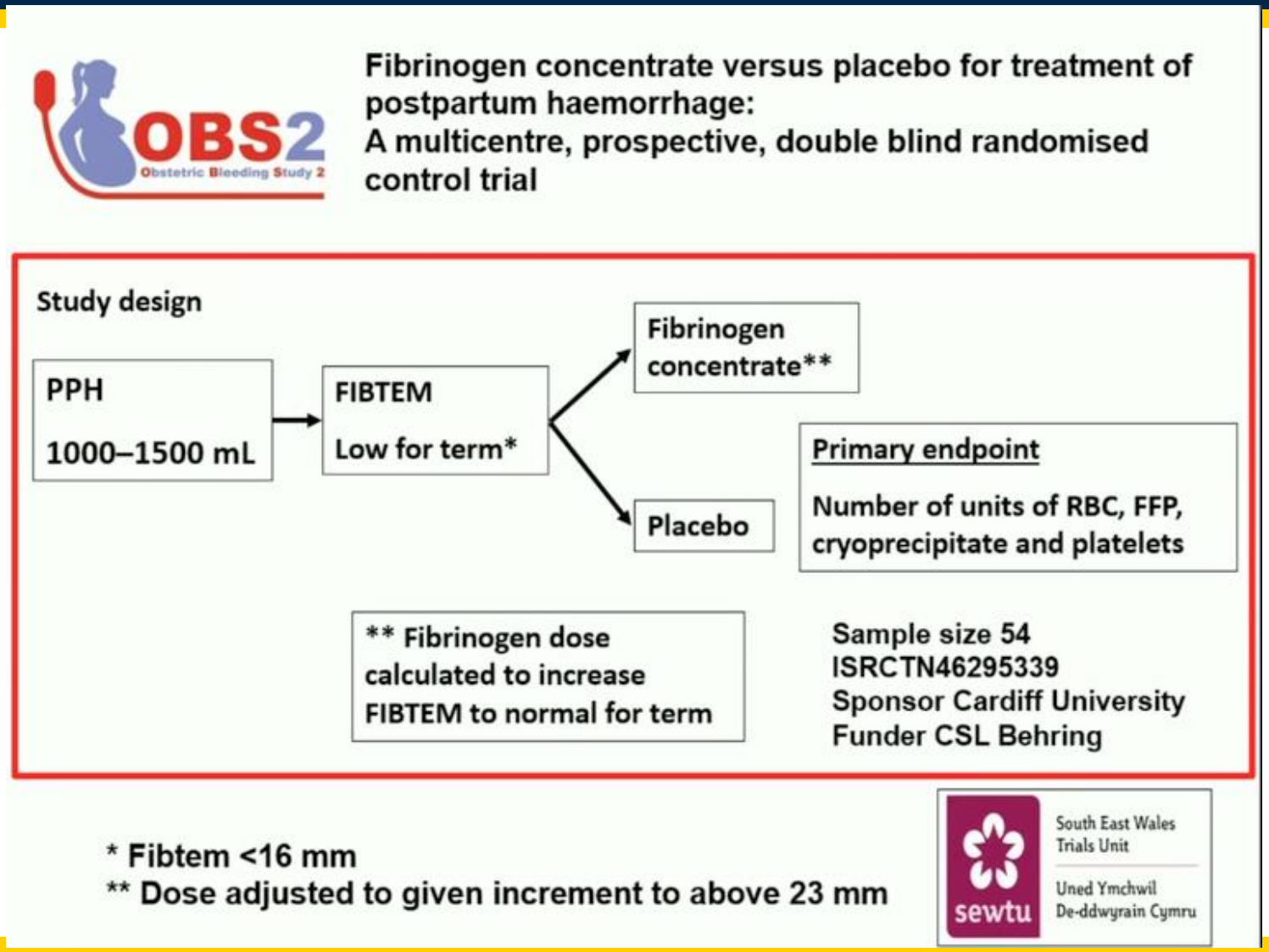
Transfusion Management



Collins et. al. Viscoelastometric-guided early fibrinogen concentrate replacement during postpartum haemorrhage: OBS2, a double-blind randomized controlled trial. BJA, 119 (3): 411–21 (2017)

Transfusion Management

- No difference in outcome when a goal:
  - FIBTEM A5 > 16mm (300 mg/dL) used as threshold.
  - FIBTEM A5 > 12mm (200 mg/dL) used as threshold.
- No benefit to treat fibrinogen level > 200 mg/dL

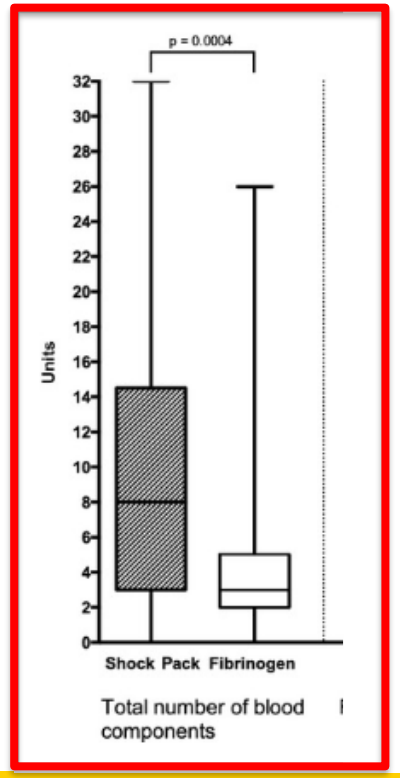


Transfusion Management

Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in major obstetric haemorrhage

S. Mallaiah,[1] P. Barclay,[1] I. Harrod,[2] C. Chevannes[1] and A. Bhalla[2]

- EBL > 1500cc with coagulopathy
- 2011-2012: “shock pack”
  - **Emphasis on early transfusion**
- 2012-2013: “fibrinogen phase”
  - **Emphasis on ROTEM guidance**
  - Use of fibrinogen concentrate



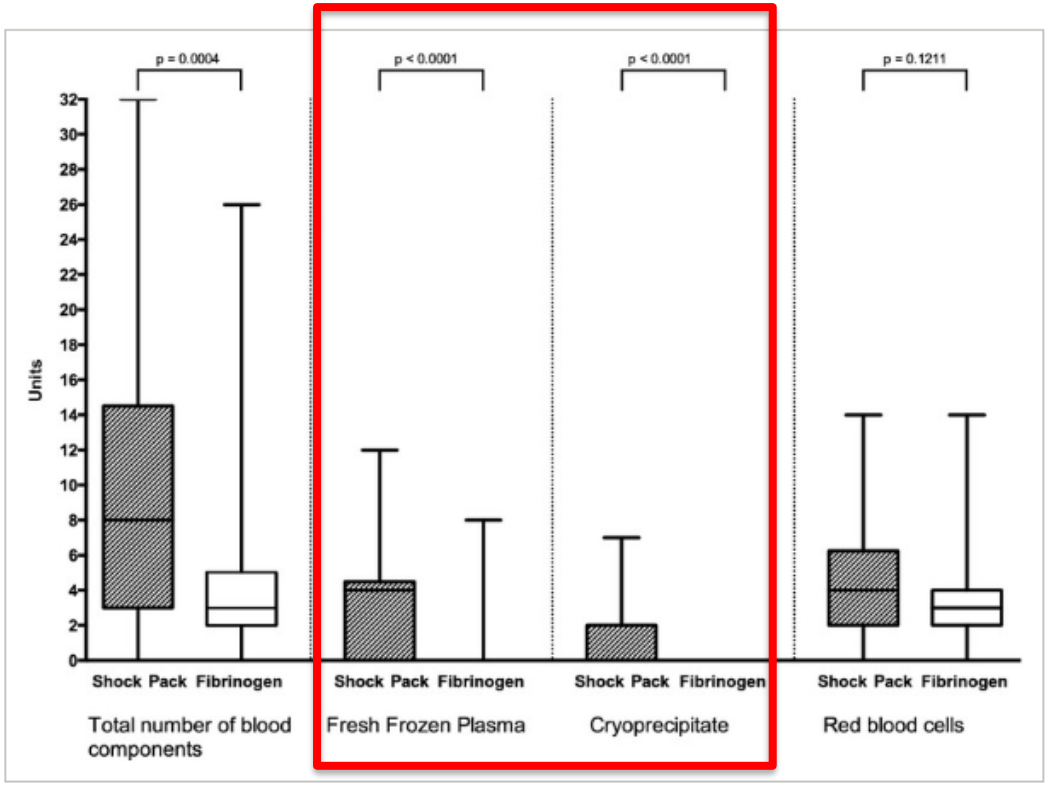
Anaesthesia. 2015 Feb;70(2):166-75

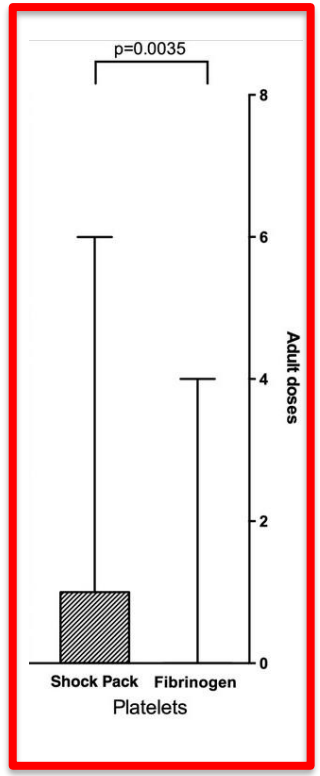
Transfusion Management

Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in major obstetric haemorrhage

S. Mallaiah,[1] P. Barclay,[1] I. Harrod,[2] C. Chevannes[1] and A. Bhalla[2]

- EBL > 1500cc with coagulopathy
- 2011-2012: “shock pack”
  - **Emphasis on early transfusion**
- 2012-2013: “fibrinogen phase”
  - **Emphasis on ROTEM guidance**
  - Use of fibrinogen concentrate





Anaesthesia. 2015 Feb;70(2):166-75

Transfusion Management

Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in major obstetric haemorrhage

S. Mallaiah,[1] P. Barclay,[1] I. Harrod,[2] C. Chevannes[1] and A. Bhalla[2]

- EBL > 1500cc with coagulopathy
- 2011-2012: “shock pack”
  - **Emphasis on early transfusion**
- 2012-2013: “fibrinogen phase”
  - **Emphasis on ROTEM guidance**
  - Use of fibrinogen concentrate

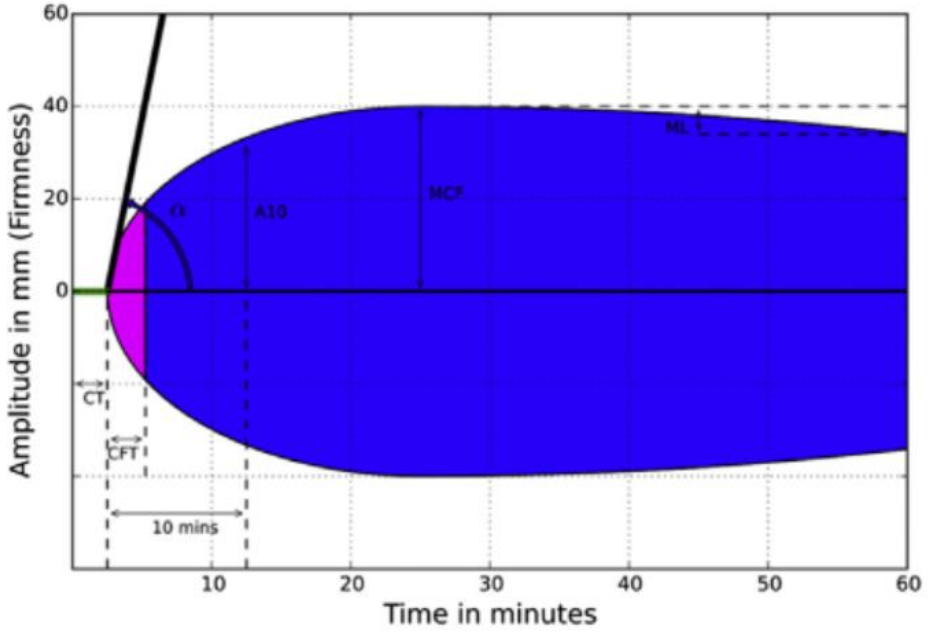
	Shock Pack (n = 42)	Fibrinogen (n = 51)	p value
ICU admission	4 (9%)	1 (2%)	NS
TACO	4 (9%)	0	0.0367
TRALI	0	0	NS
Postpartum hysterectomy	6 (14%)	3 (6%)	NS
Death	0	0	NS

Anaesthesia. 2015 Feb;70(2):166-75

Transfusion Management

Point-of-care viscoelastic testing improves the outcome of pregnancies complicated by severe postpartum hemorrhage

Denis Snegovskikh, M.D. [a,*], Dmitri Souza, M.D.,Ph.D. [b], Zachary Walton, M.D., Ph.D. [a], Feng Dai, Ph.D. [c], Rachel Rachler [d], Angelique Garay [e], Victoria V. Snegovskikh, M.D. [f], Ferne R. Braveman, M.D. [e], Errol R. Norwitz, M.D., Ph.D. [g]



- Retrospective cohort study: 2011-2015
- Before and after study
  - standard massive transfusion protocol vs. point-of-care ROTEM-based protocol
- ROTEM-guided administration of:
  - Cryoprecipitate (FIBTEM)
  - FFP (CT)
  - Platelets (MCF)

Snegovskikh, D. et. al. Point-of-care viscoelastic testing improves the outcome of pregnancies complicated by severe postpartum hemorrhage. Journal of Clinical Anesthesia 44 (2018) 50–56.

Transfusion Management

- Reduction in:
  - pRBC, FFP and platelet administration
  - Length of hospital stay
  - ICU admissions
- Reduction in hysterectomies

Table 2
Postoperative outcomes of the study population[a].

	PCVT ($n = 28$)	Non-PCVT ($n = 58$)	*P*-value
Hematocrit on postoperative day 1 (%)	24.7 (23.0–26.6)	27.8 (24.5–30.0)	0.004
Hysterectomy, yes	7 (25.0%)	31 (53.5%)	0.013
Estimated blood loss (mL)	2000 (1600–2500)	3000 (2000–4000)	<0.001
Crystalloids (mL)	3500 (3100–4500)	3500 (3000–4100)	0.88
Hextend (mL)	0 (0–250)	0 (0–500)	0.45
Red blood cells (units)			<0.001
- 0	11 (39.3%)	3 (5.2%)	
- 1	7 (25.0%)	3 (5.2%)	
- ≥2	10 (35.7%)	52 (89.6%)	
Fresh frozen plasma (units)			<0.001
- 0	25 (89.3%)	16 (27.6%)	
- ≥1	3 (10.7%)	42 (72.4%)	
Albumin (units)			0.09
- 0	28 (100%)	51 (87.9%)	
- 500 to 1000	0 (0%)	7 (12.1%)	
Cryoprecipitate (units)			0.78
- 0	22 (78.6%)	47 (81.0%)	
- ≥5	6 (21.4%)	11 (19%)	
Platelets (units)			<0.001
- 0	28 (100%)	32 (55.2%)	
- ≥5	0 (0%)	26 (44.8%)	
Length of hospitalization after delivery (days)	4 (3–4)	5 (4–6)	<0.001
ICU admission	1 (3.6%)	25 (43.1%)	<0.001

[a] Data are expressed as n (%), median (interquartile range).

Snegovskikh, D. et. al. Point-of-care viscoelastic testing improves the outcome of pregnancies complicated by severe postpartum hemorrhage. Journal of Clinical Anesthesia 44 (2018) 50–56.

Transfusion Management

Table 3
Cost of hospitalization for patients with severe postpartum hemorrhage managed with or without PCVT[a].

	PCVT ($n = 17$)	Non-PCVT ($n = 37$)	Total ($n = 54$)	*P*-value
Indirect	$5746.65 ($2458.16)	$8585.65 ($4412.28)	$7691.89 ($4101.13)	0.004
Direct	$6056.29 ($2519.45)	$11,833.43 ($7182.55)	$10,014.70 ($6655.29)	<0.001
Total	$11,802.94 ($4936.91)	$20,419.08 ($11,550.47)	$17,706.59 ($10,690.84)	<0.001

[a] Data are expressed as mean (SD).

Snegovskikh, D. et. al. Point-of-care viscoelastic testing improves the outcome of pregnancies complicated by severe postpartum hemorrhage. Journal of Clinical Anesthesia 44 (2018) 50–56.

Tranexamic Acid

Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial

- Randomized controlled trial, 2010-2016
- 193 hospitals, 21 countries, 20,060 women
- 1g tranexamic acid vs. placebo at clinical diagnosis of hemorrhage

Lancet. 2017 May 27;389(10084):2105-2116

Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial

- Randomized controlled trial, 2010-2016
- 193 hospitals, 21 countries, 20,060 women
- 1g tranexamic acid vs. placebo at clinical diagnosis of hemorrhage

	Tranexamic acid group (n=10 036)	Placebo group (n=9985)	RR (95% CI)	p value (two-sided)
Bleeding	155 (1·5%)	191 (1·9 %)	0·81 (0·65–1·00)	0·045
Pulmonary embolism	10 (0·1%)	11 (0·1)	0·90 (0·38–2·13)	0·82
Organ failure	25 (0·3%)	18 (0·2%)	1·38 (0·75–2·53)	0·29
Sepsis	15 (0·2%)	8 (0·1%)	1·87 (0·79–4·40)	0·15
Eclampsia	2 (0·02%)	8 (0·1%)	0·25 (0·05–1·17)	0·057
Other	20 (0·2%)	20 (0·2%)	0·99 (0·54–1·85)	0·99
Any cause of death	227 (2·3%)	256 (2·6%)	0·88 (0·74–1·05)	0·16

Data are n (%), unless otherwise indicated. RR=risk ratio.

Table 2: Effect of tranexamic acid on maternal death

Lancet. 2017 May 27;389(10084):2105-2116

Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial

- Tranexamic acid mortality:
  155/10036 - 1.5 %
- Placebo mortality:
  191/9985 - 1.9%
- Mortality in USA for PPH:
  1.7 per 100,000 births

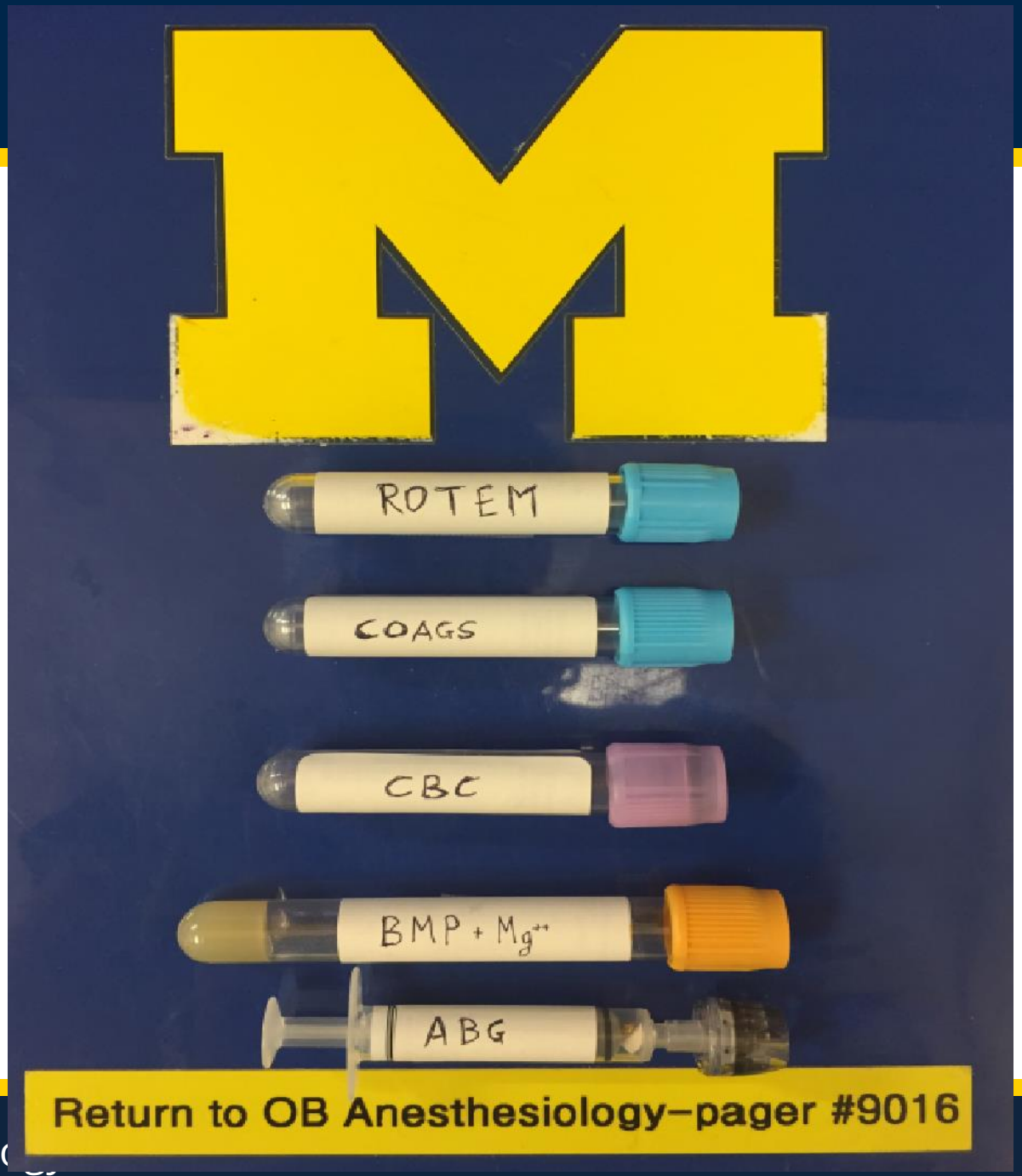
	Tranexamic acid group (n=10 036)	Placebo group (n=9985)	RR (95% CI)	p value (two-sided)
Bleeding	155 (1·5%)	191 (1·9 %)	0·81 (0·65–1·00)	0·045
Pulmonary embolism	10 (0·1%)	11 (0·1)	0·90 (0·38–2·13)	0·82
Organ failure	25 (0·3%)	18 (0·2%)	1·38 (0·75–2·53)	0·29
Sepsis	15 (0·2%)	8 (0·1%)	1·87 (0·79–4·40)	0·15
Eclampsia	2 (0·02%)	8 (0·1%)	0·25 (0·05–1·17)	0·057
Other	20 (0·2%)	20 (0·2%)	0·99 (0·54–1·85)	0·99
Any cause of death	227 (2·3%)	256 (2·6%)	0·88 (0·74–1·05)	0·16

Data are n (%), unless otherwise indicated. RR=risk ratio.

Table 2: **Effect of tranexamic acid on maternal death**

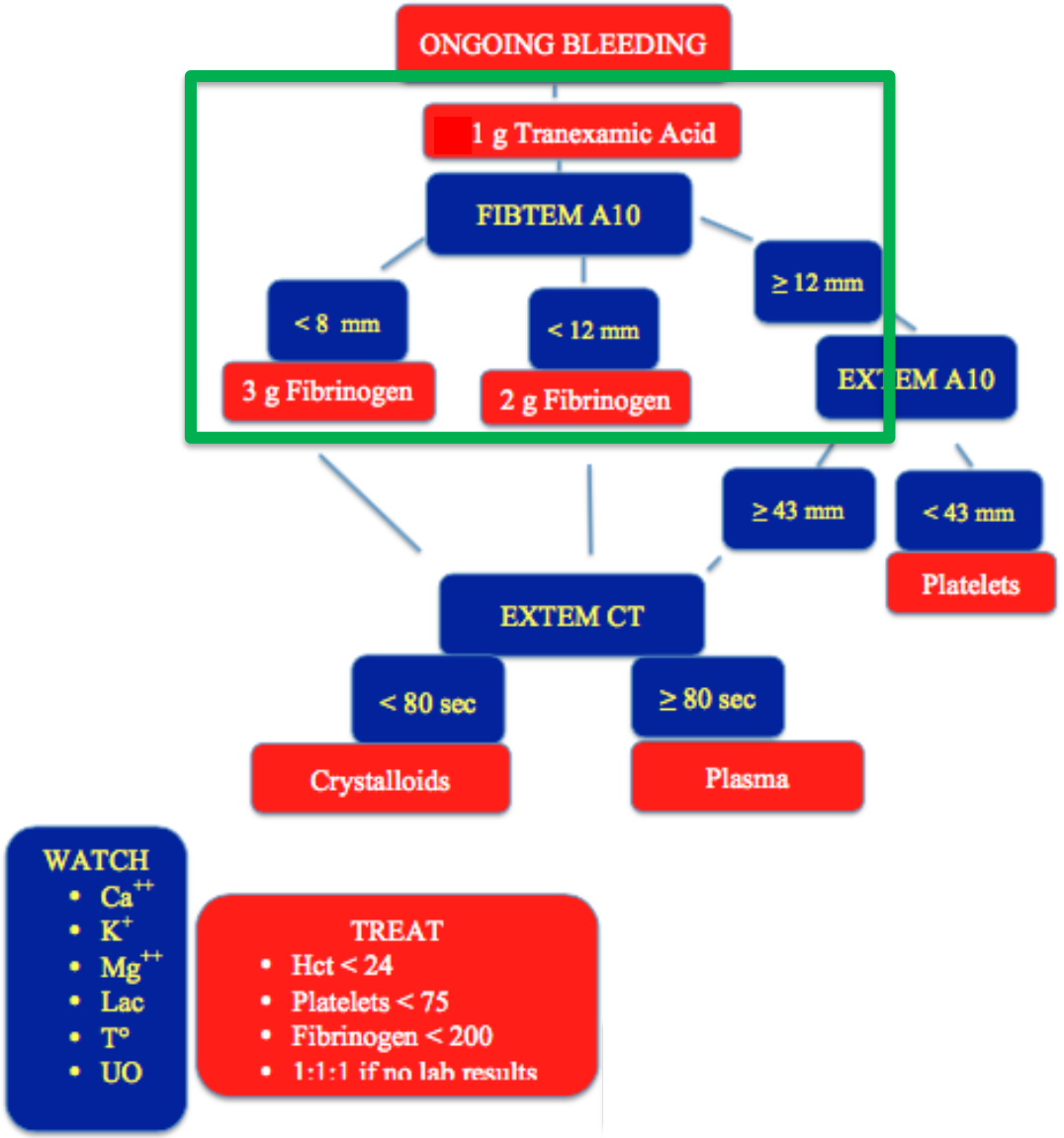
Lancet. 2017 May 27;389(10084):2105-2116

The Michigan Medicine PPH Transfusion Protocol

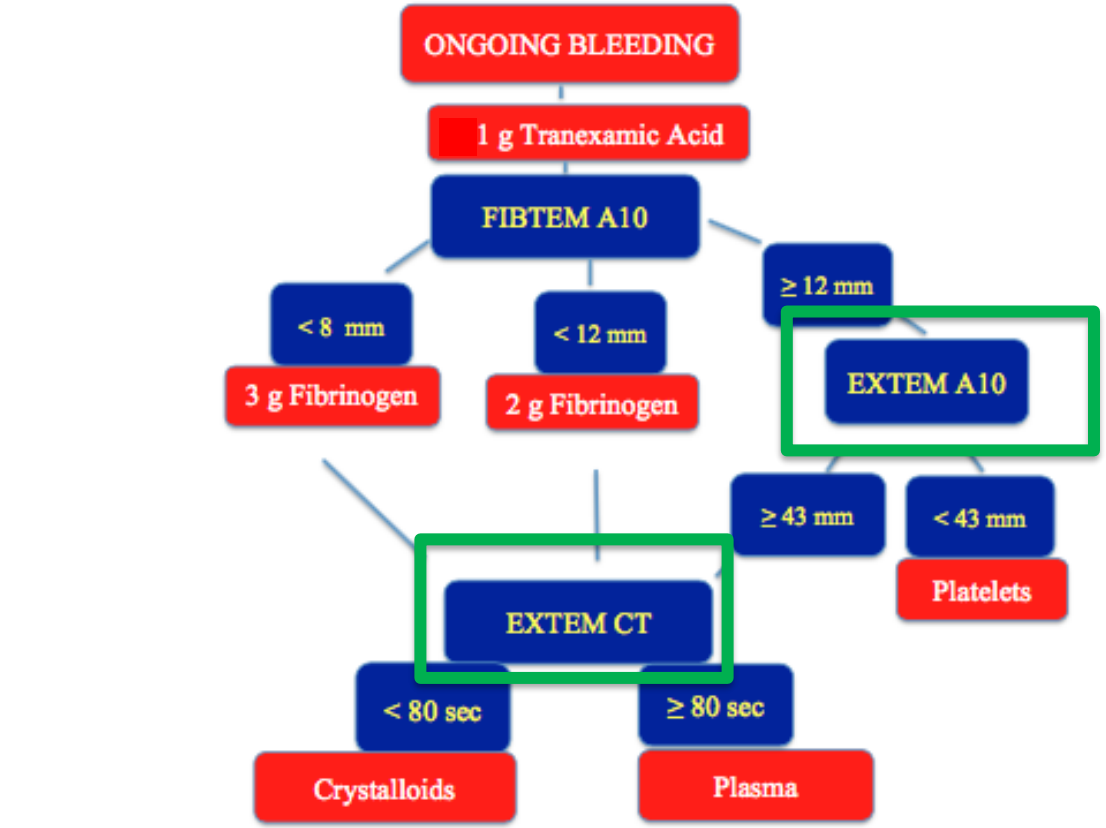

ROTEM
COAGS
CBC
BMP + Mg++
ABG
Return to OB Anesthesiology–pager #9016

VON VOIGTLANDER WOMEN'S HOSPITAL
UNIVERSITY OF MICHIGAN HEALTH SYSTEM

POSTPARTUM HEMORRHAGE



POSTPARTUM HEMORRHAGE



WATCH
- Ca^{++}
- K^{+}
- Mg^{++}
- Lac
- T°
- UO

TREAT
- Hct < 24
- Platelets < 75
- Fibrinogen < 200
- 1:1:1 if no lab results

Preparation and Response

Maternal Early Warning System

Preparation and Response

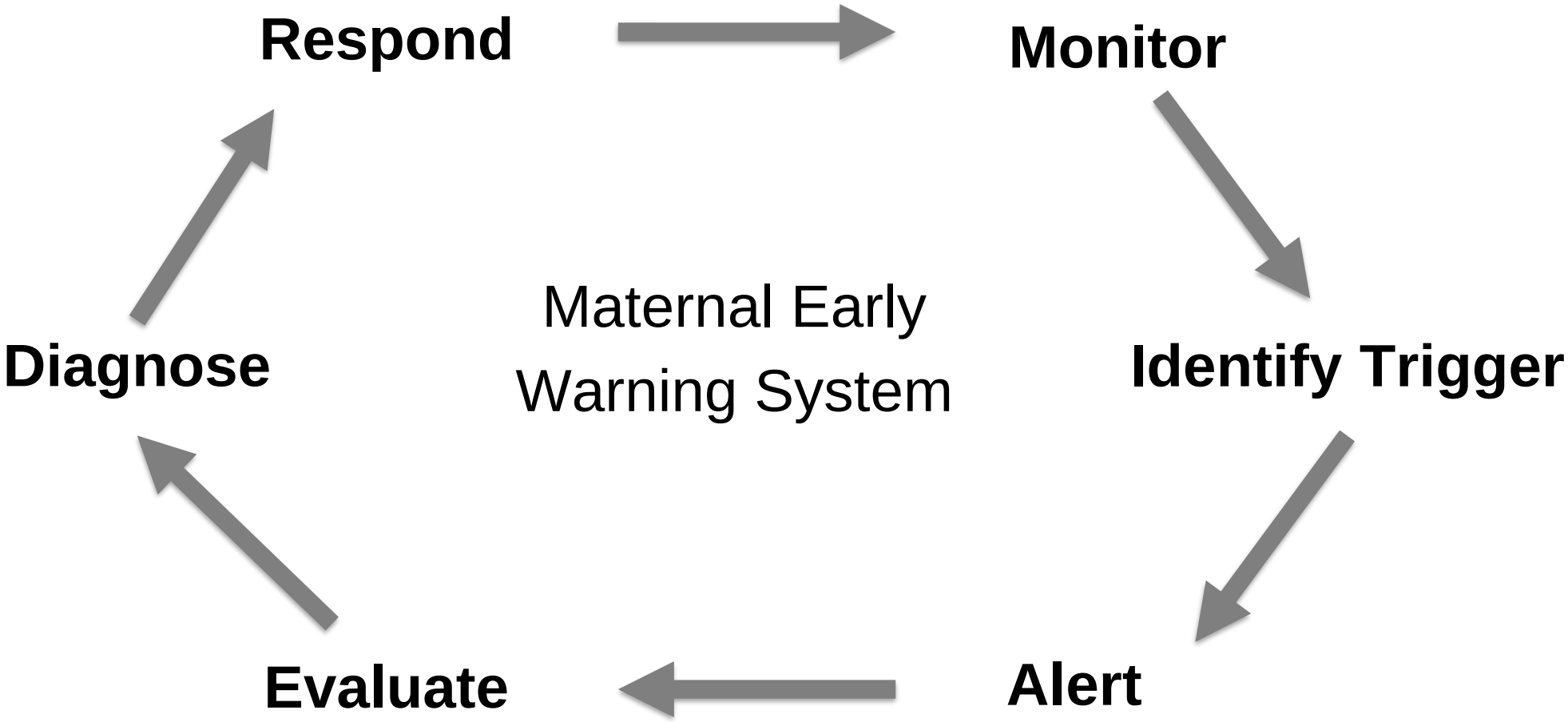
Table 1. The Maternal Early Warning Criteria

Systolic BP (mm Hg)	<90 or >160
Diastolic BP (mm Hg)	>100
Heart rate (beats per min)	<50 or >120
Respiratory rate (breaths per min)	<10 or >30
Oxygen saturation on room air, at sea level, %	<95
Oliguria, mL/hr for ≥2 hours	<35
Maternal agitation, confusion, or unresponsiveness; Patient with preeclampsia reporting a non-remitting headache or shortness of breath	

Mhyre J. et. al. The Maternal Early Warning Criteria A Proposal From the National Partnership for Maternal Safety. Obstet Gynecol 2014;124:782–6

Maternal Early Warning System

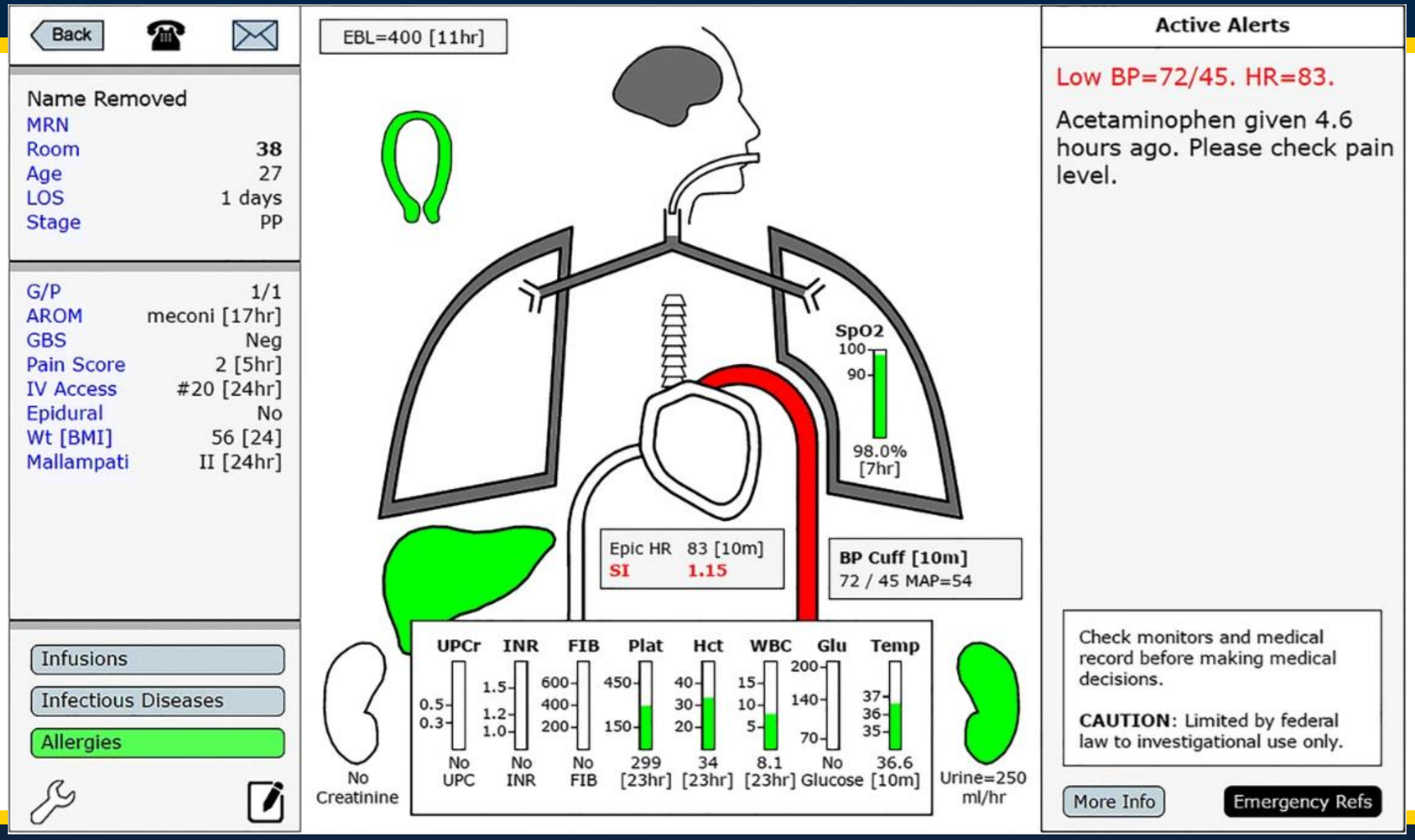
Preparation and Response



Preparation and Response

Klumpner TT, Kountanis JA, Langen ES, Smith RD, Tremper KK. Use of a novel electronic maternal surveillance system to generate automated alerts on the labor and delivery unit. BMC Anesthesiol. 2018;18(1):78.

Preparation and Response



Klumpner TT, Kountanis JA, Langen ES, Smith RD, Tremper KK. Use of a novel electronic maternal surveillance system to generate automated alerts on the labor and delivery unit. BMC Anesthesiol. 2018;18(1):78.

Preparation and Response

Health.mil

Simulation Training

Preparation and Response

MATERNAL-FETAL & NEONATAL MEDICINE

http://informahealthcare.com/jmf
ISSN: 1476-7058 (print), 1476-4954 (electronic)

J Matern Fetal Neonatal Med, 2015; 28(5): 495–499
 DOI: 10.3109/14767058.2014.923393

informa healthcare

ORIGINAL ARTICLE

Impact of simulation and team training on postpartum hemorrhage management in non-academic centers

Nicole E. Marshall[1], Jeroen Vanderhoeven[1], Karen B. Eden[2], Sally Y. Segel[1], and Jeanne-Marie Guise[1,2,3]

[1]Department of Obstetrics and Gynecology, [2]Department of Medical Informatics and Clinical Epidemiology, and [3]Department of Public Health and Preventive Medicine, Oregon Health & Science University, Portland, OR, USA

- Effect of simulation and team training on response to simulated hemorrhage
- 6 rural and urban non-academic centers
- Simulated PPH followed by didactic

Marshall NE, et. al. Impact of simulation and team training on postpartum hemorrhage management in non-academic centers. J Matern Fetal Neonatal Med. 2015 Mar;28(5):495-9.

Preparation and Response

Table 2. Time of PPH management before and after training.

	Before	After	Reduction	
Time from baby's head out	Mean ± SD (s)	Mean ± SD (s)	Mean ± SD (s)	*p* value (paired *t*)
Recognized PPH	124.8 ± 51.7	94.5 ± 35.5	30.3 ± 57.7	0.02
Use first medication*	135.4 ± 42.4	87.3 ± 49.2	48.1 ± 65.9	0.003
Perform uterine massage	134.1 ± 34.9	105.7 ± 45.2	28.5 ± 50.0	0.01
Use second medication†	216.0 ± 73.0	147.0 ± 48.2	69.0 ± 71.9	0.0003
Correct PPH‡	404.0 ± 154.5	349.0 ± 110.6	55.0 ± 191.9	0.19

*Oxytocin.
†Misoprostol or carboprost.
‡The single team that did not resolve the scenario in 10 min by using three indicated medications was excluded from this time point.

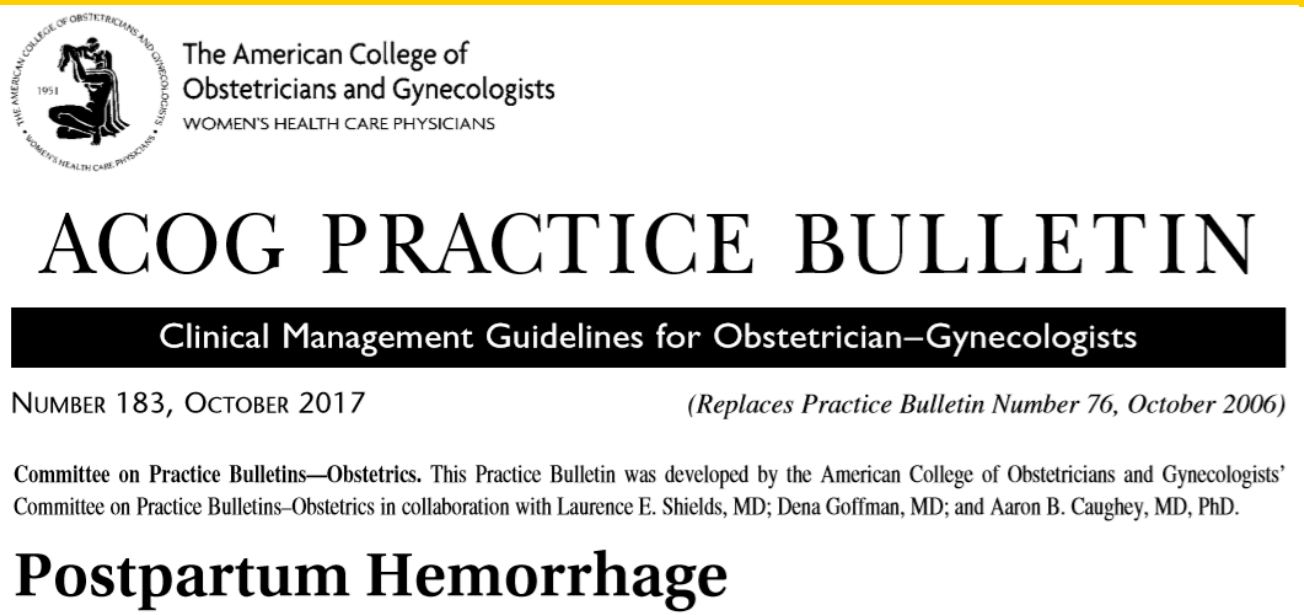
- Improvement in:
  - Recognition of PPH
  - Time to use oxytocin
  - Time to perform uterine massage
  - Time to use a secondary uterotonic

Marshall NE, et. al. Impact of simulation and team training on postpartum hemorrhage management in non-academic centers. J Matern Fetal Neonatal Med. 2015 Mar;28(5):495-9.

Postpartum Hemorrhage Protocols

Preparation and Response – PPH Protocol

- Use of a postpartum hemorrhage management protocol is recommended by ACOG



The American College of Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician–Gynecologists

NUMBER 183, OCTOBER 2017 *(Replaces Practice Bulletin Number 76, October 2006)*

Committee on Practice Bulletins—Obstetrics. This Practice Bulletin was developed by the American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics in collaboration with Laurence E. Shields, MD; Dena Goffman, MD; and Aaron B. Caughey, MD, PhD.

Postpartum Hemorrhage

Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. Obstet Gynecol. 2017 Oct;130(4):e168-e186.

Preparation and Response – PPH Protocol

EXPERT REVIEWS ajog.org

PATIENT SAFETY SERIES

Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety

Laurence E. Shields, MD; Suzanne Wiesner, RN; Janet Fulton, RN, PhD; Barbara Pelletreau, RN

- Comprehensive PPH protocol across 29 hospitals comprising 60,000 births annually.
- 2010-2012

Shields, LE. et. al. Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety. Am J Obstet Gynecol. 2015 Mar;212(3):272-80.

Preparation and Response – PPH Protocol

TABLE 3
Blood product use and peripartum hysterectomy

Variable	Baseline	Assessment 1	Assessment 2	Change from baseline to assessment 2, %
Deliveries, n	10,433	10,457	11,169	+7
Stage 2, n	73	99	107	
Stage 2 per 1000 deliveries, %	7.01	9.47	9.58	+37
Stage 3, n	28	32	48	
Stage 3 per 1000 deliveries, %	2.68	3.06	4.29	+60
Packed red blood cells, n	232	180	197	−15 ($P = .02$)
Platelets, n	65	37	26	−60 ($P < .01$)
Cryoprecipitate, n	43	18	18	−58 ($P < .01$)
Fresh frozen plasma, n	35	24	56	+60 ($P < .01$)
Total blood products, n	375	354	297	
Blood products per 1000 deliveries, %	35.9	33.9	26.6	−25.9 ($P < .01$)
Year[a]	2011		2012	
Hemorrhage with peripartum hysterectomy, n	82		67	
Hysterectomy per 1000 births	1.22		1.04	−14.8 ($P = .2$)

Baseline and assessments 1 and 2 were 2 months in duration.

[a] Data are for entire calendar year.

Shields. Systematic approach to maternal hemorrhage. Am J Obstet Gynecol 2015.

- PPH protocol:
  - hemorrhage risk assessment
  - early escalation of care and monitoring
  - sending laboratory studies
  - uterotonic administration
  - transfusion guidance

- 26% reduction in blood product administration.

Shields, LE. et. al. Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety. Am J Obstet Gynecol. 2015 Mar;212(3):272-80.

STAGE 2
OB Hemorrhage

Ongoing bleeding and/or vital sign instability, and < 1500 ml cumulative blood loss (EBL/QBL)

MOBILIZE

Primary Nurse:
- ❑ Activate OB Hemorrhage Protocol
- ❑ Call/Birth Center Page Team Leader and Anesthesiology to room

Team Leader or designee:
- ❑ Bring Hemorrhage Cart to patient's location if not in OR
- ❑ Notify Charge Nurse
- ❑ Assign designees to continue Blood Bank communication
- ❑ Designate a provider, nurse, or SW as family support person

OR Team Leader:
- ❑ Prepare OR & staff for patient transfer if not already there

ACT

OB/Nurse/Anesthesia Team Leaders
- ❑ Continue IV oxytocin, IV crystalloid, uterine massage
- ❑ Obtain and document quantitative blood loss q 10 minutes
- ❑ Continue uterotonic medication per protocol (Virtual Hemorrhage Pack in Pyxis)*

Give once, if no response, move to next agent

- ❑ Administer methergine 0.2 mg IM (if not hypertensive); may repeat dose q 2 hr
- ❑ Administer misoprostol 800 mcg buccal or rectal
- ❑ Administer hemabate 0.25 mg IM (if not asthmatic); may repeat dose q 15 min

Don't delay other interventions while waiting for response. Consider move to OR.
- ❑ Vital signs, including O2 sat & level of consciousness (LOC) q 5 minutes
- ❑ Administer oxygen to maintain O2 sats at > 95% & keep patient warm
- ❑ Empty bladder; straight cath or place Foley with urimeter
- ❑ Transfusion
- ❑ Bring 2 units PRBCs to bedside (mobile refrigerator on unit or blood bank)
  - ❑ Consider activation of Massive Transfusion Protocol
  - ❑ **Transfuse PRBCs based on clinical signs & response; don't wait for lab results**
- ❑ Order labs STAT (CBC, CMP, Coag/Fibrinogen, Point-of-care labs)

Second nurse or OR techs:
- ❑ Obtain portable light and OB procedure tray
- ❑ Assist with transfer to OR (if indicated)

THINK

Vaginal birth
- **Trauma** (vaginal, cervical, or uterine) ⍰ Visualize & repair
- **Retained placenta** ⍰ D&C
- **Uterine atony/**LUS bleeding ⍰ Bakri
- **Other** ⍰ Arterial embolization (IR)

Cesarean Section
- **Atony** ⍰ B-Lynch, Intrauterine Balloon
- **Uterine Inversion** ⍰ Anesthesia & uterine relaxation for manual reduction
- **Amniotic Fluid Embolism** ⍰ Maximally aggressive respiratory, vasopressor, and blood product support
- **VS worse than blood loss** ⍰ consider uterine rupture or broad ligament tear with internal bleeding ⍰ **move to laparotomy**

Once stabilized:
- ❑ **Postpartum Debrief**
- ❑ **Update Postpartum Risk Assessment:** Modified postpartum management with increased surveillance

Cumulative blood loss (EBL/QBL) > 1500 ml, > 2units PRBCS given, VS unstable or suspicion for DIC?

Proceed to STAGE 3

STAGE 2
OB Hemorrhage

Ongoing bleeding and/or vital sign instability, and < 1500 ml cumulative blood loss (EBL/QBL)

MOBILIZE	ACT	THINK

Primary Nurse:
- ❑ Activate OB Hemorrhage Protocol
- ❑ Call/Birth Center Page Team Leader and Anesthesiology to room

Team Leader or designee:
- ❑ Bring Hemorrhage Cart to patient's location if not in OR
- ❑ Notify Charge Nurse
- ❑ Assign designees to continue Blood Bank communication
- ❑ Designate a provider, nurse, or SW as family support person

OR Team Leader:
- ❑ Prepare OR & staff for patient transfer if not already there

Cumulative blood loss (EBL/QBL) > 1500 ml, > 2units PRBCS given, VS unstable or suspicion for DIC?

Proceed to STAGE 3

STAGE 2
OB Hemorrhage

Ongoing bleeding and/or vital sign instability, and < 1500 ml cumulative blood loss (EBL/QBL)

MOBILIZE | **ACT** | **THINK**

OB/Nurse/Anesthesia Team Leaders

- ❑ Continue IV oxytocin, IV crystalloid, uterine massage
- ❑ Obtain and document quantitative blood loss q 10 minutes
- ❑ Continue uterotonic medication per protocol (Virtual Hemorrhage Pack in Pyxis)*

Give once, if no response, move to next agent

- ❑ Administer methergine 0.2 mg IM (if not hypertensive); may repeat dose q 2 hr
- ❑ Administer misoprostol 800 mcg buccal or rectal
- ❑ Administer hemabate 0.25 mg IM (if not asthmatic); may repeat dose q 15 min

Don't delay other interventions while waiting for response. Consider move to OR.

Cumulative blood loss (EBL/QBL) > 1500 ml, > 2units PRBCS given, VS unstable or suspicion for DIC?

Proceed to STAGE 3

STAGE 2
OB Hemorrhage

Ongoing bleeding and/or vital sign instability, and < 1500 ml cumulative blood loss (EBL/QBL)

MOBILIZE

ACT

THINK

Vaginal birth

- **Trauma** (vaginal, cervical, or uterine) ? Visualize & repair
- **Retained placenta** ? D&C
- **Uterine atony/**LUS bleeding ? Bakri
- **Other** ? Arterial embolization (IR)

Cesarean Section

- **Atony** ? B-Lynch, Intrauterine Balloon
- **Uterine Inversion** ? Anesthesia & uterine relaxation for manual reduction
- **Amniotic Fluid Embolism** ? Maximally aggressive respiratory, vasopressor, and blood product support
- **VS worse than blood loss** ? consider uterine rupture or broad ligament tear with internal bleeding ? **move to laparotomy**

Cumulative blood loss (EBL/QBL) > 1500 ml, > 2units PRBCS given, VS unstable or suspicion for DIC?

Proceed to STAGE 3

COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE

safe health care for every woman

PATIENT SAFETY BUNDLE

Obstetric Hemorrhage

READINESS

Every unit

- Hemorrhage cart with supplies, checklist, and instruction cards for intrauterine balloons and compressions stitches
- Immediate access to hemorrhage medications (kit or equivalent)
- Establish a response team - who to call when help is needed (blood bank, advanced gynecologic surgery, other support and tertiary services)
- Establish massive and emergency release transfusion protocols (type-O negative/uncrossmatched)
- Unit education on protocols, unit-based drills (with post-drill debriefs)

RECOGNITION & PREVENTION

Every patient

- Assessment of hemorrhage risk (prenatal, on admission, and at other appropriate times)
- Measurement of cumulative blood loss (formal, as quantitative as possible)
- Active management of the 3rd stage of labor (department-wide protocol)

RESPONSE

Every hemorrhage

- Unit-standard, stage-based, obstetric hemorrhage emergency management plan with checklists
- Support program for patients, families, and staff for all significant hemorrhages

REPORTING/SYSTEMS LEARNING

Every unit

- Establish a culture of huddles for high risk patients and post-event debriefs to identify successes and opportunities
- Multidisciplinary review of serious hemorrhages for systems issues
- Monitor outcomes and process metrics in perinatal quality improvement (QI) committee

https://safehealthcareforeverywoman.org/wp-content/uploads/safe-health-care-for-every-woman-Obstetric-Hemorrhage-Bundle.pdf

SOAP
Society for Obstetric Anesthesia and Perinatology

HOME | JOIN SOAP | MEMBER CENTER | RESIDENTS/FELLOWS | MEETINGS | RESEARCH & FUNDING | CENTERS OF EXCELLENCE

Join Now

Search our site... Sea

Provider Education Preview

The SOAP Education Committee has assembled the materials below to serve as resources for your practices. Some materials are for SOAP members only and require you to be logged in to access. If you are not a member, we encourage you to join SOAP today to take advantage of these resources!

Access the SOAP Members Only Provider Education

Learning Modules: Practical information and worksheets covering specific clinical and non-clinical topics. Great for getting a program off the ground or to tailor a program that is up and running! Current modules include maternal cardiac disease, hemorrhage, communication, and simulation

Video Based Learning: Short videos aimed at discussing topics in brief. Current content is centered around Point of Care Ultrasound (POCUS).
View a sample video on Probes/Knobology

Quick Links

MEMBER CENTE
Become a Memb
Career Center
Latest News/Med

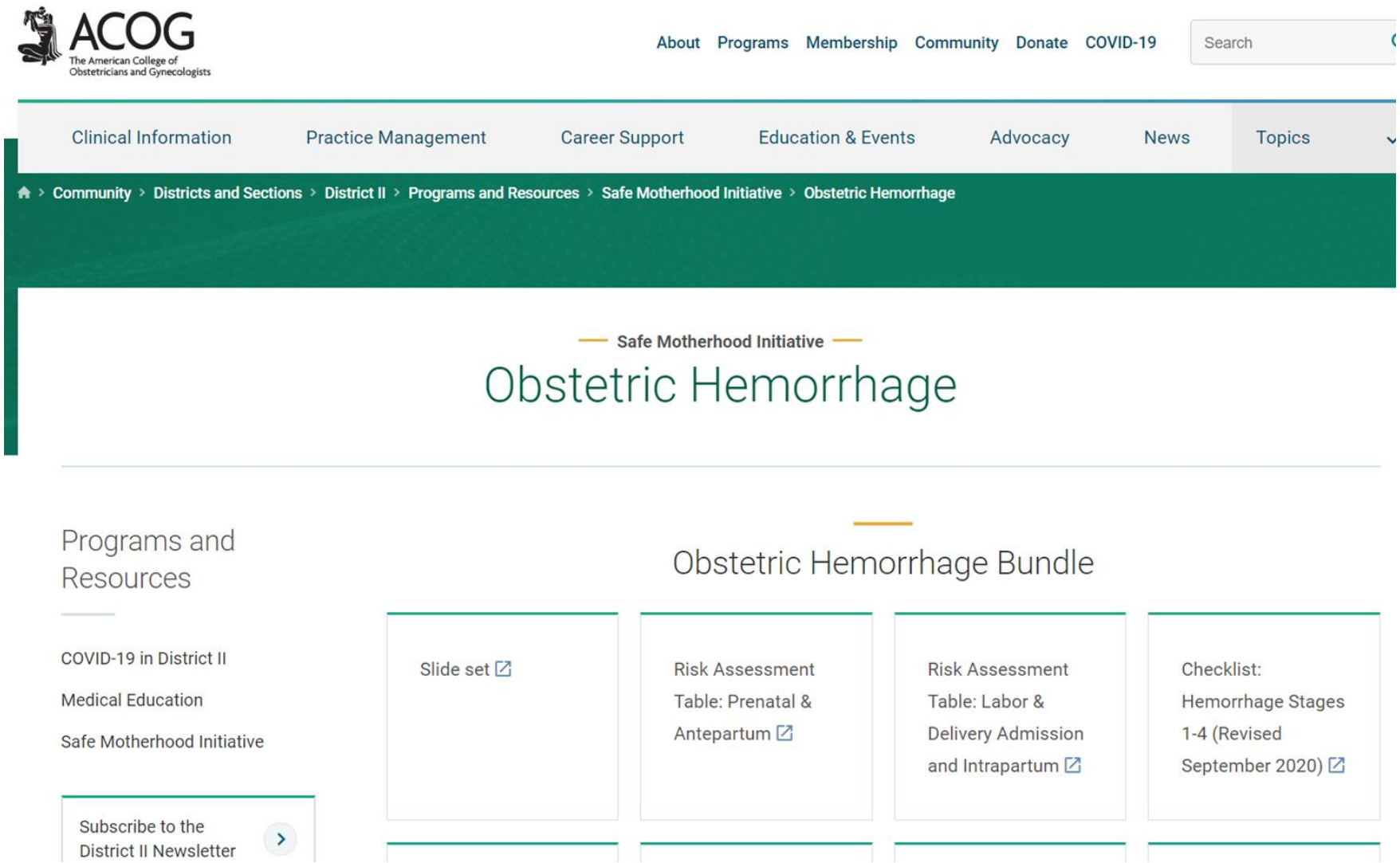
Upcoming Events

Wed May 11, 2022
54th Annual Meeting

Wed May 3, 2023
55th Annual Meeting

View Full Calenda

https://soap.org/



https://www.acog.org/

Preparation and Response – Quality Measures?

MPOG
MULTICENTER PERIOPERATIVE OUTCOMES GROUP

ASPIRE Obstetric Anesthesia Subcommittee Meeting

MPOG
MULTICENTER PERIOPERATIVE OUTCOMES GROUP

Take Home Points

Conclusion

- Maternal mortality in the US is rising, while it is decreasing in other developed countries.
- Improving our response to PPH may reverse this trend.
- Early identification of PPH is important.
- Get involved early.
- Quickly escalate care.
- Consider viscoelastic testing/send labs early.
- PPH protocols improve outcomes.

Please join us for the OB panel.