Maternal Mortality and Hemorrhage

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Office of Vital Statistics

Office of the City Medical Examiner

SPARCS

Bureau of Maternal, Infant and Reproductive Health

Maternal Mortality Ratio

Deaths/100,000 live births during pregnancy or within 1 year of termination. A ratio not a rate: cannot count total # pregnancies

Pregnancy Related OB complications, management, or disease exacerbated by pregnancy

Pregnancy Associated
Not related to pregnancy

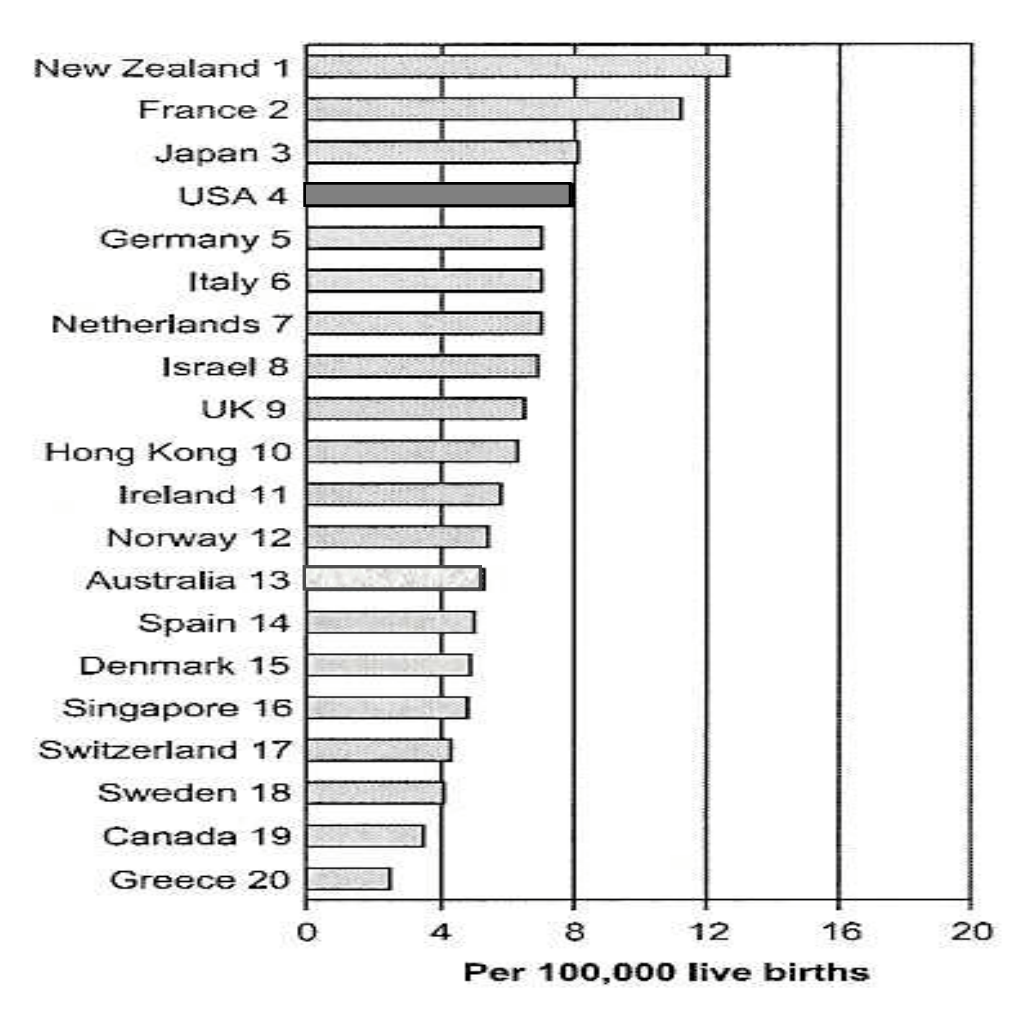
Direct
OB diseases or management

Indirect
Preexisting disease aggravated by pregnancy

NYC Health

MMR Industrialized Nations

1990-1994



Source: JAMWA 2001

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US Historical Perspective:
Racial Disparities

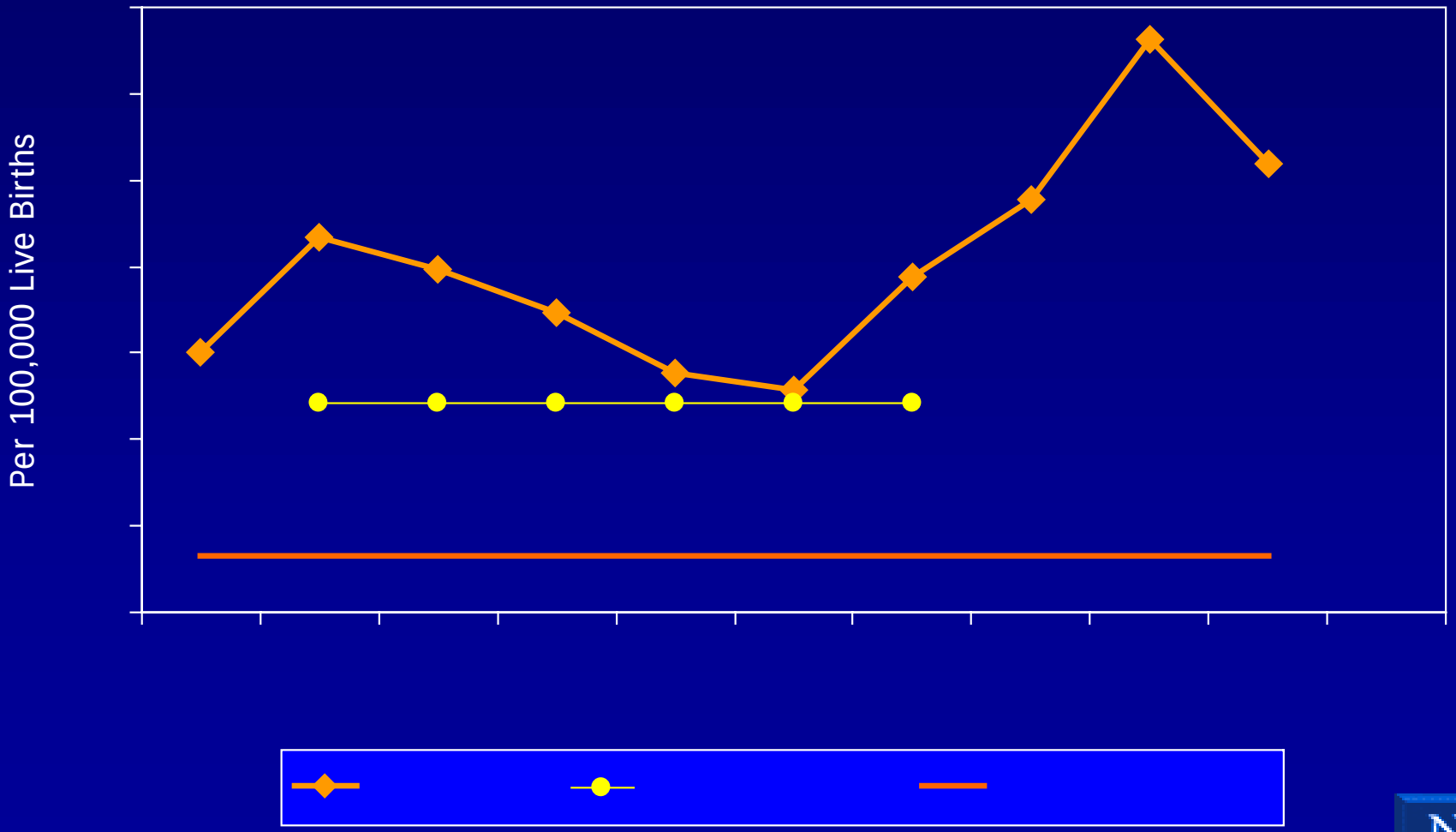
Year	MMR White	MMR Black	Risk Ratio
1915	601.0	1056.0	1.76
1930	601.0	1174.0	1.95
1945	172.0	445.0	2.59
1950	61.0	222.0	3.64
1990	6.5	26.7	4.11
1991-1999	8.1	30.0	3.70

Sources: MMWR 2003; JAMWA 57(3), 2002

NYC Health

Trends in Maternal Mortality Ratio

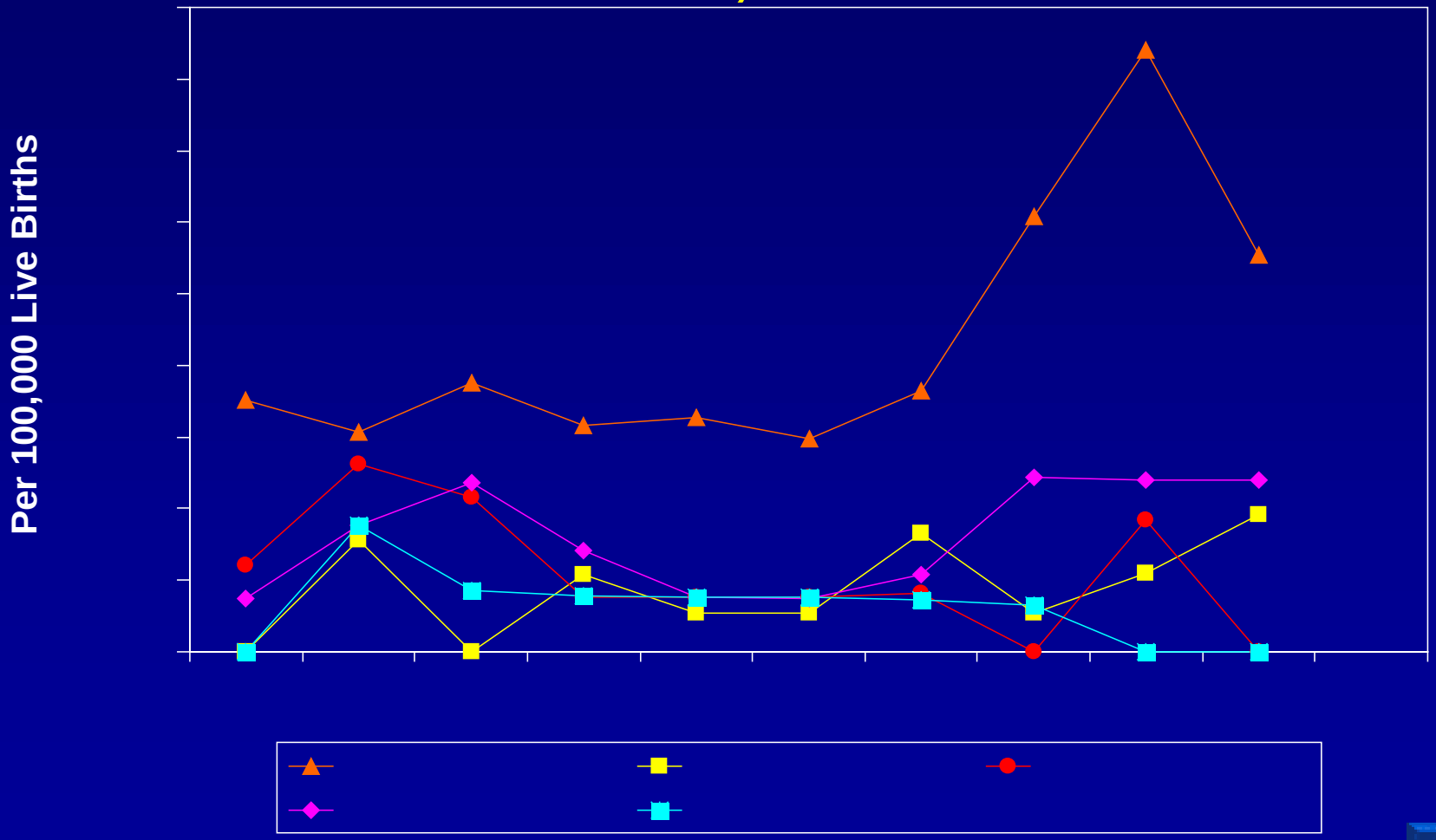
NYC, 1993-2002



Source: NYC DOHMH Office of Vital Statistics

Trends in Maternal Mortality Ratio by Race/Ethnicity

NYC OVS, 1993-2002



Source: NYC DOHMH Office of Vital Statistics

BMIRH MMR Enhanced Surveillance Methods

- Case ascertainment
  - Vital Statistics, Medical Examiner, SPARCS
- Case Review
  - Medical records, ME reports, maternal death certificates, infant birth certificates
- Data entry and analysis

NYC MMR Review 1998-2000

BMIRH Enhanced Surveillance

Year	# Cases OVS	# Cases BMIRH (enhanced surveillance including OVS)
1998	25	52 (110%)
1999	49	63 (30%)
2000	34	54 (60%)
Total	108	169 (60%)

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Referral Source of Maternal Deaths

BMIRH 1998-2000

Source	Direct	Indirect	Not related	Total
OVS	67	24	17	108
OCME	4	6	22	32
SPARCS	10	8	8	26
Total	81	38	47	166*

* Missing = 3

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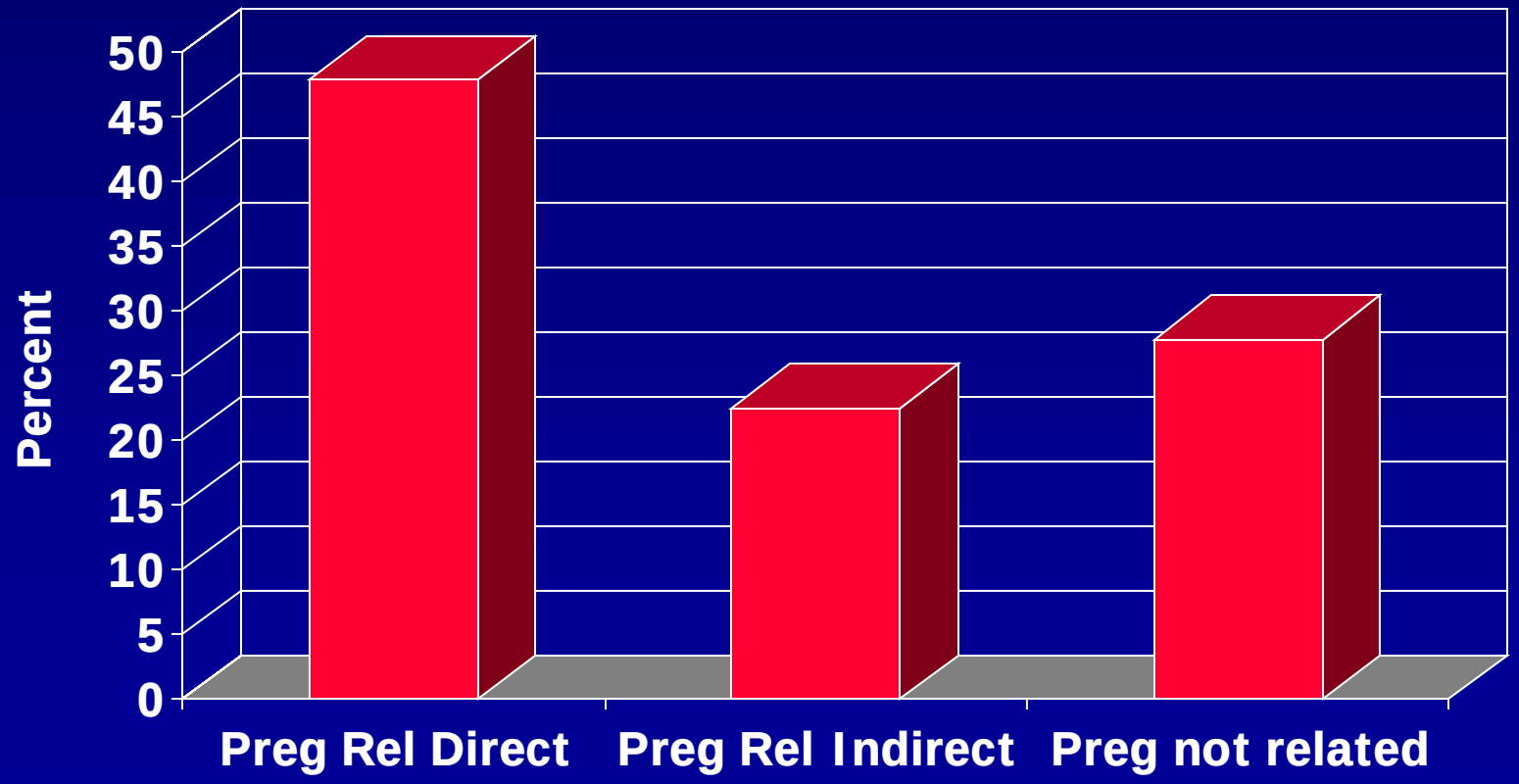
CDC/ACOG Categorization of Maternal Deaths

BMIRH 1998-2000



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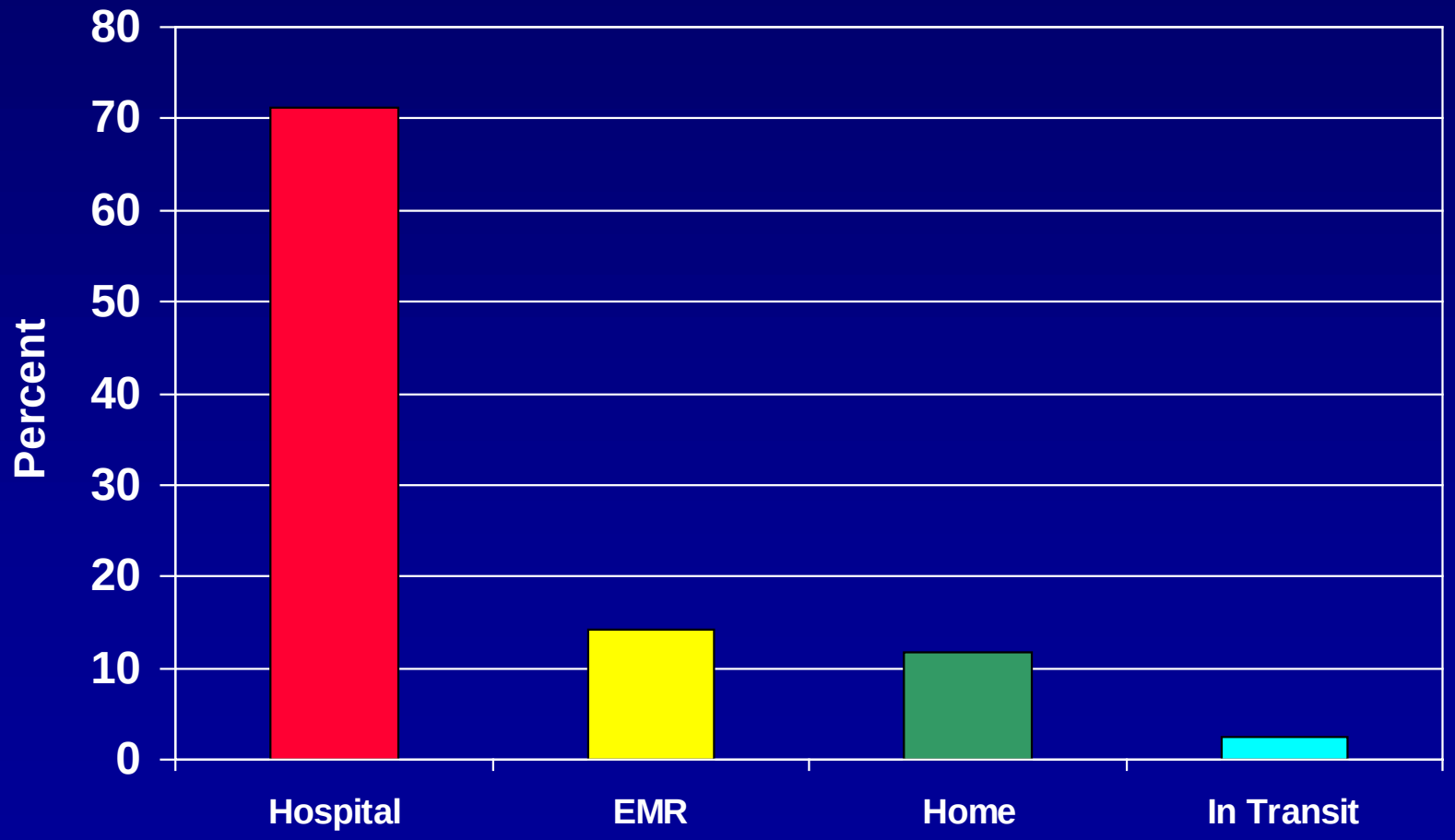
Location of Death

BMIRH 1998-2000



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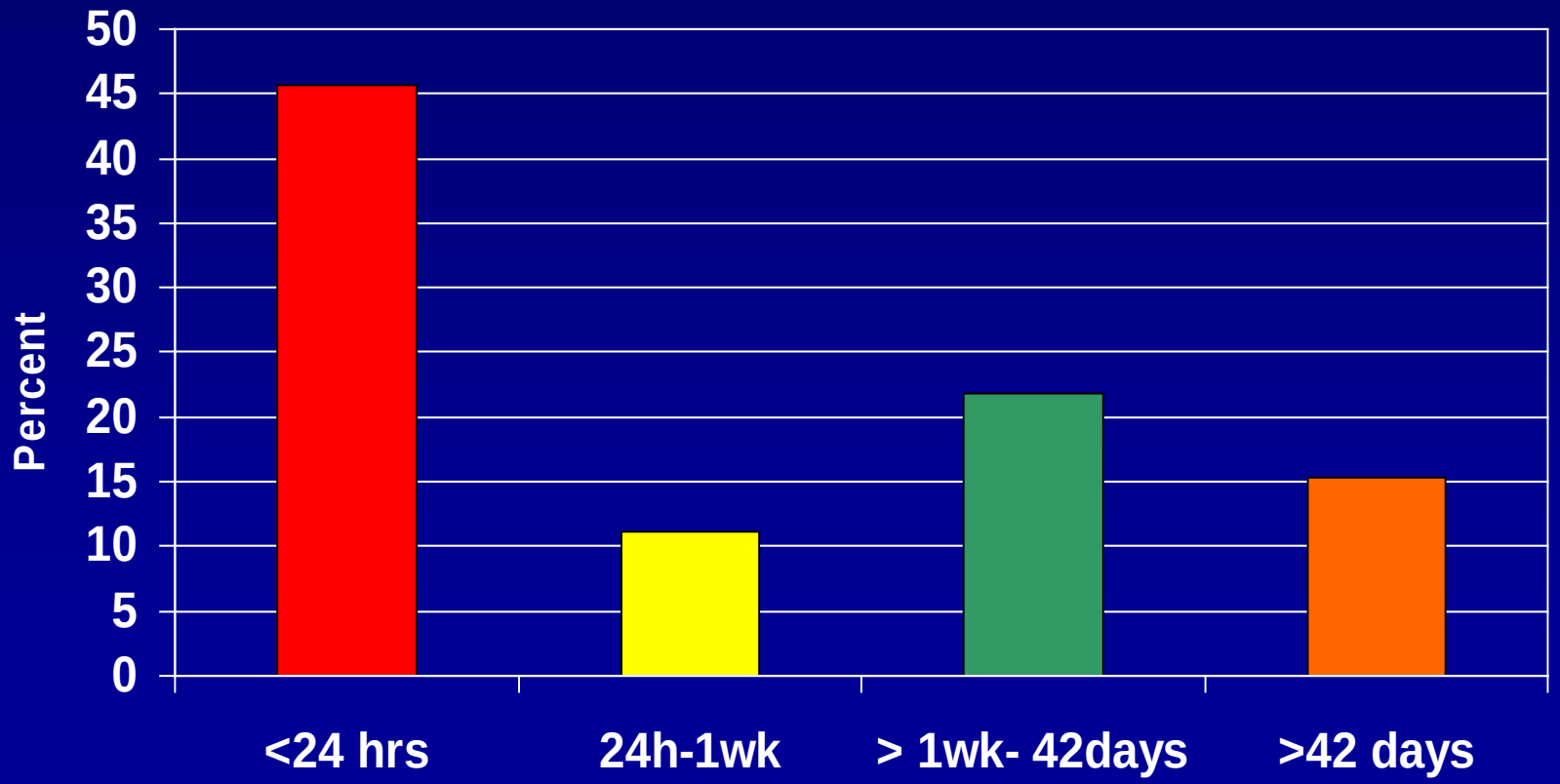
Timing of Death After Delivery

BMIRH 1998-2000



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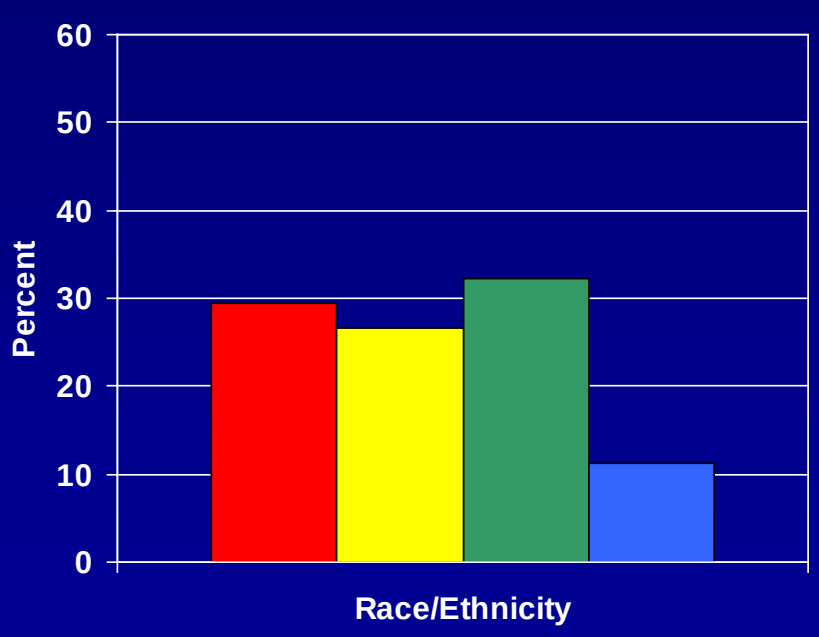
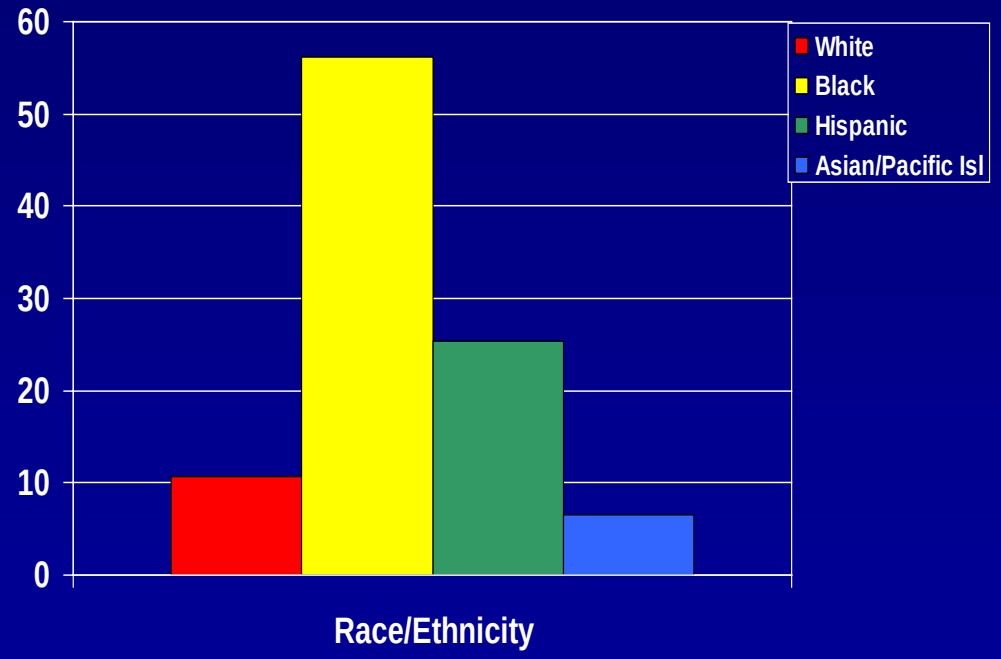
Percent of Live Births and Maternal Deaths By Race/Ethnicity

BMIRH 1998-2000



Live Births



Maternal Deaths

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Concurrent Morbidity: Obesity

BMIRH 1998-2000 (n =169)

- Obese 24%
- Not Obese 44%
- Missing 33%

- Weight > 200 lbs 20%
  at delivery

Comparing Leading Causes of Death (%)

Cause	International PRMR*	National PRMR N=4200**	NYC PRMR N=119
Embolism	Negligible	20%	7%
Hypertensive Disorders	12%	16%	10%
Hemorrhage	25%	17%	32%
Infection/ Sepsis	15%	13%	7%
Other	Obstructed Labor 8% Unsafe Ab 13%	Cardiomyopathy 8% CVA 5.0% Anesthesia 2%	Cardiomyopathy 8% Anesthesia 7%

*International WHO 1993, JAMWA 2002

**National MMWR 2003

***NYC BMIRH 1998-2000

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Hemorrhage Related Deaths

BMIRH 1998-2000

- Black 64 %
- Hispanic 21 %
- White 8 %
- Asian/Pacific Isl. 8 %

- In hospital 97%

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Hemorrhage Deaths*

% Related Cause

n=39

- Abnormal Coagulation — 31%
  - DIC/ Coagulopathy — 13%
  - Amniotic Fluid Embolism — 10%
  - HELLP syndrome — 5%
  - Abruptio placenta — 3%
- Active bleeding — 28%
  - Uterine atony — 15%
  - Placenta other — 8%
  - Placenta previa — 5%
- Unspecified/Unknown — 36%

* Coagulopathy is the final common pathway

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Pregnancy Outcome %

All Deaths vs. Hemorrhage

Pregnancy Outcome	All NYC Maternal Deaths (n=169)	NYC Hemorrhage Deaths (n=39)	US Hemorrhage Deaths (n=470)
Live Birth	44	54	14
Stillbirth	8	13	12
Induced Abortion/ miscarriage	13	18	8*
Ectopic	1	5	47
Molar	2	5	0.2
Undelivered	23	3	8
Unknown	8	3	10

*US data combines abortion and miscarriage

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Obesity: Maternal Mortality Risk From Hemorrhage

BMIRH 1998-2000

Obesity	NYC Live Births 1998-2000 (n=373,554; % of total)	Maternal Deaths (n=169)% of total, OR [CI]	Maternal Hemorrhage Deaths (n=39; % of total) OR [CI]
Yes	17	24 2.24 [1.5, 3.34]	38 3.88 [1.82, 8.26]
No	71	44	41
Missing	12	33	21

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Hemorrhage

- 1/ 1000 deliveries
  - Likely
    - Previa, Abruptio, uterine distension, previous history, Uterine rupture
  - Unanticipated
    - Uterine atony
    - Post partum

Physiologic Response to Pregnancy

- Increased vascular volume
- Decreased systemic vascular resistance
- Increased HR
- Increased cardiac output
- Placental blood flow 500-650 cc/minute
- Auto transfusion at delivery

Physiology of Hemorrhage

- Decreased
  - MAP, CO, CVP, PCWP, SV, Stroke work, O2 consumption, MVO2
- Increased
  - SVR, A-V O2 difference, Catecholamine release, HR, PVR, Myocardial contractility
  - Platelet aggregation
    - Small vessel occlusion
    - Impaired microcirculation
    - Embolization to lungs

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Physiology of Hemorrhage

- Adrenergic effect
  - constriction of venules and small veins
    - Increased venous return (preload)
  - Systemic hypotension
  - Decr capillary hydrostatic pressure
  - Fluid mobilizaton
  - decr blood viscosity

Physiology of Hemorrhage

- Anaerobic metabolism
  - Metabolic acidosis
  - Hyperventilation
    - Incr. intra-thoracic pressure
    - Incr. venous return
  - Vasoconstriction
    - Blood redistribution

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Impact of Hemorrhage

- Hypotenson
- Oliguria
- Acidosis
- Collapse

- Acute renal failure
- Shock liver, lung
- ARDS
- Pituitary necrosis

- salvage brain, heart, adrenals
- Fetal cerebral blood flow decr.

Mortality Risk

- Hb < 3.5-5 mg/dl (Hct.10.5-15)
- Multi organ failure

Class	Blood Loss	Volume Deficit	Spx	Rx
I	≤ 1000 cc	15%	Orthostatic tachycardia	Crystalloid
II	1001-1500	15-25%	Incr. HR, orthostasis, mental Decr cap refill	Crystalloid,
III	1501-2500	25-40%	Incr HR, RR Decr BP, Oliguria	Crystalloid Colloid, RBCs
IV	> 2500	> 40%	Obtunded Oliguria/anuria CV collapse	RBC, Crystalloid, Colloid

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Replacement fluids

- Restore Volume with crystalloid
  - NS preferred
  - 3:1 ratio to blood loss
- Transfuse RBCs
  - Signs of O2 deficiency
- Consider colloid
  - Albumen
  - Hetastarch

Transfusion

- NS only
  - D5W – hemolysis
  - RL - neutralizes citrate anticoagulant
- Blood used within 4 hours
  - Return to blood bank < 30 minutes
- Blood warming
  - Administered > 100cc/min
  - Cold => arrhythmia, coagulopathy

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Transfusion Risks

- Febrile Rxn (> 38C)
- Allergic Rxn
- Acute lung injury
- Septic Rxn (temp increased >2 Deg)
- Blood born infection
  - HIV - 0.9/1million
  - HTLV - 1/641k
  - Hep C – 1/103K
  - Hep B – 1/250K
- Calcium depletion
- Coagulopathy
- Dilution of clotting factors

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Blood Components

Product	Volume	Component	Indication/ Utility
Whole blood	450-500 cc	Hct. 36-44%	1u =1g/dl Hb
PRBC	200-250 cc	Hct. 70-80%	1u = 1g/dl Hb
Platelets	30-50cc	Platelets WBC Ag	1u = 5000uL
FFP	100cc	Fibrinogen, clotting factors	PT, PTT> 1.5 x nl, INR $\geq$ 1.6
Cryo precipitate	50-75cc	Factor 8c, VW factor Fibrinogen	Fibrinogen replacement

Other Approaches to Hemorrhage

- Preop donation
- Acute normovolemic hemodilution
- Hemobate (F2 alpha)
- Rectal Misoprostol
- Placental bed suture
- Uterine artery ligation
- Hypogastric artery ligation
- Hysterectomy

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Approaches to Hemorrhage

- Hemorrhage drills
  - Ob, Anesthesiolgy, Blood Bank, Nursing, other staff
- Experienced operator for anticipated blood loss
- O neg blood available
- Organized response team for unanticipated blood loss

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What doesn't work

- Preop uterine artery stents
- Lack of immediate response
- Crystalloid when blood is needed
- Delayed operative response
- Delayed transfusion response

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