Ethnicity, Severe Maternal Morbidity and Mortality

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No conflicts of interest to disclose

Objectives

- Demographic changes
- “Near miss” maternal mortality
- Ethnicity and “Near Miss mortality”

Maternal Mortality

United Nations Millennium Development Goal-5

- 75% reduction in maternal mortality between 1990-2015

Maternal Mortality Ratio(MMR)

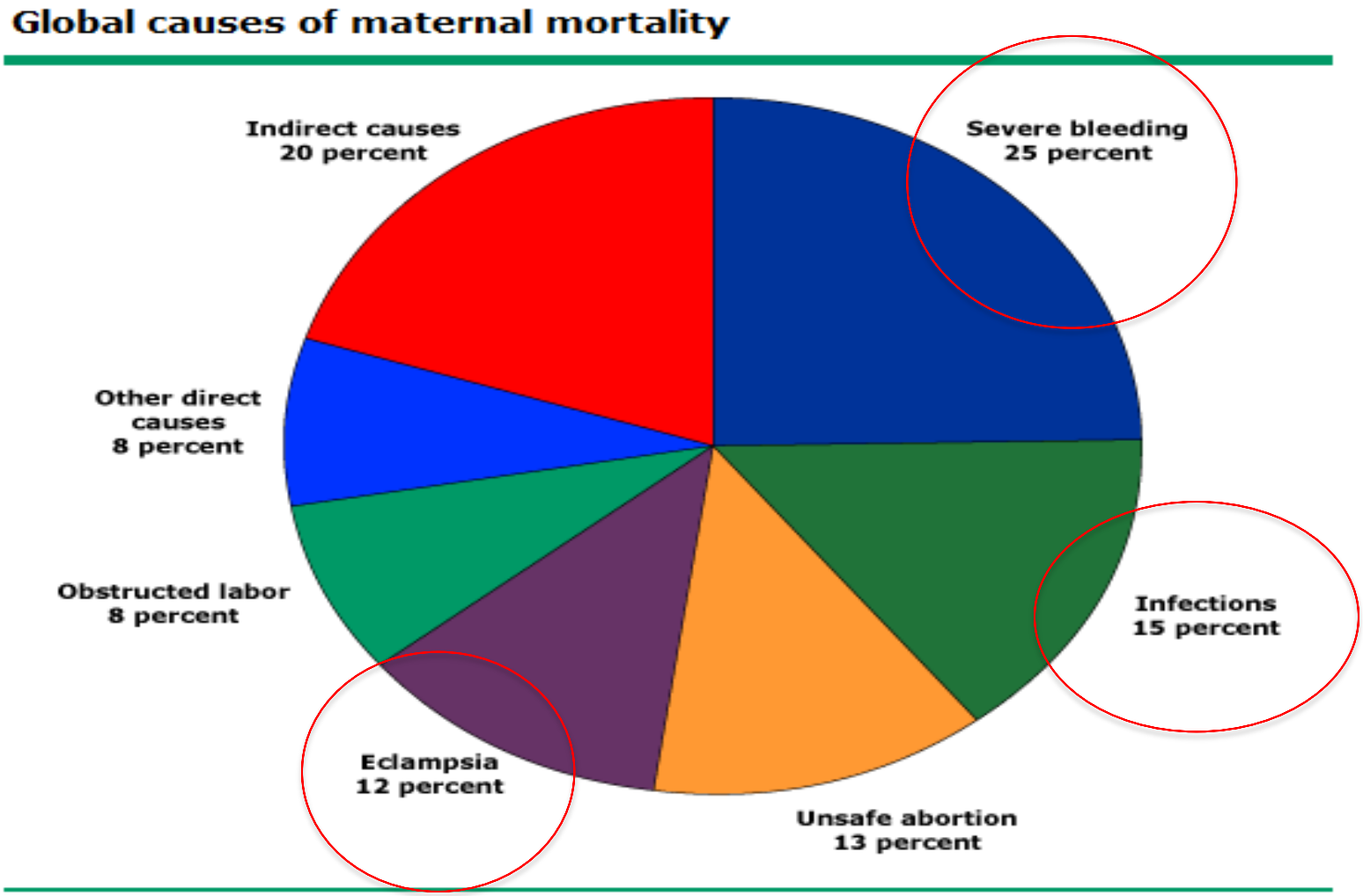
- Number of maternal deaths/100,000 live births
- Indicator of a woman's risk of dying for each pregnancy she undergoes

Maternal Mortality

- Direct causes:
  obstetric causes
  -hemorrhage, sepsis, preeclampsia

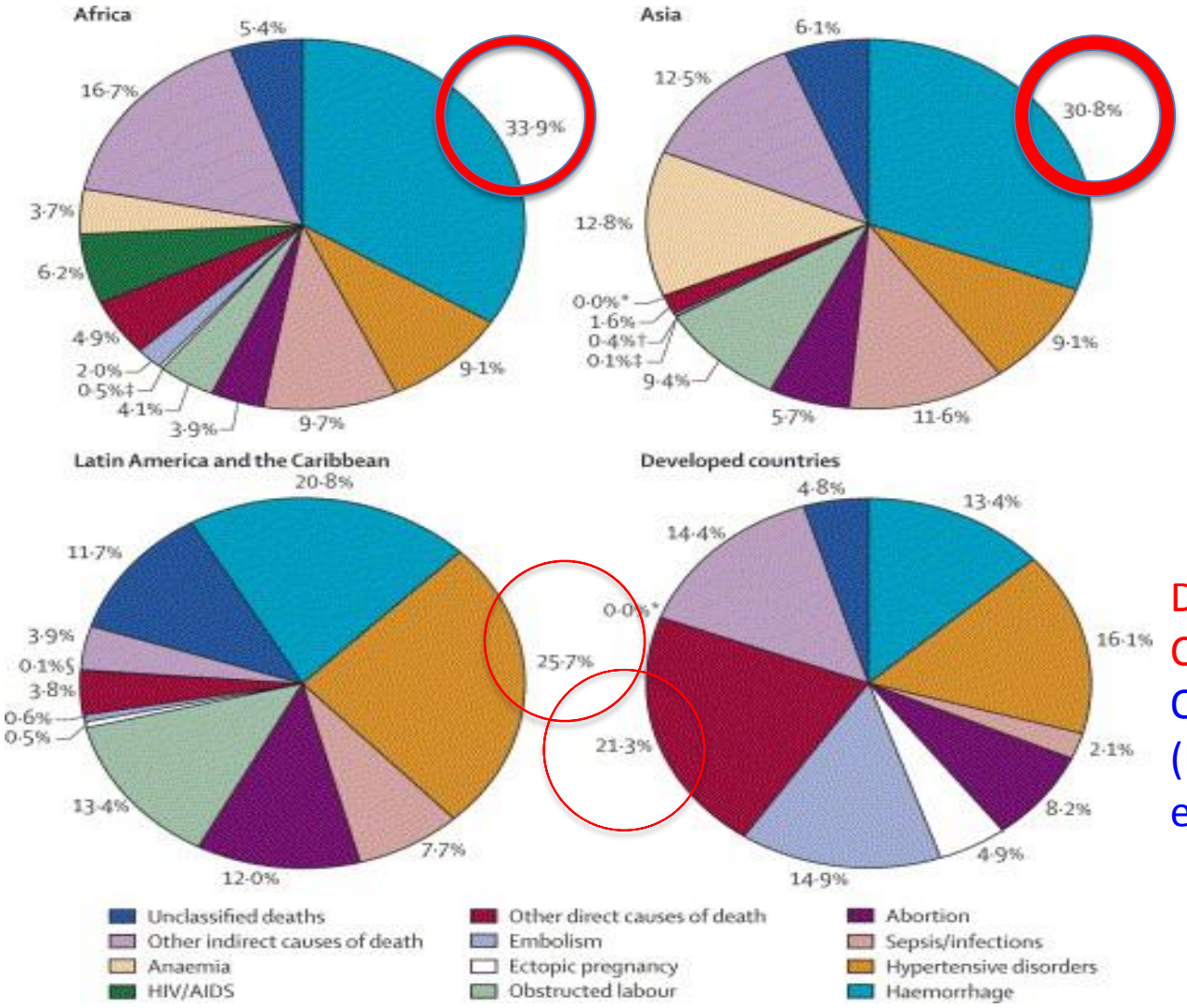
- Indirect causes:
  exacerbated by pregnancy
  -diabetes, obesity, *cardiac disease*

Worldwide



Causes of maternal death by region

AFRICA & ASIA
Hemorrhage



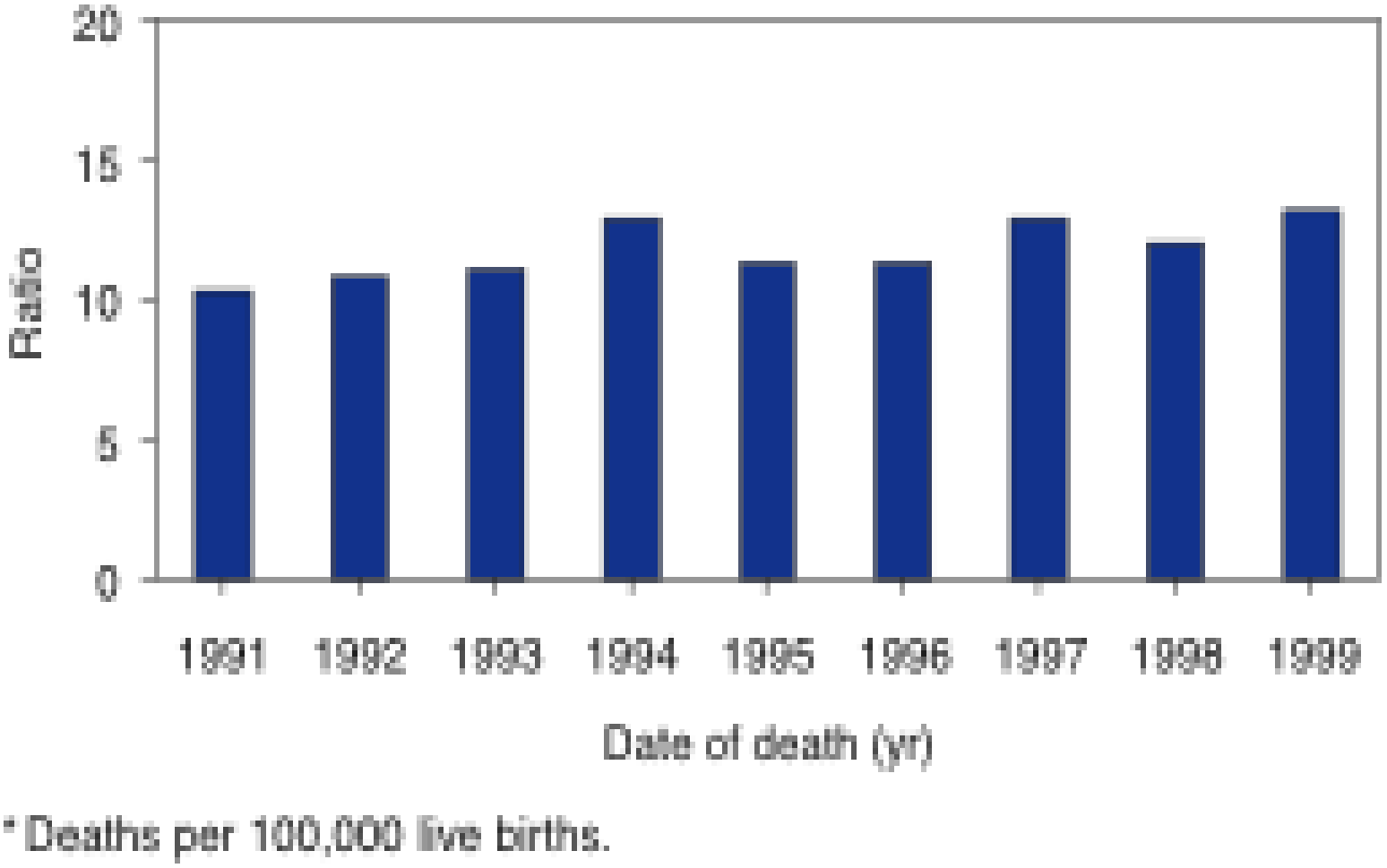
LATIN AMERICA/ CARIBBEAN
Hypertensive Disease

DEVELOPED COUNTRIES
Other Direct (Pulmonary embolism)

Khan, KS. Wojdyla D, Say L, Gulmezoglu AM, Van Look PFA. WHO analysis of causes of maternal death: a systematic review. Lancet. 2006 Apr. 367: 9516, 1066–1074

Maternal Mortality-CDC

pregnancy related maternal mortality ratios* by year 1991-1999



* Deaths per 100,000 live births.

CDC – pregnancy related mortality surveillance - 2003

Maternal Mortality-US

Pulmonary Embolism	20%
Hemorrhage	17%
Preeclampsia/Eclampsia	16%
Infection	13%
Cardiomyopathy	8%

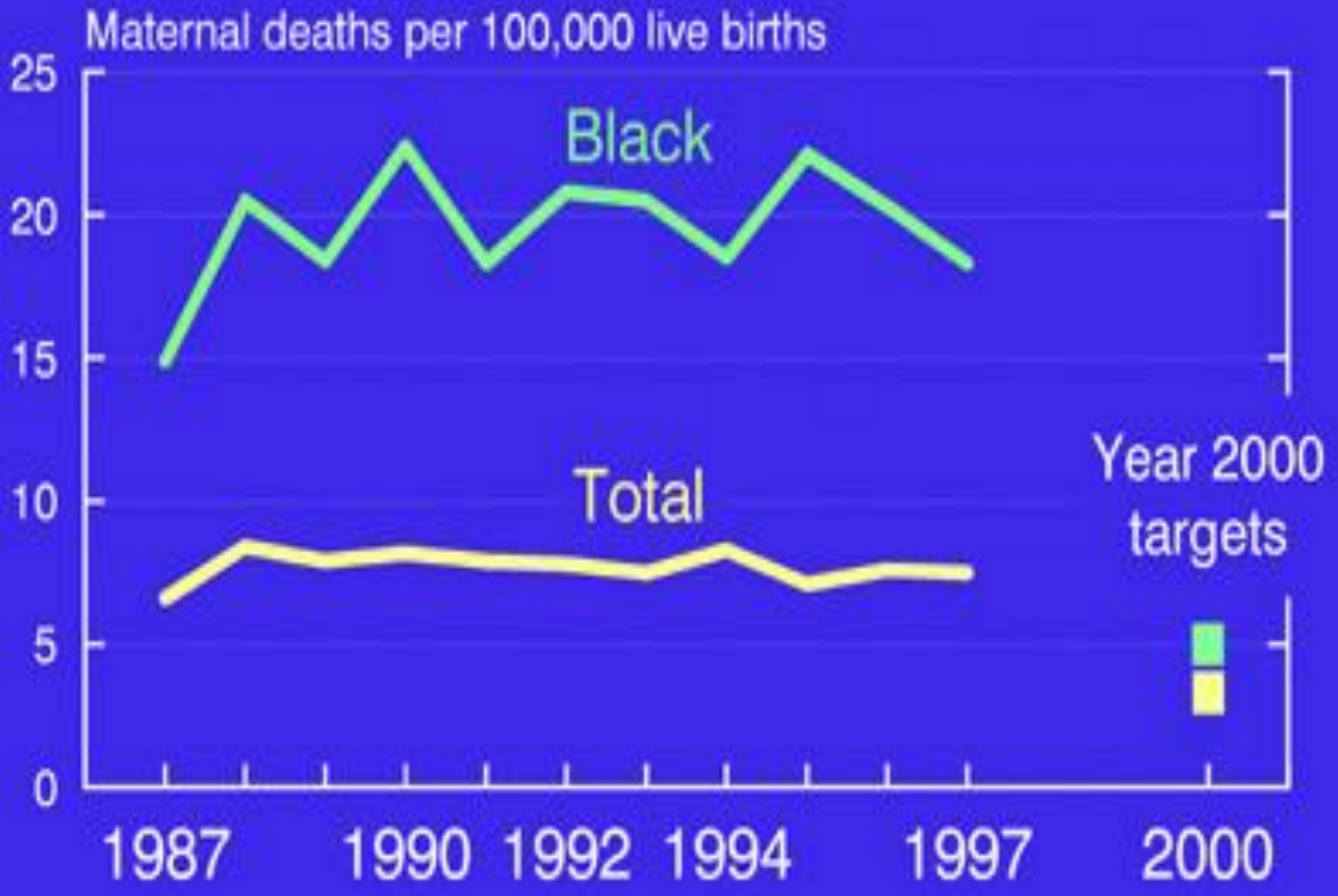
CDC – pregnancy related mortality surveillance - 2003

Maternal Age

Age	Risk Ratio (95% CI)
≤19	referent
20-24	1.1(.8-1.5)
30-34	1.4((1.1-1.8)
35-39	2.5(2-3.2)
over 39	5.3(4.2-6.6)

CDC – pregnancy related mortality surveillance - 2003

Maternal Mortality Rates



Maternal deaths are those assigned to ICD-9 630-676. Data for 1997 are preliminary.

Maternal Mortality

2006	**MMR**
Overall	13.3
White	9.5
Hispanic	10.2
African American	32.7

CDC, 2010

Maternal Mortality

“race and ethnicity are not risk factors for maternal mortality

but instead may be markers of social, economic, cultural, health-care access and quality, and other interrelated factors that may increase the risk for death among pregnant women”

cdc, 1999

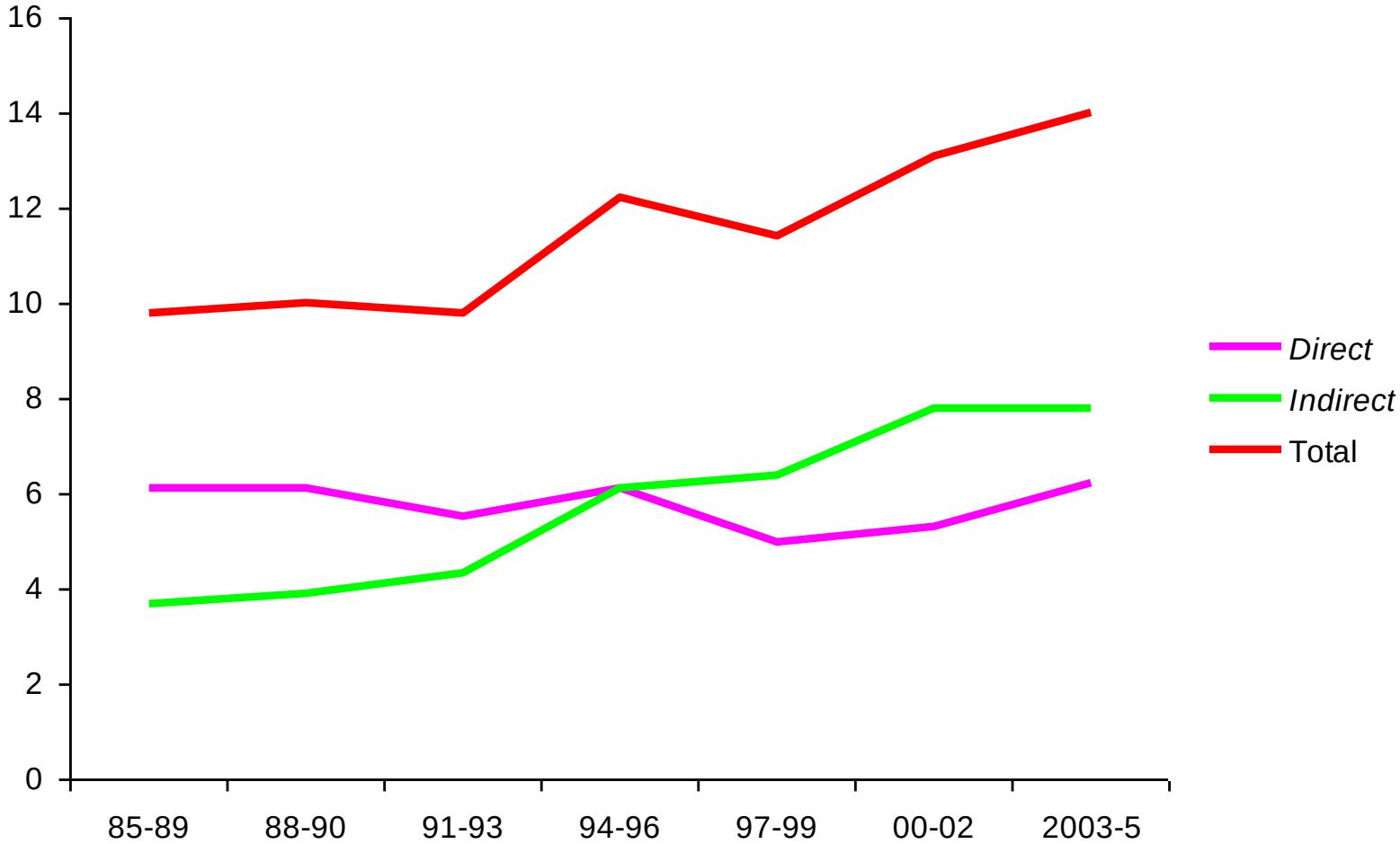
UK Confidential Inquiry

Maternal Deaths: Numbers and rates per 100,000 maternities by type: UK 1985-2005

	Caused *Direct*		Aggravated *Indirect*		Total	
1994-1996	134	6.1	134	6.1	268	12.2
1997-1999	106	5	116	6.4	242	11.4
2000-2002	106	5.3	155	7.8	261	13.1
2003-2005	132	6.2	163	7.7	295	14

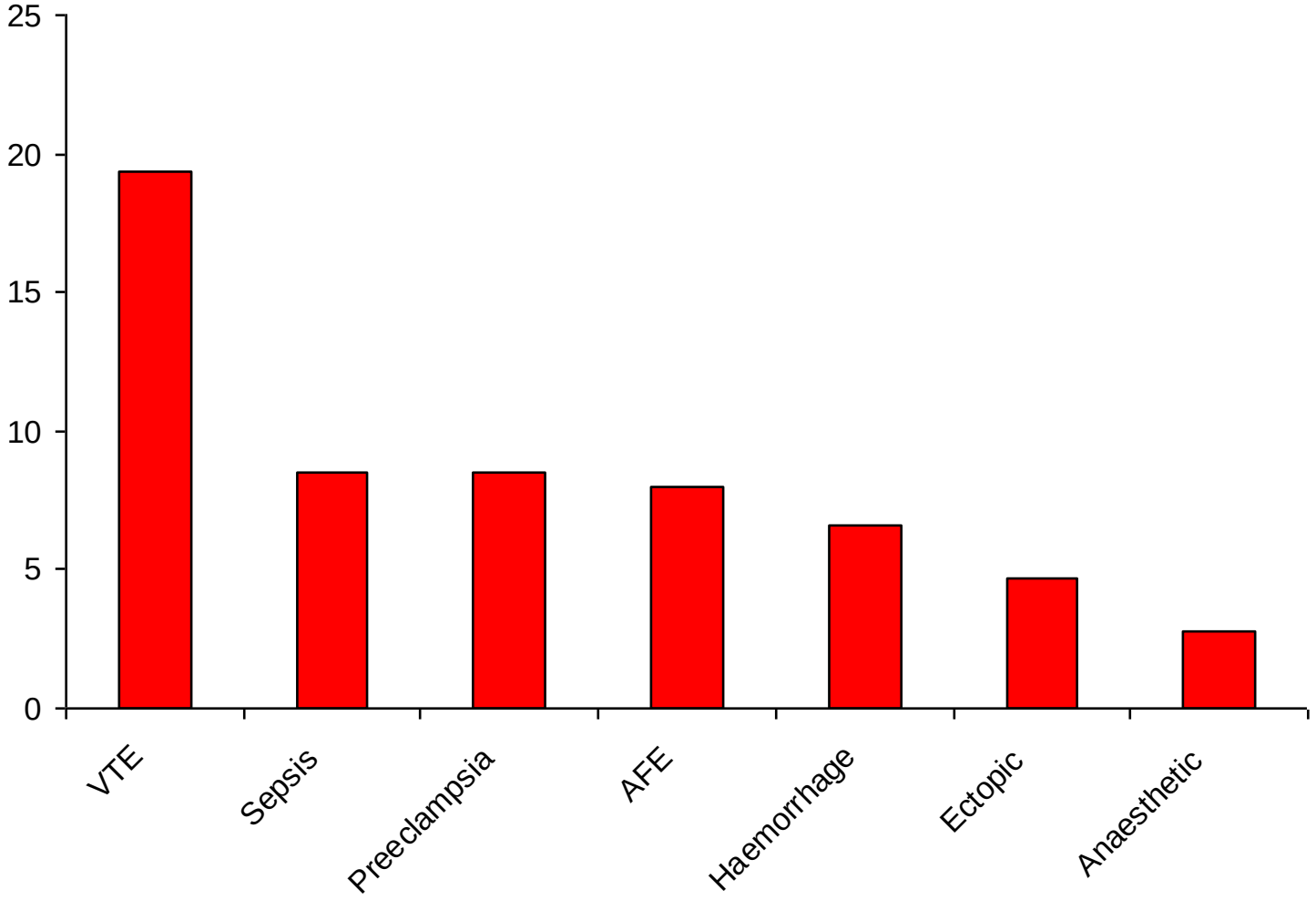
Lewis, CEMACH, 2011

Direct and *Indirect* rates UK :1985-2005



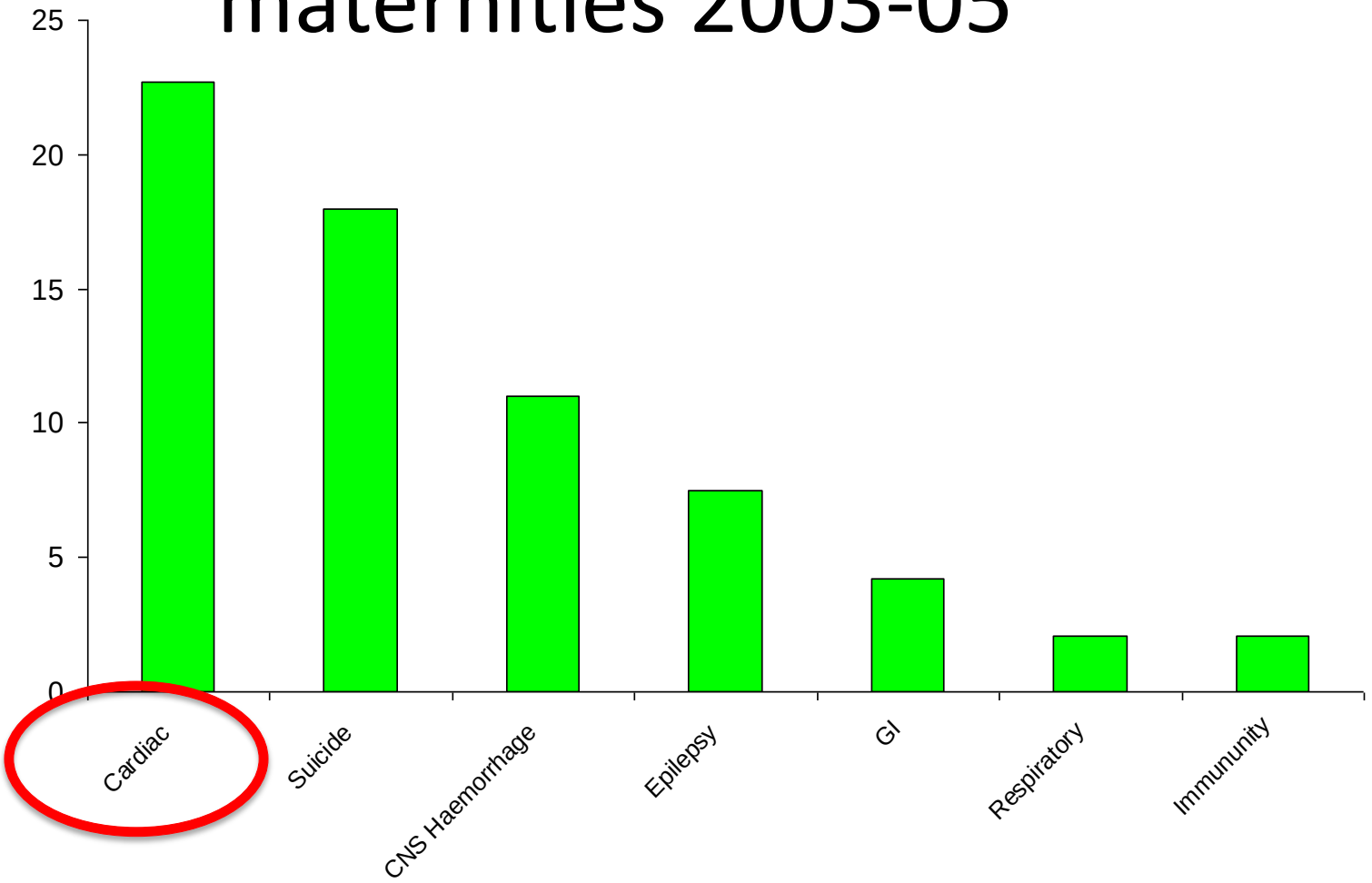
Lewis, CEMACH, 2011

Leading causes of *Direct* deaths: UK rates per million maternities 2003-05



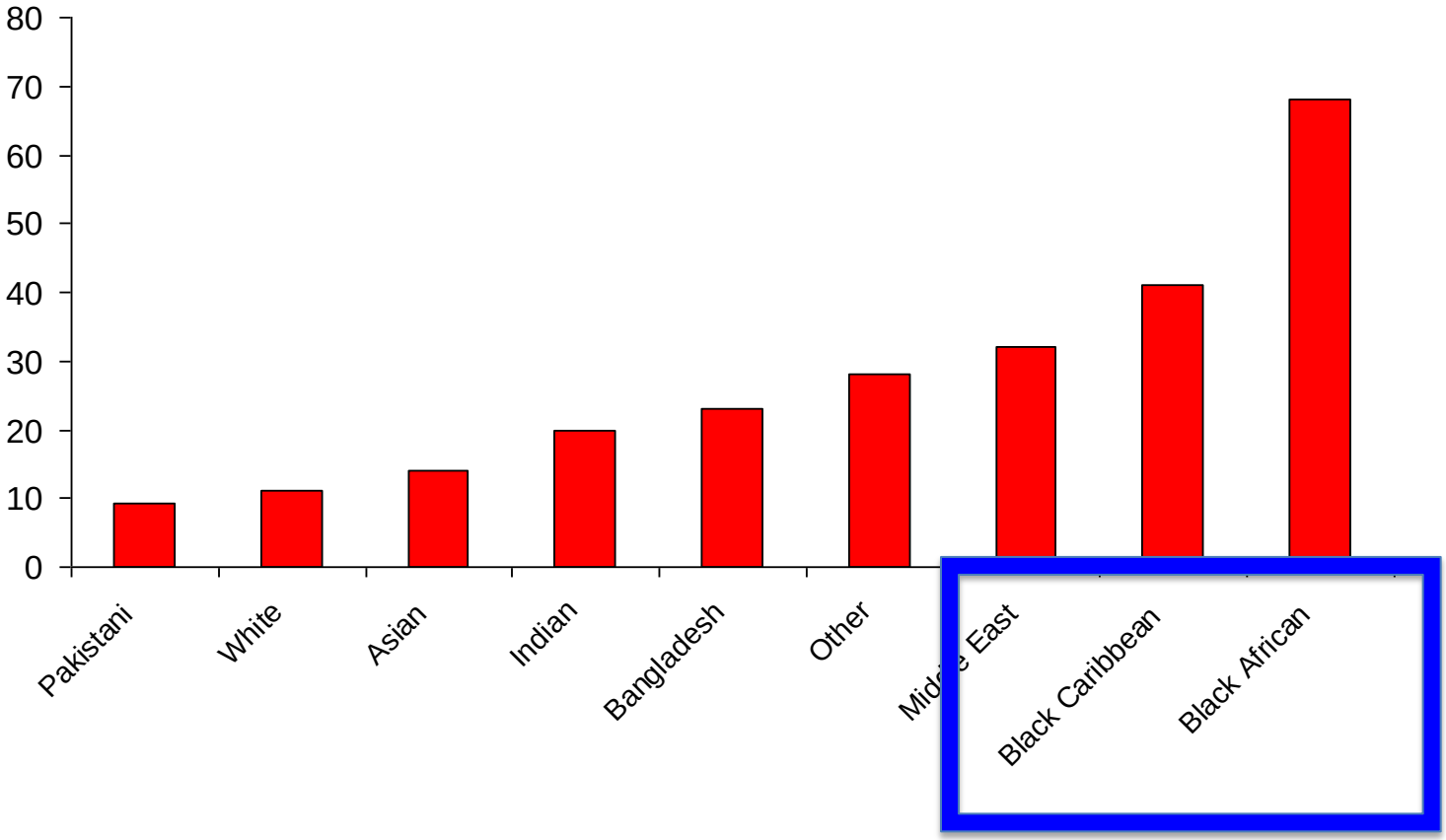
Lewis, CEMACH, 2011

Leading causes *of* *Indirect* deaths: rates per million maternities 2003-05



Lewis, CEMACH, 2011

Maternal mortality rates by major ethnic group; England only 2003-05

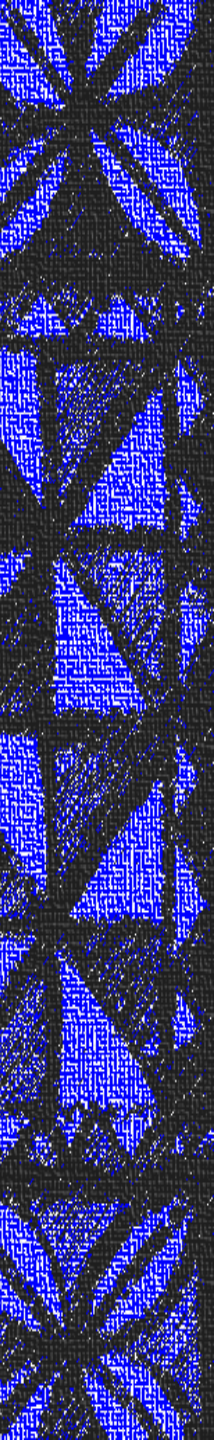


Lewis, CEMACH, 2011

CEMACH 2011: Obesity

- 52% of mothers who died were overweight or obese

Lewis, CEMACH, 2011



Other Settings

Netherlands: 1993-2005

- MMR 12 (compared to 9.7 from 1983-1992)
- Increase in cardiovascular disorders (OR 2.5; 1.4-4.6)
- Younger than 20 and older than 45 at high risk
- Nonwestern immigrant populations at highest risk (MMR 20)
- Substandard care: preeclampsia (91%); immigrant populations (62%)

Schutte, et al. Rise in maternal mortality in the Netherlands. BJOG, 2009

“Near Miss” Maternal Mortality

“Near Miss” Conceptual Framework

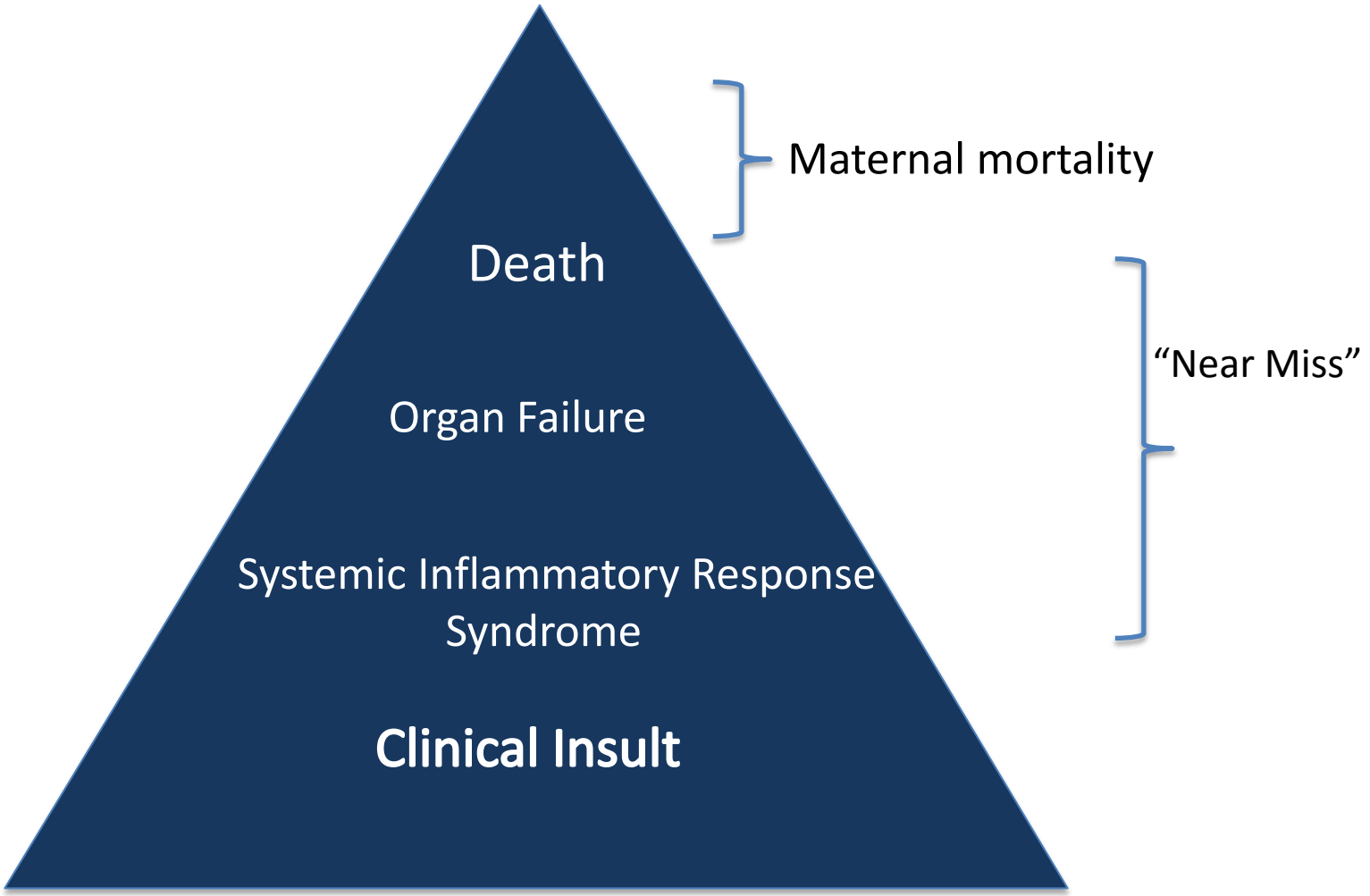
Airline Industry

Near Miss Maternal Mortality

- Maternal mortality is rare in high-income nations, while severe maternal morbidities are more frequent
- Near miss maternal can be used to provide information on quality of care

- *Indirect indicators in the evaluation of maternal deaths?*

Pregnant Population



Mantel, Buchmann, Rees, Pattinson. Severe Acute maternal morbidity: a pilot study of a definition for a near-miss. BJOG. 1998

Definitions of Near Miss Maternal Mortality: by organ system

- Cardiovascular dysfunction
  - eg. cardiac arrest
- Respiratory dysfunction
  - intubation and ventilation
- Renal dysfunction
  - Oliguria, dialysis
- Coagulation dysfunction
  - transfusion >=5 units
- Neurologic dysfunction (e.g. stroke)
- Metabolic dysfunction (e.g. DKA)

Definition of Near Miss: Management Based

- Intensive care unit admission
- Emergency hysterectomy
- Anesthetic accidents

Near Miss Maternal Mortality

- Examination of these events may provide:
  - insight into system problems
  - Insight into system success/effective interventions

Near Miss Maternal Mortality: Survivors

- Interviews with surviving women provide valuable information
  - Poor access, poor care
- Insights may provide information not easily obtained through interviews with family members or through record review *after* a maternal death

Maternal costs: Uganda

- 30 women with ‘near miss’ events (severe preeclampsia/eclampsia, hemorrhage)
- Semi-structured interviews
- “Powerlessness”
- Women describe problems in health care system (access to care, financial barriers)

Weeks et al. Personal Accounts of ‘near miss’ maternal mortalities in Kampala Uganda. BJOG. 2005

Surveillance Challenges

- Surveillance Strategies and Organizations
  - "US"
    - ACOG maternal mortality surveillance
  - Resources, surveillance support
  - Confidentiality

Discoverability—proceedings should have protection by state statute to protect from liability or discovery

Race/Ethnicity and Near Miss Mortality

“Hispanic Paradox”

The epidemiological finding that Hispanics in the United States have substantially better health outcomes than the average population

Despite what aggregate socioeconomic determinants would predict

Markides KS, Coreil J. The health of Hispanics in the southwestern United States: an epidemiologic paradox. *Public Health Rep. 1986*

Hispanic Paradox

Areas where this paradox has been documented:

- Cardiovascular Disease
- Preterm Delivery
- Low Birth Weight

Brown, H, Chireau M, Jallah, Y, Howard, D The "Hispanic paradox": an investigation of racial disparity in pregnancy outcomes at a tertiary care medical center. *American Journal of Obstetrics and Gynecology.* 2007

Beukens P, Notzon F, Kotelchuck M, Wilcox A. Why do Mexican Americans give birth to few low birth weight infants? Am J Epidemiol 2000

Hispanic Paradox

Socioeconomic factors

- Younger maternal age
- Later entry into prenatal care
- Lack of insurance
- Shorter interpregnancy intervals
- Lower levels of formal maternal education
- Increased rates of unemployment

Guendelman et al. Social Disparities in Maternal Morbidity During Labor and Delivery between Mexican Born and US born White Californians, 1996-1998. AJPH, 2005

Hispanic Paradox: Theories

"Healthy immigrant" Effect

Strong social support networks


Diet
Lifestyle choices
(less alcohol, tobacco, illicit drug use)

Role of Ethnicity: Complex and Heterogeneous

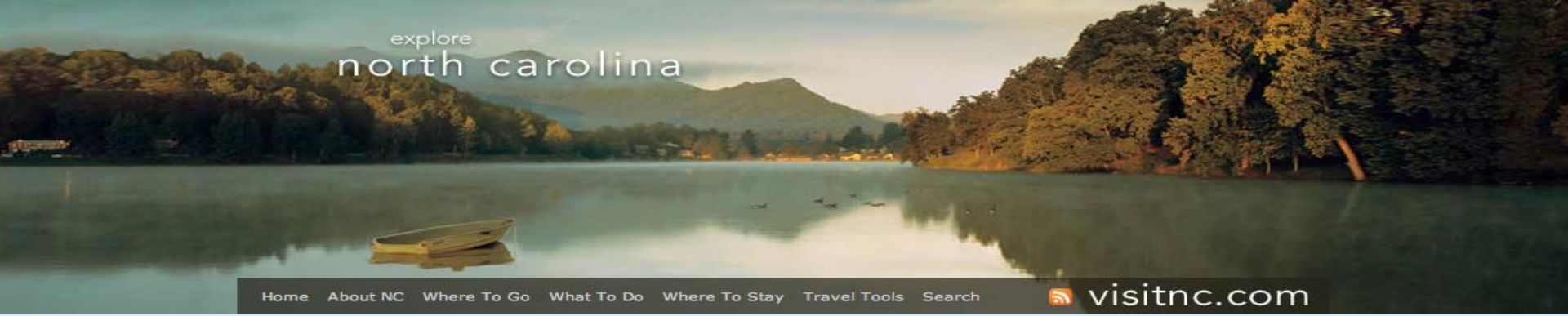
- NYC: no reduction in preterm birth rates among Hispanic/Latino women
  - Puerto Rican (28.9%), Dominican (25.%)
- Preterm birth analyzed by race/ethnicity and country of origin (Gestational age 22-31weeks)
  - African American Women OR 4.9 (4.6, 5.3)
  - Dominican Republic 2.5 (2.3, 2.8)
  - Puerto Rico 3.2 (3, 3.4)
  - Mexico 1.8 (1.6, 2.1)

Stein, et al. Maternal Ethnic Ancestry and Adverse Perinatal Outcomes in NYC. Am J Obstet Gynecol. 2009

Maternal Mortality Pregnancy Mortality Surveillance 1993-2006

	White	Hispanic	Black
Within same race/ethnic group	.83 (.69, 98)	1.28 (1.18, 1.38)	3.55 (3.18, 3.98)
Compared to US born white women	.77 (.77,.78)	1.54(1.54,1.55)	3.63(3.62,3.64)

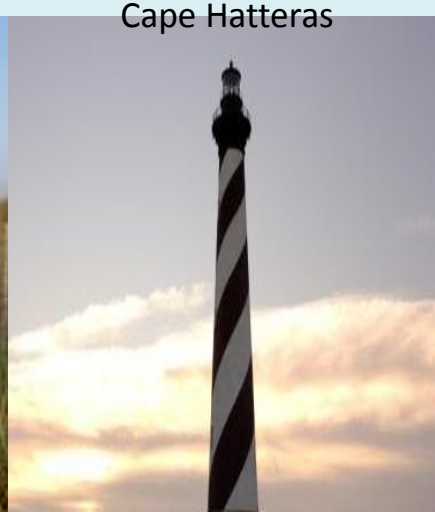
Creanga, Race Ethnicity and Nativity Differentials in Pregnancy-Related Morality in the US 1993-2006. Obstet Gynecol. 2012



North Carolina

Wrightsville beach

Cape Hatteras



North Carolina

- Hispanic population is fastest growing in US.
- 300% increase from 1990-2000
  - 74% born outside US: 65% from Mexico or Central America, 8% migrants from other states

North Carolina

- Cross sectional analysis of birth data Medicaid population (n= 12, 774) between 1994-2005 at DUMC

Ethnicity and Maternal Health: North Carolina

- African American women had highest rates of preterm birth, infant, and maternal mortality
- Hispanic women lowest rates demonstrated
  - Although, more socioeconomic disadvantage and access barriers than African American and White women

Brown, Chireau, Jallah, MSb,Howard The "Hispanic paradox": an investigation of racial disparity in pregnancy outcomes at a tertiary care medical center. *Am J ObGyn.* 2007

Near Miss Maternal Mortality: Multiethnic Population

- ICD-9 codes associated with severe morbidity and obstetric complications
  - Measures of “near miss” maternal mortality: (e.g. cardiac failure, cardiac arrest, stroke)
  - Ob Complications (e.g. severe preeclampsia)

Brown H, Small M, Taylor Y, Chireau M, Howard D. Near Miss Maternal Mortality in a Multiethnic Population. Annals of Epi. 2011

Results

- 12,744 women in sample, 57% African American, 23. 5% Hispanic, 19.8% White

- Hispanic women were more likely to be nulliparous, unemployed, and more likely to reside in Durham, NC

Near Miss Mortality in Multiethnic Population

- Presence of medical co-morbidity highest among African-American women (9.1%) when compared to Whites (8.1%) and Hispanic (2.6%)

- Presence of near miss maternal mortality highest for Hispanic women than African American women

Distribution of Pregnancy outcomes by race/ethnicity

Pregnancy outcome n(%)	Af Am N=7238	White N=2533	Hispanic N=3003	P*
Near Miss Mortality	332(4.6)	103(4.1)	177(5.9)	.004
Pregnancy complications	1835(25.4)	550(21.7)	564(18.8)	.001

Near Miss Mortality NC: Risk of Morbid Outcomes

RR (95% CI)

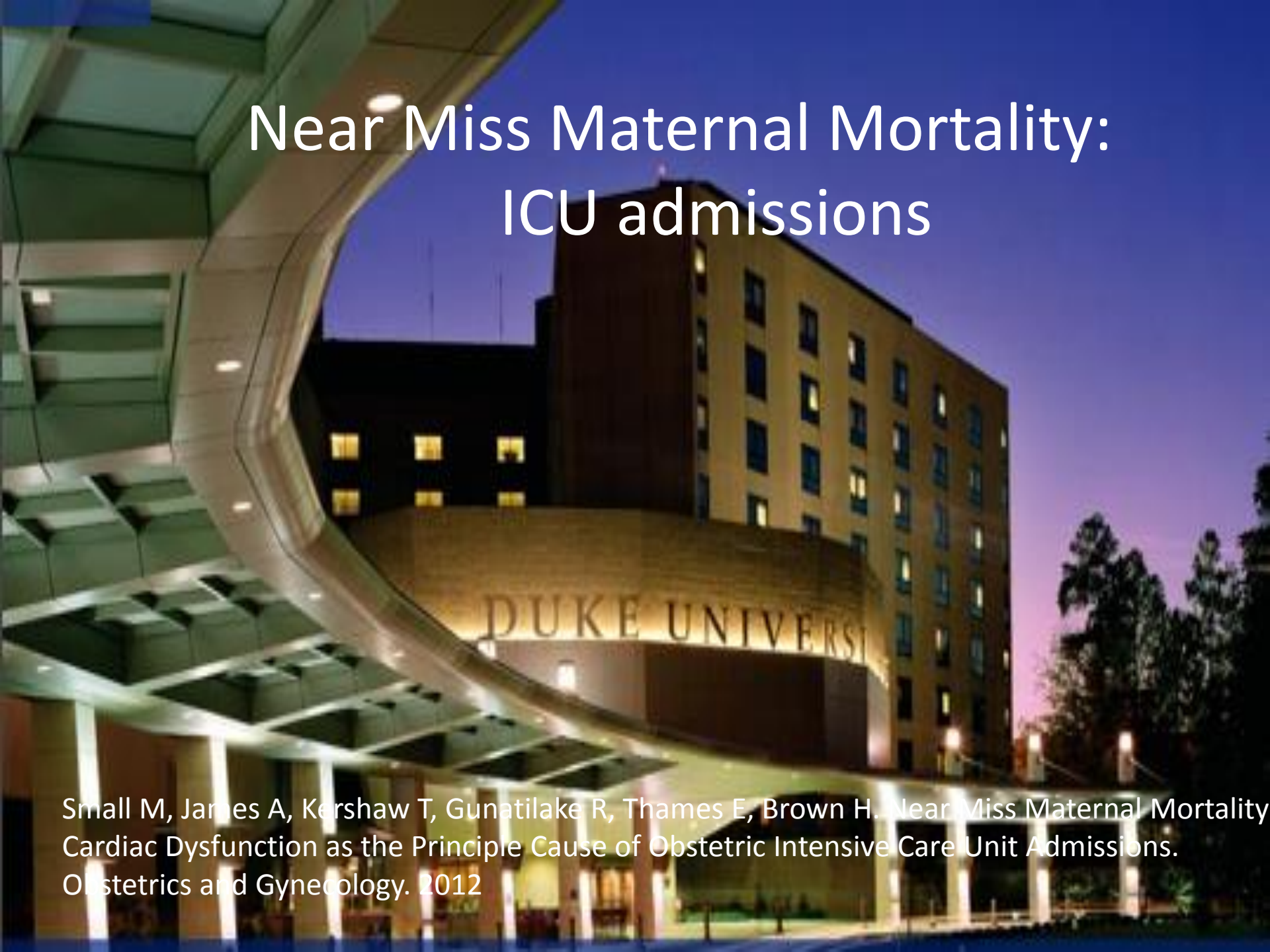
	Near Miss mortality	Pregnancy Complication
African American	1.13(.91, 1.4)	1.17(1.07, 1.27)
Hispanic	1.45(1.14, 1.84)	.86(.78, .96)

REF= White

Near Miss Maternal Mortality in a Multiethnic Population

- Hispanic women had higher rates of ‘near miss’ maternal mortalities when compared to African American and Caucasian women
- Limitations: 1° language, education, income level, country of origin, adequacy of prenatal care

Near Miss Maternal Mortality: ICU admissions



Small M, James A, Kershaw T, Gunatilake R, Thames E, Brown H. Near Miss Maternal Mortality Cardiac Dysfunction as the Principle Cause of Obstetric Intensive Care Unit Admissions. Obstetrics and Gynecology. 2012

High Dependency Unit (HDU)

- Capacity to manage severe conditions
  - e.g. eclampsia, hemorrhage, pulmonary embolism, cardiac disease
- Only the most critically ill patients are admitted to the ICU
  - e.g. require prolonged ventilation

ICU admissions

- Pregnant and post partum patients admitted to DUMC surgical, medical, cardiac, pulmonary, and neurology ICUs from Jan 2005-2011

- Patients or family members/designated proxies consented to participation in Ob ICU registry

ICU admissions

All records were reviewed and primary admission diagnoses leading to ICU admission reviewed

ICU admissions

- 19, 575 births
- 5 maternal deaths: metastatic melanoma(1), cystic fibrosis (2) sepsis/H1N1 (1)
- 94 obstetrics patients admitted to ICU (5/1,00 deliveries) 8 declined participation

Maternal Characteristics

	Total N=86	White N=32	Af Am N=39	Hispanic N=9	Other N=6	p
Age (y)	29.8+/-7.2	29.4+/-7.2	30.1+/-7.4	28.6+/-8.1	32.3+/-4.1	.77
Gest age	33+/-7	32.5+/-7.1	32.7+/-7.6	33.6+/-6.1	33+/-7.0	.78
Parity	1	<1	2	2	1	.02
Birth weight(g)	2, 481	2, 330	2, 473	2, 847	2, 686	.16
Employed	42(48.8)	20 (62.5)	17(43.6)	17(43.6)	2(33.3)	.18
Private Insurance	35(40.7)	20(62.5)	10(25.6)	1(11.1)	4(66.7)	0
Marital Status	35(40.7)	20(62.5)	8(20.5)	4(44.4)	3(50)	.03
BMI	32.3+/-9.7	28.2+/-6.5	35.6+/-10.8	36.1+/-11.1	25.9+/-2.4	.01

Data are mean+/- standard deviation, mean (not including index) or (%) within racial and ethnic groups unless otherwise specified

Characteristics of Ob ICU Stay for Obstetric Patients

Type of ICU	
SICU CICU MICU Other	33(38.4) 26(30.2) 22(25.6) 5(5.8)
Postspartum	75(87)
Days postpartum	2+/- 3.7
Total length of stay(days)	10 +/- 8
Days in Newborn ICU	10+/- 21
Maternal intubation	36 (42)
Pulmonary Artery Catheterization	21 (24)
Cesarean Hysterectomy	12 (14)
ICU, intensive care unit, Data are n(%) or mean +/- standard deviation	

Ob ICU Admissions

CARDIAC	31(36)
Hemorrhage	25(29)
Sepsis	8(9)
Hypertensive Disease	8(9)
Pulmonary Embolus	3(3)
Stroke or encephalopathy	2(2)
Catastropic antiphospholipid antibody syndrome	2(2)
Diabetic ketoacidosis	1
Hepatic Failure	1
Neurosyphilis, HIV	1
Amniotic fluid embolus	1
Thrombotic thrombocytopenic purpura	1
Hypoxemia secondary to extreme obesity and obstructive sleep apnea, post op cesarean section	1
Acute Respiratory Distress, cystic fibrosis	1

Cardiac Disease in Pregnancy

Cardiac Disease Requiring ICU admission (n=31)	
Valvular Disease (4)	Critical Aortic Stenosis (2) Mitral stenosis with cardiomyopathy and valvuloplasty during pregnancy Double mechanical valves with complications
Congenital Heart Disease with complications (5)	-Repaired Tetralogy of Fallot with pulmonary atresia -Repaired Tetralogy of Fallot with acute renal failure due to medication toxicity -Transposition of the Great Vessels with stent placement during pregnancy -Single ventricle -Ebsteins Anomaly and severe preeclampsia
Marfans Syndrome with dilated aortic root (3 total)	Additional complications: aortic root dissection(1), cerebral aneurysm and left ventricle dysfunction(1)
Severe Pulmonary hypertension (5 total)	Additional complications: right heart failure (2), end stage renal disease, mitral valve replacement in pregnancy (1)

Ob ICU Admissions: Cardiomyopathy

Cardiomyopathy ---CM (14)	--Acute peripartum cardiomyopathy-PPCM (6) --Intraoperative cardiac arrest in patient with history of PPCM --Cardiac Decompensation in patient with history of PPCM and LVAD in previous pregnancy --CM and Antiphospholipid Antibody Syndrome (APLAS), heparin-induced thrombocytopenia (HIT) --CM associated with doxorubicin therapy for breast cancer and pulmonary embolism requiring left ventricular assist device (LVAD) --CM associated with acute myocardial infarction(MI) --CM, left ventricular thrombus, congenital endocardiofibroelastosis and congestive heart failure --Severe hypertrophic CM(multiple family members with CM-associated sudden death) and pacemaker placement in index pregnancy

Obesity and Near Miss Maternal Mortalities

- Few studies of ICU admissions report maternal BMI
- UK confidential inquiries, obesity associated with 50% of maternal deaths
- Disparity for Hispanic women and African American women in our ICU population but did not affect medical comorbidities

Ethnicity and ‘Near Miss” Maternal Mortality: ICU admissions

- No increase in ’near miss’ events for Hispanic women
- African American Women largest group admitted to ICU

Small M, James A, Kershaw T, Gunatilake R, Thames E, Brown H. Near Miss Maternal Mortality: Cardiac Dysfunction as the Principle Cause of Obstetric Intensive Care Unit Admissions. Obstetrics and Gynecology. 2012

Limitations of ICU admissions as 'Near Miss' Measure

- Criteria for admission varies across institutions
- Represent 1/3 of severe obstetric morbidities
- Possible use as quality assessment indicators for obstetric care
- May reflect a different population than maternal mortalities

Maternal Mortality: NC 1990-99

Cause of Death	% of all Pregnancy Related Deaths
Cardiomyopathy	21
Hemorrhage	14
Pregnancy induced Hypertension	10
Stroke	9
Chronic Conditions	9
Amniotic Fluid Embolism	7
Infection	7
Pulmonary Embolism	6

Obstet Gynecol 2005;106:1228–34

Maternal Cardiac Morbidity and Mortality, NC

- Aggressive identification and treatment in our population
- Tertiary care referral center for women with congenital heart disease

Congenital Heart Disease (CHD)

- Chronic heart disease prevalence in pregnancy 1.4% with majority CHD
- Increasing prevalence of severe maternal morbidity from cardiac disease in 2004-2005, compared to 1995-1997
  - (e.g. cardiac arrest, myocardial infarction)

Kulkina, Callaghan, Chronic Heart disease and severe obstetric morbidity among hospitalizations for pregnancy in the USA 1995-2006. BJOG, 2010

Cardiovascular Disease

- A leading cause- if not THE leading cause- of indirect maternal mortalities in High Income Countries

Maternal Mortality and Near Miss Maternal Morbidity

- As childbirth delayed, contribution of indirect maternal deaths and severe maternal morbidity increases
- Cardiac conditions, demonstrate a greater contribution to maternal morbidity and mortality

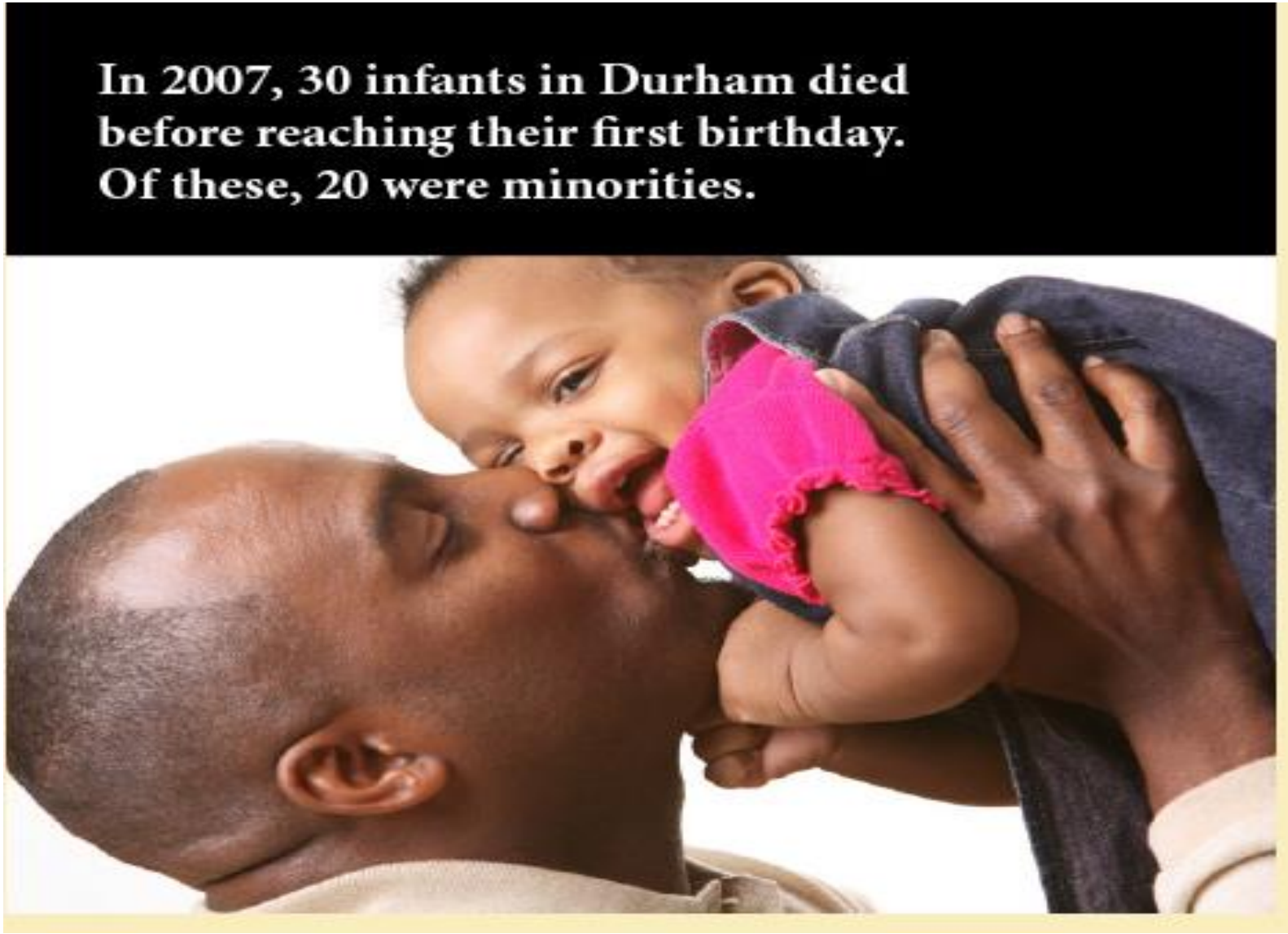
Joint Commission Recommendations

- Communication between providers and family
  - Interpreters (CEMACH)
  - Preconception care and counseling
- Prompt identification of change in clinical conditions
  - response with best practice and local protocols
- Pneumatic compression stockings
  - high risk patients and those having cesarean deliveries

The Joint Commission. Sentinel Event Alert. Preventing Maternal Death. Issue 44. January 2010. http://www.jointcommission.org/assets/1/18/SEA_44.PDF

Maternal Death and "Near Miss" Mortality

- Racial/ethnic disparities worldwide
  - Analyses, and interventions based on country/region specific data
- Medical co-morbidities, aging, and obesity increasing
- 'Near miss" surveillance: an adjunct to maternal mortality review



Partnership for a Healthy Durham, 2007

THANK YOU

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