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
Global causes of maternal mortality

- Severe bleeding: 25 percent
- Indirect causes: 20 percent
- Other direct causes: 8 percent
- Obstructed labor: 8 percent
- Eclampsia: 12 percent
- Unsafe abortion: 13 percent
- Infections: 15 percent

Causes of maternal death by region

AFRICA & ASIA
- Hemorrhage

LATIN AMERICA/ CARIBBEAN
- Hypertensive Disease

DEVELOPED COUNTRIES
- Other Direct (Pulmonary embolism)

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

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary Embolism</td>
<td>20%</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>17%</td>
</tr>
<tr>
<td>Preeclampsia/Eclampsia</td>
<td>16%</td>
</tr>
<tr>
<td>Infection</td>
<td>13%</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>8%</td>
</tr>
</tbody>
</table>

CDC – pregnancy related mortality surveillance - 2003
## Maternal Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Risk Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤19</td>
<td>referent</td>
</tr>
<tr>
<td>20-24</td>
<td>1.1 (.8-1.5)</td>
</tr>
<tr>
<td>30-34</td>
<td>1.4 (1.1-1.8)</td>
</tr>
<tr>
<td>35-39</td>
<td>2.5 (2-3.2)</td>
</tr>
<tr>
<td>over 39</td>
<td>5.3 (4.2-6.6)</td>
</tr>
</tbody>
</table>

CDC – pregnancy related mortality surveillance - 2003
Maternal Mortality Rates

Maternal deaths per 100,000 live births

Year 2000 targets

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

<table>
<thead>
<tr>
<th>2006</th>
<th>MMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>13.3</td>
</tr>
<tr>
<td>White</td>
<td>9.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>10.2</td>
</tr>
<tr>
<td><strong>African American</strong></td>
<td><strong>32.7</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Caused Direct</th>
<th>Aggravated Indirect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1994-1996</strong></td>
<td>134 (6.1)</td>
<td>134 (6.1)</td>
<td>268 (12.2)</td>
</tr>
<tr>
<td><strong>1997-1999</strong></td>
<td>106 (5)</td>
<td>116 (6.4)</td>
<td>242 (11.4)</td>
</tr>
<tr>
<td><strong>2000-2002</strong></td>
<td>106 (5.3)</td>
<td>155 (7.8)</td>
<td>261 (13.1)</td>
</tr>
<tr>
<td><strong>2003-2005</strong></td>
<td>132 (6.2)</td>
<td>163 (7.7)</td>
<td>295 (14)</td>
</tr>
</tbody>
</table>

Lewis, CEMACH, 2011
Leading causes of *Direct* deaths: UK rates per million maternities 2003-05

- VTE
- Sepsis
- Preeclampsia
- AFE
- Haemorrhage
- Ectopic
- Anaesthetic

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%)

“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

- Death
- Organ Failure
- Systemic Inflammatory Response Syndrome
- Clinical Insult

Maternal mortality

“Near Miss”

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

Hispanic Paradox

Areas where this paradox has been documented:

- Cardiovascular Disease
- Preterm Delivery
- Low Birth Weight


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

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 22-31 weeks)
  - 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)


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

North Carolina
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)

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

<table>
<thead>
<tr>
<th>Pregnancy outcome n(%)</th>
<th>Af Am N=7238</th>
<th>White N=2533</th>
<th>Hispanic N=3003</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Miss Mortality</td>
<td>332(4.6)</td>
<td>103(4.1)</td>
<td>177(5.9)</td>
<td>.004</td>
</tr>
<tr>
<td>Pregnancy complications</td>
<td>1835(25.4)</td>
<td>550(21.7)</td>
<td>564(18.8)</td>
<td>.001</td>
</tr>
</tbody>
</table>
Near Miss Mortality NC: Risk of Morbid Outcomes
RR (95% CI)

<table>
<thead>
<tr>
<th></th>
<th>Near Miss mortality</th>
<th>Pregnancy Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African American</strong></td>
<td>1.13 (0.91, 1.4)</td>
<td>1.17 (1.07, 1.27)</td>
</tr>
<tr>
<td><strong>Hispanic</strong></td>
<td>1.45 (1.14, 1.84)</td>
<td>0.86 (0.78, 0.96)</td>
</tr>
</tbody>
</table>

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

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 (5/1,000 deliveries) 8 declined participation
# Maternal Characteristics

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

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

<table>
<thead>
<tr>
<th>Type of ICU</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SICU</td>
<td>33 (38.4)</td>
</tr>
<tr>
<td>CICU</td>
<td>26 (30.2)</td>
</tr>
<tr>
<td>MICU</td>
<td>22 (25.6)</td>
</tr>
<tr>
<td>Other</td>
<td>5 (5.8)</td>
</tr>
<tr>
<td>Postpartum</td>
<td>75 (87)</td>
</tr>
<tr>
<td>Days postpartum</td>
<td>2 +/- 3.7</td>
</tr>
<tr>
<td>Total length of stay(days)</td>
<td>10 +/- 8</td>
</tr>
<tr>
<td>Days in Newborn ICU</td>
<td>10 +/- 21</td>
</tr>
<tr>
<td>Maternal intubation</td>
<td>36 (42)</td>
</tr>
<tr>
<td>Pulmonary Artery Catheterization</td>
<td>21 (24)</td>
</tr>
<tr>
<td>Cesarean Hysterectomy</td>
<td>12 (14)</td>
</tr>
</tbody>
</table>

ICU, intensive care unit, Data are n(%) or mean +/- standard deviation
## Ob ICU Admissions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CARDIAC</strong></td>
<td>31(36)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>25(29)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>8(9)</td>
</tr>
<tr>
<td>Hypertensive Disease</td>
<td>8(9)</td>
</tr>
<tr>
<td>Pulmonary Embolus</td>
<td>3(3)</td>
</tr>
<tr>
<td>Stroke or encephalopathy</td>
<td>2(2)</td>
</tr>
<tr>
<td>Catastrophic antiphospholipid antibody syndrome</td>
<td>2(2)</td>
</tr>
<tr>
<td>Diabetic ketoacidosis</td>
<td>1</td>
</tr>
<tr>
<td>Hepatic Failure</td>
<td>1</td>
</tr>
<tr>
<td>Neurosyphilis, HIV</td>
<td>1</td>
</tr>
<tr>
<td>Amniotic fluid embolus</td>
<td>1</td>
</tr>
<tr>
<td>Thrombotic thrombocytopenic purpura</td>
<td>1</td>
</tr>
<tr>
<td>Hypoxemia secondary to extreme obesity and obstructive sleep apnea, post op cesarean section</td>
<td>1</td>
</tr>
<tr>
<td>Acute Respiratory Distress, cystic fibrosis</td>
<td>1</td>
</tr>
</tbody>
</table>
# Cardiac Disease in Pregnancy

## Cardiac Disease Requiring ICU admission (n=31)

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valvular Disease (4)</strong></td>
<td>Critical Aortic Stenosis (2)</td>
</tr>
<tr>
<td></td>
<td><strong>Mitral stenosis with cardiomyopathy and valvuloplasty during pregnancy</strong></td>
</tr>
<tr>
<td></td>
<td>Double mechanical valves with complications</td>
</tr>
<tr>
<td><strong>Congenital Heart Disease with complications (5)</strong></td>
<td>- Repaired Tetralogy of Fallot with pulmonary atresia</td>
</tr>
<tr>
<td></td>
<td>- Repaired Tetralogy of Fallot with acute renal failure due to medication toxicity</td>
</tr>
<tr>
<td></td>
<td>- Transposition of the Great Vessels with stent placement during pregnancy</td>
</tr>
<tr>
<td></td>
<td>- Single ventricle</td>
</tr>
<tr>
<td></td>
<td>- Ebsteins Anomaly and severe preeclampsia</td>
</tr>
<tr>
<td><strong>Marfans Syndrome with dilated aortic root (3 total)</strong></td>
<td>Additional complications: aortic root dissection (1), cerebral aneurysm and left ventricle dysfunction (1)</td>
</tr>
<tr>
<td><strong>Severe Pulmonary hypertension (5 total)</strong></td>
<td>Additional complications: right heart failure (2), end stage renal disease, mitral valve replacement in pregnancy (1)</td>
</tr>
<tr>
<td>Cardiomyopathy (CM) (14)</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td>Acute peripartum cardiomyopathy-PPCM (6)</td>
<td></td>
</tr>
<tr>
<td>Intraoperative cardiac arrest in patient with history of PPCM</td>
<td></td>
</tr>
<tr>
<td>Cardiac Decompensation in patient with history of PPCM and LVAD in previous pregnancy</td>
<td></td>
</tr>
<tr>
<td>CM and Antiphospholipid Antibody Syndrome (APLAS), heparin-induced thrombocytopenia (HIT)</td>
<td></td>
</tr>
<tr>
<td>CM associated with doxorubicin therapy for breast cancer and pulmonary embolism requiring left ventricular assist device (LVAD)</td>
<td></td>
</tr>
<tr>
<td>CM associated with acute myocardial infarction (MI)</td>
<td></td>
</tr>
<tr>
<td>CM, left ventricular thrombus, congenital endocardiofibroelastosis and congestive heart failure</td>
<td></td>
</tr>
<tr>
<td>Severe hypertrophic CM (multiple family members with CM-associated sudden death) and pacemaker placement in index pregnancy</td>
<td></td>
</tr>
</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>% of all Pregnancy Related Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiomyopathy</td>
<td>21</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>14</td>
</tr>
<tr>
<td>Pregnancy induced Hypertension</td>
<td>10</td>
</tr>
<tr>
<td>Stroke</td>
<td>9</td>
</tr>
<tr>
<td>Chronic Conditions</td>
<td>9</td>
</tr>
<tr>
<td>Amniotic Fluid Embolism</td>
<td>7</td>
</tr>
<tr>
<td>Infection</td>
<td>7</td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td>6</td>
</tr>
</tbody>
</table>

*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

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
In 2007, 30 infants in Durham died before reaching their first birthday. Of these, 20 were minorities.
THANK YOU

Acknowledgments:
Dr. HL Brown
Dr. Leo Brancazio