

Lessons Learned from Maternal Mortality Surveillance in Michigan, 1999-2004

45th Annual Conference on Maternal and Perinatal Health



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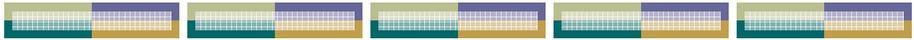
Monitoring Maternal Mortality

Measures of maternal mortality:

Maternal Mortality Ratio (MMR): number of maternal deaths per 100,000 live births

Maternal Mortality Rate: number of maternal deaths per 1,000 women of reproductive age

Reminder: One of the basic health indicators that reflect a nation's health status



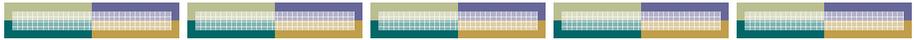
Plans for Future Healthy People 2010

- 16-4 Reduce maternal deaths
(3.3/100, 000 live births)
- 16-5 Reduction in maternal illness and complications
 - 16-5a Maternal complications during hospitalized labor and delivery (24/100 deliveries)
 - 16-5b Ectopic pregnancies
 - 16-5c Postpartum complications, including postpartum depression



What do we know?





Maternal Mortality Study Group

Established in 1987 by:

- CDC's Division of Reproductive Health
- American College of Obstetricians and Gynecologists (ACOG)
- State health departments



Example of Public Health Functions and Activities related to Women's Health

Public Health Function/Activity	Perinatal Care
Assess & Monitor Health Status	Use vital statistics data to study birthweight-specific infant mortality and to monitor rates of maternal mortality.
Diagnose & Investigate Health Problems & Hazards	Extend and maintain existing initiatives , such as the Pregnancy Risk Assessment and Monitoring System, study of the rise in congenital syphilis from unidentified and/or untreated maternal syphilis, and Maternal Mortality Reviews , which uncover woman specific and system factors contributing to poor pregnancy outcomes.

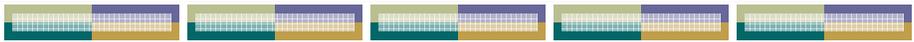
"Charting a Course for the Future of Women's and Perinatal Health"/ HRSA March 1999



Public Health Surveillance

- Definition: The ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health.
- Public health surveillance systems have been developed to address a range of public health needs.

CDC / MMWR: July 27, 2001 / 50(RR13);1-35



Public Health Surveillance (cont.)

- Activities are generally authorized by legislators and carried out by public health officials.
- Data disseminated by a public health surveillance system can be used for immediate public health action, program planning and evaluation, and formulating research hypotheses.

CDC / MMWR: July 27, 2001 / 50(RR13);1-35



Maternal Mortality Surveillance is needed to:

- Systematically collect comprehensive information related to deaths circumstances
- Analyze the data
- Disseminate the findings
- Develop targeted prevention strategies with greater population impacts

Classification Scheme of Maternal Mortality

Investigative Groups	Definitions	Problems with Both Classifications
Centers for Disease Control and Prevention–American College of Obstetricians and Gynecologists (Maternal Mortality Study Group)	<p>Pregnancy-related: death occurring during pregnancy, or within 1 year after delivery and resulting from pregnancy-specific complications</p> <p>Pregnancy-associated: death occurring during pregnancy, or within 1 year after delivery regardless of etiology</p>	<ul style="list-style-type: none"> • Causality often difficult to establish • Death certificates may not specify duration of time between pregnancy and death • A small proportion of deaths related to pregnancy may occur more than 1 year after delivery, given life-sustaining technology • Deaths from first trimester complications may not be properly recorded • No universal and comprehensive data collection system
<i>International Classification of Diseases, Tenth Revision</i>	<p>Maternal death: death occurring during pregnancy, or within 42 days of delivery from pregnancy-specific complications</p> <p>Late maternal death: death between 42 days to within 1 year of delivery regardless of cause</p>	

Adapted from Atrash HK, Alexander S, Berg CJ. Maternal mortality in developed countries: not just a concern of the past. *Obstet Gynecol* 1995;86:700–5 and World Health Organization (WHO). Report of the International Conference on International Classification of Diseases. In: *International Classification of Diseases and Related Health Problems, Tenth Revision*. Vol. 1. Geneva: WHO, 1992 and Hibbard BM, Milner D. Maternal mortality in Europe. *Eur J Obstet Gynecol Reprod Biol* 1994;56:37–41.



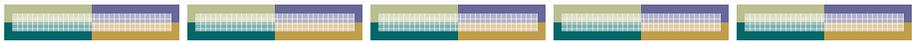
Sources of Maternal Mortality data

Autopsy reports
Medical records
Maternal and fetal death certificates
Vital statistics records
Linkage of death certificates to infant birth and death certificates
Maternal mortality committees
Interviews with family members
Individual health care providers
Federal, state, and local natality statistics and reports
Questionnaires
Scientific publications

Best data sources

- Comprehensive death certificates
- Linkage to vital records
- Case review

Adapted from Atrash HK, Alexander S, Berg CJ. Maternal mortality in developed countries: not just a concern of the past. *Obstet Gynecol* 1995;86:700-5 and Fikree FF, Gray RH, Berendes HW, Karim MS. A community-based nested case-control study of maternal mortality. *Int J Gynaecol Obstet* 1994;47:247-55.



Maternal Mortality in Michigan

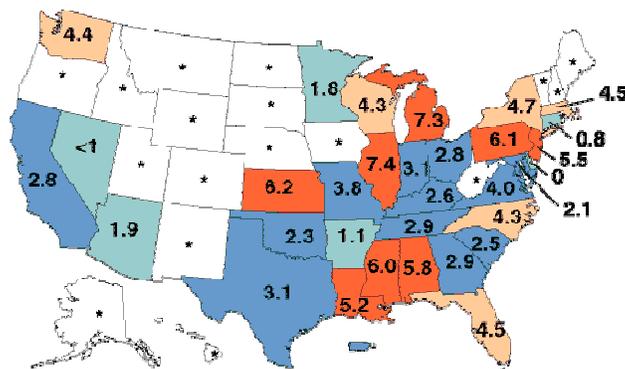


Maternal Mortality in Michigan 1987-1996 data

- Maternal Mortality Ratio (MMR) = 7.5
(pregnancy-related)
- Black / White ratio = 6.3*

*"Maternal Mortality among Black and White women by State: United States, 1987-1996";
MMWR, 1999, 48(23);492

Black-White Gap in Maternal Mortality: NCHS, Vital Statistics, 1992-1996 (Preliminary)



National B/W Gap for 1992-1996 was 4.0

* < 10,000 black births

http://www.thehormoneshop.com/reproductivehealth/images/mm_map.gif



Background

Michigan Maternal Mortality Study (MMMS) Initiated in 1950 as a collaborative effort among:

- Michigan Department of Community Health,
- Committee on Maternal and Perinatal Health of the Michigan State Medical Society and
- Chairs of the Departments of Obstetrics and Gynecology of the Medical Schools in Michigan



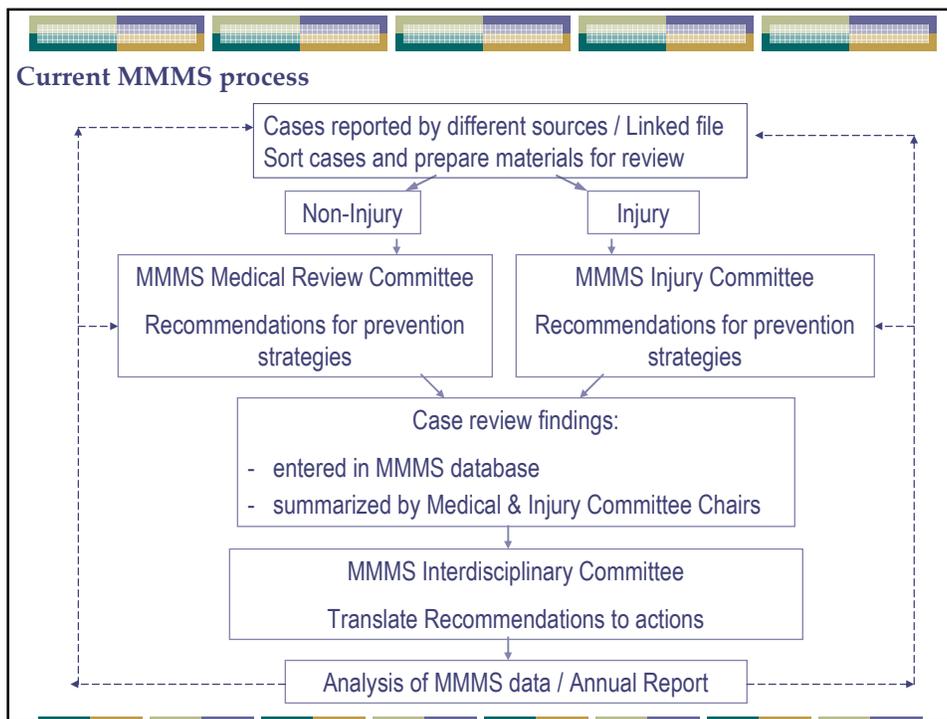
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Currently: Michigan Maternal Mortality Surveillance (MMMS) is:

- Michigan Department of Community Health (MDCH)'s program
 - Bureau of Epidemiology and Bureau of Family, Maternal and Child Health share the responsibilities
 - Committee on Maternal and Perinatal Health of the Michigan State Medical Society - committed and strong partner
- 

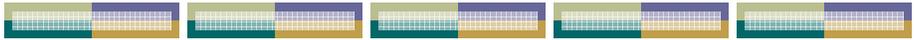


Case Definitions (used by MMMS)

Pregnancy-associated death = the death of a woman while pregnant or within 1 year of termination of pregnancy, *irrespective of cause*

• **Pregnancy-related death** = the death of a woman while pregnant or within 1 year of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by her pregnancy or its management, but not from accidental or incidental causes

• **Not-pregnancy-related death** = the death of a woman while pregnant or within 1 year of termination, due to a cause unrelated to pregnancy



Case identification

- Cases identified and reported to MDCH by:
 - Hospitals
 - Medical examiners
 - Office of Vital Statistics



Data sources

- Cases identified and reported to MDCH by:
 - Hospitals
 - Medical examiners
 - Office of Vital Statistics
- **New electronic maternal mortality linked file** of 1999-2002 deaths was created in 2003: recently updated with 2004 data



Maternal Mortality linked file: main current source of data for analysis

- Death certificates of women of reproductive age (10 to 45 years) were linked to live births certificates
- Added records:
 - Maternal deaths for which pregnancies ended in a fetal death were identified from the hospital reporting to MDCH
 - Pregnancy-related deaths not identified by previously mentioned sources, such as deaths due to ectopic or molar pregnancies, were identified by using ICD10 "O" codes from death certificates



Results

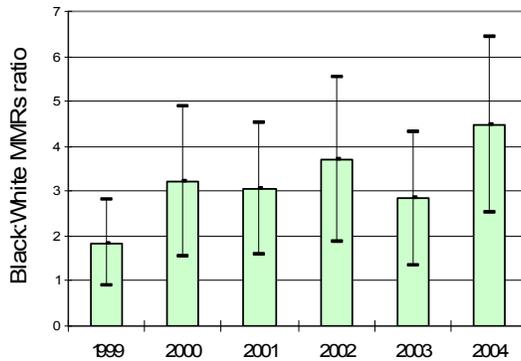
Numbers and Maternal Mortality Ratio (MMR) by year of death

Year of death	Number of cases	MMR (95%CI)
1999	74	55.5 (42.9-68.1)
2000	61	45.7 (34.2-57.2)
2001	70	51.4 (39.4-63.4)
2002	66	49.5 (37.6-61.4)
2003	69	52.8 (40.3-65.3)
2004	84	64.8 (50.9-78.7)
Total	424	53.5 (48.4, 58.6)

Numbers and Maternal Mortality Ratio (MMR) by race and by year of death

Year	White		Black		Black:White
	Number	MMR (95%CI)	Number	MMR (95% CI)	MMRs ratio (95% CI)
1999	50	47.7 (34.5,60.9)	21	88.1 (50.4,125.8)	1.8 (0.9, 2.8)
2000	34	32.3 (21.4, 43.2)	25	103.9 (63.2, 144.6)	3.2 (1.6, 4.9)
2001	41	38.9 (27.0,50.8)	28	119.2 (75.0, 163.4)	3.1 (1.6, 4.5)
2002	35	34.0 (22.7,45.3)	28	125.9 (79.3, 172.5)	3.7 (1.9, 5.5)
2003	37	36.3 (24.6,48.0)	23	102.8 (60.8, 144.8)	2.8 (1.4, 4.3)
2004	41	40.7 (28.2, 53.2)	41	182.5 (126.6, 238.4)	4.5 (2.5, 6.4)

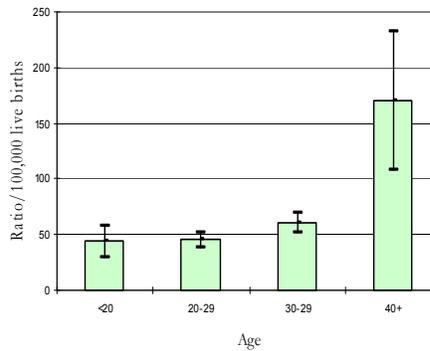
Black:White MMRs ratio



Varied from the lower of 1.8 (95%CI: 0.9, 2.8) in 1999 to the highest of 4.5 (95%CI: 2.5, 6.4) in 2004 but no statistical significant difference was found

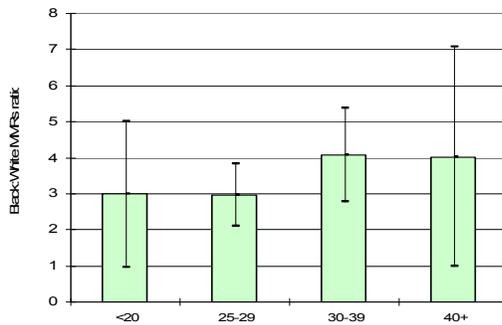
Maternal deaths by age

Age at death	No. #	Percent %	MMR (95%CI)
<20	35	8.3	43.7 (29.2, 58.2)
20-29	190	44.8	45.7 (39.5, 51.8)
30-39	170	40.1	60.9 (52.2, 69.5)
40+	29	6.8	170.0 (111.3, 228.7)
Total	424	100.0	53.5 (48.4, 58.6)



Mean age at death: 28.9 (95% CI: 28.3, 29.6); Std deviation=6.9; Mode: 25

Black:White MMR ratio by age



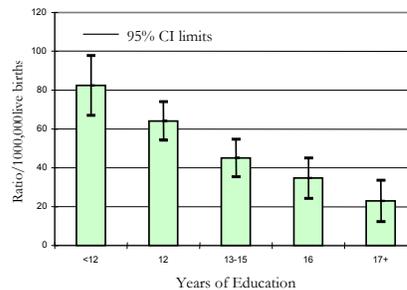
The mean age at death was lower in Black compared to White women (27.0 versus 28.6 respectively; t-test p-value=0.07).

Highest Black:White MMRs ratio of 4.0 (95%CI: 1.0, 7.1 and 2.7, 5.3 respectively) in 30-39 and 40+ age groups

Maternal deaths by education

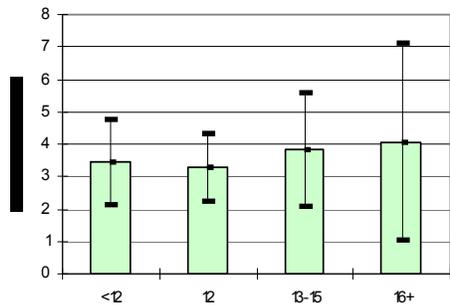
Years of Education at death	Number #	Percent %	MMR	(95%CI)
<12	110	25.9	82.4	(67.0 97.8)
12	163	38.4	64.1	(54.3 74.0)
13-15	83	19.6	45.1	(35.4 54.8)
16	43	10.1	34.7	(24.3 45.1)
17+	18	4.2	23.0	(12.4 33.6)
UNK	7	1.7	37.5	(9.7* 65.2*)
Total	424	100.0	53.5	(48.4 58.6)

* Wide CI due to small number



Mean education at death: 12.4 (95%CI: 12.2, 12.6); Std deviation=2.3; Mode=12; Maximum=17

Black:White MMR ratio by education

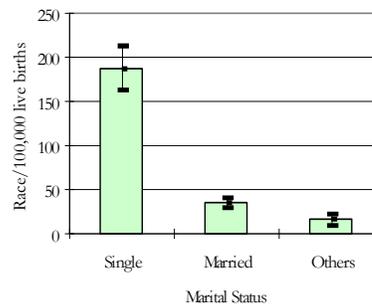


The same distribution of the education status was noticed in both, White and Black populations.

Highest Black:White MMRs ratio in the group of women with 16+ years of education (4.1; 95% CI: 1.0, 7.1) followed by the group of 13-15 years of education (3.8; 95% CI: 2.1, 5.6).

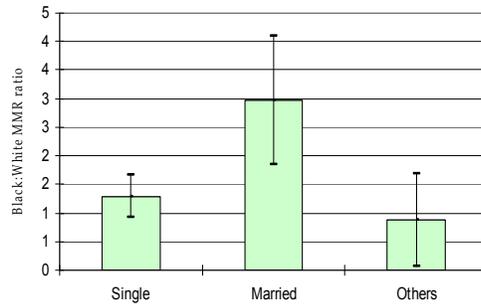
Maternal deaths by marital status at death

Marital status	Number #	Percent %	MMR	(95%CI)
Single	210	49.5	187.6	(213.0 162.3)
Married	183	43.2	35.1	(40.2 30.1)
Others	26	6.1	16.2	(22.5 10.0)
Missing/ UNK	5	*	*	*
Total	424	100.0	53.5	(78.9 28.1)



Marital status: different coding in death file compared to birth file

Black:White MMR ratio by marital status



The vast majority of Black women were recorded as never married (76.5%) which translates in more than ¾ of cases in this population being single moms at death.

Significant high Black:White MMR ratio in married group.

Maternal deaths (numbers and MMR) by other characteristics

	White		Black		Black:White	
	Percent	MMR (95%CI)	Percent	MMR (95%CI)	MMRs Ratio	(95%CI)
Smoking						
→ Yes	26.9	68.3 (51.5, 85.0)	18.7	144.2 (93.4, 194.9)	2.1	(1.2, 3.0)
→ No	52.9	25.1 (20.7, 29.5)	62.0	82.1 (66.2, 97.9)	3.3	(2.4, 4.1)
Prenatal Care Began						
→ 1st trimester	59.2	11.4 (9.5, 13.2)	47.6	77.8 (60.6, 94.9)	6.8	(5.0, 8.7)
2nd trimester	12.6	22.8 (14.6, 31.0)	15.7	88.5 (54.5, 122.5)	3.9	(1.8, 5.9)
3rd trimester	8	80.1 (44.1, 116.1)	15.7	391.3 (240.9, 541.8)	4.9	(2.0, 7.8)
None	2.5	56.9 (11.4, 102.4)	7.2	292.5 (127.0, 457.9)	5.1	(0.1, 10.2)
Preterm						
<31 weeks	3.4	89.3 (27.4, 151.3)	7.2	214.0 (92.9, 335.1)	2.4	(0.3, 4.5)
32-36 weeks	11.3	52.3 (32.6, 72.0)	13.9	134.7 (79.7, 189.8)	2.6	(1.1, 4.0)
→ Term 37+ weeks	58.4	26.3 (21.9, 30.7)	45.8	74.7 (57.9, 91.5)	2.8	(2.0, 3.6)
Interval to death						
→ <=42 days	22.3	8.6 (6.2, 10.9)	26.5	31.8 (22.4, 41.1)	3.7	(2.2, 5.2)
43-365 days	60.1	23.1 (19.3, 26.9)	60.2	72.2 (58.0, 86.3)	3.1	(2.3, 3.9)

The cases with missing information are not included and thus the percentages may not add up to 100.

Maternal deaths within the first 42 days by race

Interval to death	White			Black			Black:White	
	Percent	MMR	(95%CI)	Percent	MMR	(95%CI)	MMRs Ratio	(95%CI)
0-6 days	41.5	3.5	(2.1, 5.0)	50.0	15.9	(9.2, 22.5)	4.5	(1.1, 7.8)
→ 0 days (within 24 hours)	20.8	1.8	(0.7, 2.8)	31.8	10.1	(4.8, 15.4)	5.7	(3.1, 8.3)
1-6 days	20.8	1.8	(0.7, 2.8)	18.2	5.8	(1.8, 9.8)	3.3	(0.1, 6.4)
7-30 days	43.4	3.7	(2.2, 5.2)	40.9	13.0	(7.0, 19.0)	3.5	(2.1, 4.9)
31-42 days	15.1	1.3	(0.4, 2.2)	*	*	*	*	*
Total	100.0	8.6	(6.2, 10.9)	100.0	31.8	(22.4, 41.1)	3.7	(2.2, 5.2)

* Small numbers (below 5) and thus the percent and ratio considered unstable and not reported

Maternal deaths causes

- The ICD10 classification was utilized to separate patients who experience a pregnancy-related (“0” codes) from non-pregnancy related (all other codes) deaths.
- Pregnancy-related: 99 cases (MMR=12.5; 95%CI: 10.0, 14.9)
- Non-Pregnancy related:
 - 152 - other health conditions (MMR=19.2; 95%CI: 16.1, 22.2) (e.g. pre-existing hypertension, cardiac diseases.
 - 155 - violent deaths(MMR=19.6; 95%CI: 16.5, 22.6)
 - 18 - uncertain diagnostics (i.e. unknown and other ill defined)

Maternal deaths by main causes

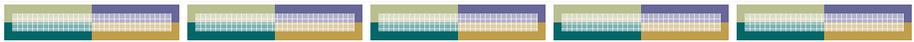
	Number	Percent
Pregnancy-related (ICD10 'O' codes)		
Obstetric embolism (O881, O882)	15	15.2
Amniotic fluid embolism (O881)	11	11.1
Obstetric blood-clot embolism (O882)	4	4.0
Hypertension during pregnancy (O141, O149, O152, O159)	13	13.1
Cardiomyopathy in puerperium (O903)	13	13.1
Haemorrhage (O469, O678, O721)	7	7.1
Other specified diseases and conditions complicating pregnancy, childbirth and puerperium (O998)	7	7.1
Violent deaths		
Accidents (V01-X59)	89	57.4
Motor vehicle accidents (V03, V28-V29, V40-V49, V50-V59, V86-V87)	82	52.9
Assaults (X85-Y09)	43	27.7
Intentional self-harm (X60-X84)	17	11.0
Other health conditions		
Cardiac diseases (I20-I52)	37	24.3
Cardiomyopathy (not pregnancy related) (I42)	11	7.2
Malignant neoplasms (C00-C97)	35	23.0
Mental and behavioral disorders due to substance use (F10-F19)	12	7.9

Preventability?

- 194 Cases reviewed between 1999-2004
- Committees decisions:
 - 114 were preventable
 - 66 were not preventable
 - 14 unknown/uncertain



Interdisciplinary Committee Recommendations



Approved for further actions

1. Mandatory autopsy in each case of maternal death in Michigan.
 2. Promote knowledge of interventions and use of the available resources in the identification and treatment of depression during pregnancy and the postpartum period.
 3. Increase awareness of special needs of pregnant women in Emergency Department Services: consideration of the special roles of Emergency Room Nurses as well as Emergency Medical Transport Services must be made.
 4. Develop and implement public education project regarding the use of seatbelts during pregnancy to prevent maternal deaths associated with motor vehicle accidents.
 5. Inform all care providers of women of child-bearing age about the importance of documenting known or suspected substance abuse.
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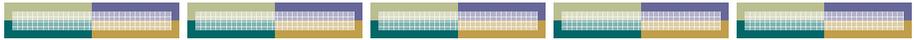


On the “waiting list”: Actions needed but not resources yet

- Actions be taken regarding surveillance in the area of management of cardiovascular disease and pregnancy.
- The first trimester entry into prenatal care is important in achieving good pregnancy outcomes.
- Additional means must be found to educate health care providers, pregnant women, and organizations, which monitor rental property regarding the need for smoke detectors and home safety to prevent maternal deaths due to home fires.
- All private providers of prenatal care and health care systems take steps to assure legibility of health care records.
- Domestic Violence is identified as an issue needing to be addressed in the prevention of maternal deaths.



Lessons learned



Conclusions

- **Maternal mortality remains an important indicator of the status of health care in the modern world**
- Many different factors interact in complex ways to increase a pregnant women's risk for death
- **The preconceptional period is the best time to deal with emotional issues surrounding past poor outcomes or difficult pregnancies.**
- Ideally, the social, financial, and medical problems that can adversely affect a pregnant woman's health should be addressed prior to pregnancy.
- **Encouraging planned pregnancies and addressing racial and cultural disparities in medical and prenatal care are indispensable components in the care of pregnant women.**



Addressing Cultural Differences*

- Question relevant to maternal mortality: Does the woman's cultural background affect the content of her interactions with health care providers and influences the interventional strategies and preventive care services offered (as well as her attitude toward them)?
- Maternal mortality rates have been shown to be higher in African American women, even after correcting for degree of utilization of prenatal care services (Koonin LM, MacKay AP, Berg CJ, et al. Pregnancy-related mortality surveillance—United States, 1987–1990. MMWR Morbidity and Mortality Weekly Report CDC Surveill Summ 1997;46:17–36.)
- African American women were only as likely as White women to receive treatment for premature labor, although their risk of preterm labor is higher (Brett KM, Schoendorf KC, Kiely JL. Differences between black and white women in the use of prenatal care technologies. Am J Obstet Gynecol 1994;170:41–6.)

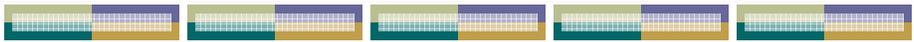
* *Maternal Mortality: Strategies in Prevention and Care*; Linda A. Goodrum, MD, Clinical Review Article; *Hospital Physician* January 2001



Addressing Cultural Differences (cont.)*

- African American women were less likely to receive advice on smoking cessation, alcohol use, and the benefits of breast-feeding (Kogan MD, Kotelchuck M, Alexander GR, Johnson WE. Racial disparities in reported prenatal care advice from health care providers. Am J Public Health 1994;84:82-8.)
- Single African American women were also less likely to receive advice on the detrimental effects of drug use than were single White women.
- Marital status, socioeconomic class, and site at which care was received also influenced the content of prenatal care advice.
- More studies are needed to determine to what extent the content and quality of prenatal care affect the racial disparity seen with maternal mortality rates.

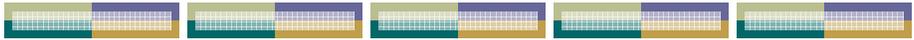
** Maternal Mortality: Strategies in Prevention and Care; Linda A. Goodrum, MD, Clinical Review Article; Hospital Physician January 2001*



Preconceptional Counseling—A Role for All Physicians*

- A physician, regardless of his or her specialty, should view every woman of reproductive age as a potential pregnancy.
- Opportunities for identifying at – risk women and providing the appropriate interventions exist in many medical settings.
- The goals of preconceptional counseling are basically fourfold:
 - (1) to identify any preexisting conditions that may affect an anticipated pregnancy;
 - (2) to allow time for interventions that could lead to more favorable outcomes;
 - (3) to educate the patient about the importance of prenatal care and overall good health; and
 - (4) to address home, social, financial and emotional issues that could affect attitudes toward pregnancy and prenatal care.

** Maternal Mortality: Strategies in Prevention and Care; Linda A. Goodrum, MD, Clinical Review Article; Hospital Physician January 2001*



Preconceptional Counseling—A Role for All Physicians* (cont.)

- A thorough family history should also be taken. A high incidence of a specific disease within a family pedigree that can adversely affect a mother's health during pregnancy (such as diabetes mellitus and hypertension) should prompt a careful evaluation/assessment
- Adequate risk assessment includes a thorough evaluation of all aspects of a woman's life, including medical, emotional, social, and gynecologic history. Past reproductive performance must be assessed to help identify factors that may predispose a woman to poor obstetric outcomes, such as recurrent miscarriages.
- The preconceptional period is also a good time to check for genetic risk factors and to discuss antenatal diagnostic modalities such as amniocentesis once pregnancy is achieved.

* Maternal Mortality: Strategies in Prevention and Care; Linda A. Goodrum, MD, Clinical Review Article; Hospital Physician January 2001



ACOG/AAP (2002)

“All health encounters during a woman's reproductive years, particularly those that are a part of preconceptional care should include counseling on appropriate medical care and behavior to optimize pregnancy outcomes.”

ACOG/AAP Guidelines for perinatal care, 5th edition, 2002

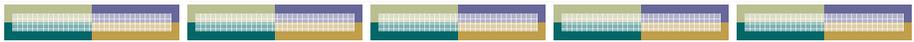




March of Dimes, 2003

“Preconception health promotion guidance can... provide prospective parents with an opportunity to prevent the preventable and to know they did all they desired to encourage a healthy pregnancy and infant.”

Preconception Health Promotion: A Focus for Women's Wellness. March of Dimes, 2003



Improving **Preconception** Health

“Optimizing a woman's health before and between pregnancies is an ongoing process that requires full participation of all segments of the health care system.”

The Importance of preconception care in the continuum of women's health care. ACOG Committee Opinion, Number 313, September 2005





Is **preconception** care being delivered today?

- Do most providers provide it?
- Do most insurers pay for it?
- Do most consumers ask for it?



CDC actions

- Established (internal) and external work groups (2004)
 - Convened a Select Panel (June 2004)
 - Held a National Summit on Preconception Care (June 2004)
 - Convened a meeting of work groups (Nov. 2004)
 - Developed recommendations to improve preconception health (June- Nov. 2004, publication Feb. 2005)
 - Commissioned a supplement to MCH Journal (anticipated March-April 2005)
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Combined Definition of Preconception Care

A set of interventions that aim to **identify and modify biomedical, behavioral, and social risks** to a woman's health or pregnancy outcome through **prevention and management**, emphasizing those factors which must be acted on before conception or early in pregnancy to have maximal impact.

CDC's Select Panel on Preconception Care, June 2005

Preconception Care Framework





Next Steps

- Publish and disseminate the recommendations
 - Increase awareness among public/private providers
 - Identify opportunities to integrate PCC programs and policies into state, local, and community health programs
 - Develop tools and guidelines for practice
 - Evaluate existing programs for feasibility and demonstrated effectiveness
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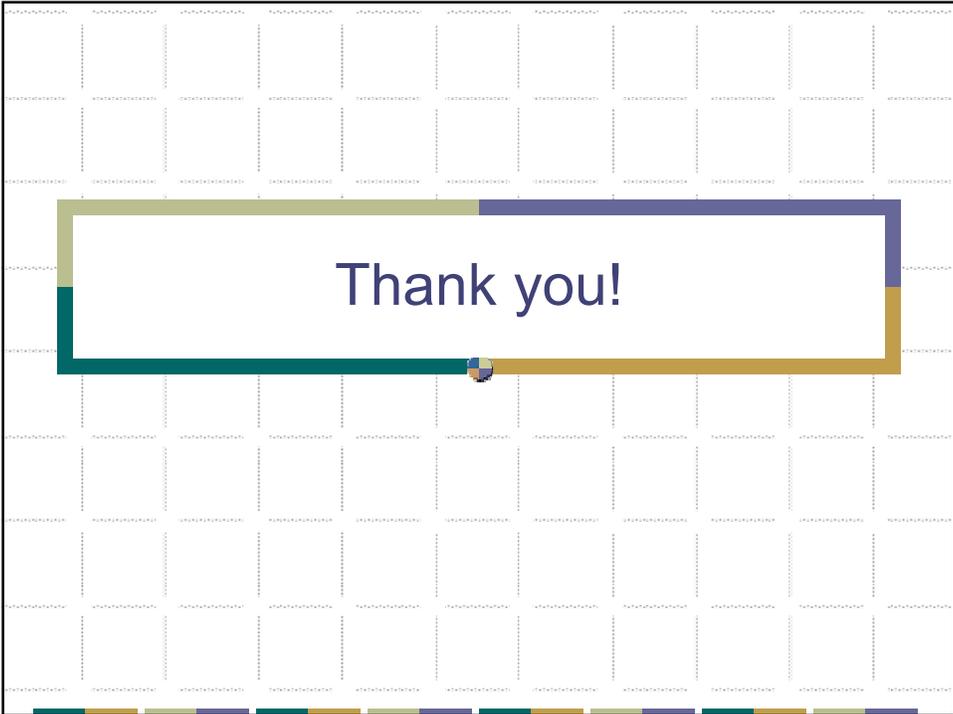
Summary:

- Establishment of maternal mortality surveillance systems and review committees enhances the collaboration between physicians and other organizations within the health care field.
 - Physicians in specialties other than obstetrics should participate in educational conferences on women's reproductive health issues and on obstetric care and complications.
 - National efforts to support the states and local activities
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Thank you!