Michigan Maternal Mortality Surveillance (MMMS)

A collaborative effort between:
Division of Family and Community Health,
Bureau of Family and Maternal and Child Health
And
Division of Genomics, Perinatal Health and Chronic Disease Epidemiology
Bureau of Epidemiology

Presented by:
Alethia Carr, RD, MBA, Director,
Bureau of Family and Maternal and Child Health
Michigan Department of Community Health
Reduce Maternal Mortality: Why This Matters

- Maternal and infant mortality are basic health indicators that reflect a nation’s health status
- Maternal mortality ratio nationwide has been approximately the same in the last 15 years (~ 7.5 maternal deaths per 100,000 live births)
- Maternal mortality ratio in Michigan fluctuated between 3.8 and 10.7 in the same time frame

“Behind each number is a human face”

William Foege, MD
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
### On an average **Day** in Michigan (2006):

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Count (Events per Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live births</td>
<td>349</td>
</tr>
<tr>
<td>Low Birth Weight Births</td>
<td>29 (one every 49 minutes)</td>
</tr>
<tr>
<td>Infant deaths</td>
<td>3</td>
</tr>
<tr>
<td>Heart Disease Deaths</td>
<td>66 (one at every 21 minutes)</td>
</tr>
<tr>
<td>Diabetes Deaths</td>
<td>24</td>
</tr>
<tr>
<td>Drug-induced Deaths</td>
<td>6</td>
</tr>
<tr>
<td>Stroke Deaths</td>
<td>13 (one at every 110 minutes)</td>
</tr>
<tr>
<td>Kidney Disease Deaths</td>
<td>4</td>
</tr>
<tr>
<td>Alzheimer’s Disease Deaths</td>
<td>6</td>
</tr>
<tr>
<td>Accidental Deaths</td>
<td>10 (one every 144 minutes or 2.4 hours)</td>
</tr>
<tr>
<td>Cancer Deaths</td>
<td>55</td>
</tr>
<tr>
<td>Suicide deaths</td>
<td>3</td>
</tr>
</tbody>
</table>

*Office of Vital Statistics and Health Data Development, Michigan Department of Community Health*
Michigan Issues and Challenges

- Higher racial disparity compared to the nation
- Need for comprehensive review of contributing factors, including:
  - Pre-existing maternal health conditions
  - Education on warning signs
  - Accessibility & acceptability of health care
  - Adherence to medical advice
  - Use of best practice interventions
- Lacking collaboration among medical and non-medical community to identify best interventions
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
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

Michigan Current Activities

- Surveillance & Analysis
  - Case Reviews by Medical Committee
- Findings disseminated through publications, grand rounds, presentations
- Planning for expanded reviews
- Budget: $49,980 (MCH Block Grant)
Michigan Maternal Mortality 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
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
Cases reported by different sources / Linked file

Sort cases and prepare materials for review

Non-Injury

MMMS Medical Review Committee
Recommendations for prevention strategies

MMMS Medical Review Committee

Injury

MMMS Injury Committee
Recommendations for prevention strategies

Case review findings:
- entered in MMMS database
- summarized by Medical & Injury Committee Chairs

MMMS Interdisciplinary Committee
Translate Recommendations to actions

Analysis of MMMS data / Annual Report
Case Definitions (used by Michigan)

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
  - Healthcare Providers
Data sources

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

- New electronic maternal mortality linked file of 1999-2002 deaths was created in 2003: recently updated with 2004 data
Maternal mortality linked file

- 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

<table>
<thead>
<tr>
<th>Year of death</th>
<th>Number of cases</th>
<th>MMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>74</td>
<td>55.5</td>
</tr>
<tr>
<td>2000</td>
<td>61</td>
<td>45.7</td>
</tr>
<tr>
<td>2001</td>
<td>70</td>
<td>51.4</td>
</tr>
<tr>
<td>2001</td>
<td>70</td>
<td>51.4</td>
</tr>
<tr>
<td>2002</td>
<td>66</td>
<td>49.5</td>
</tr>
<tr>
<td>2003</td>
<td>69</td>
<td>52.8</td>
</tr>
<tr>
<td>2004</td>
<td>84</td>
<td>64.8</td>
</tr>
<tr>
<td>2005</td>
<td>98</td>
<td>76.8</td>
</tr>
<tr>
<td>2006</td>
<td>95</td>
<td>74.5</td>
</tr>
<tr>
<td>2007*</td>
<td>77*</td>
<td>62.4*</td>
</tr>
</tbody>
</table>

*Preliminary data
### Numbers and Maternal Mortality Ratio (MMR) by race and by year of death

<table>
<thead>
<tr>
<th>Year</th>
<th>White</th>
<th>Black</th>
<th>Black:White</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>MMR</td>
<td>Number</td>
</tr>
<tr>
<td>1999</td>
<td>50</td>
<td>47.7</td>
<td>21</td>
</tr>
<tr>
<td>2000</td>
<td>34</td>
<td>32.3</td>
<td>25</td>
</tr>
<tr>
<td>2001</td>
<td>41</td>
<td>38.9</td>
<td>28</td>
</tr>
<tr>
<td>2002</td>
<td>35</td>
<td>34.0</td>
<td>28</td>
</tr>
<tr>
<td>2003</td>
<td>37</td>
<td>36.3</td>
<td>23</td>
</tr>
<tr>
<td>2004</td>
<td>41</td>
<td>40.7</td>
<td>41</td>
</tr>
<tr>
<td>2005</td>
<td>52</td>
<td>52.5*</td>
<td>35</td>
</tr>
<tr>
<td>2006</td>
<td>50</td>
<td>50.7</td>
<td>40</td>
</tr>
<tr>
<td>2007</td>
<td>38</td>
<td>**</td>
<td>34</td>
</tr>
</tbody>
</table>
# Maternal deaths by main causes

<table>
<thead>
<tr>
<th>Pregnancy-related (ICD10 'O' codes)</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetric embolism (O881, O882)</td>
<td>15</td>
<td>15.2</td>
</tr>
<tr>
<td>Amniotic fluid embolism (O881)</td>
<td>11</td>
<td>11.1</td>
</tr>
<tr>
<td>Obstetric blood-clot embolism (O882)</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>Hypertension during pregnancy (O141, O149, O152, O159)</td>
<td>13</td>
<td>13.1</td>
</tr>
<tr>
<td>Cardiomiopathy in puerperium (O903)</td>
<td>13</td>
<td>13.1</td>
</tr>
<tr>
<td>Haemorrhage (O469, O678, O721)</td>
<td>7</td>
<td>7.1</td>
</tr>
<tr>
<td>Other specified diseases and conditions complicating pregnancy, childbirth and puerperium (O998)</td>
<td>7</td>
<td>7.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Violent deaths</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents (V01-X59)</td>
<td>89</td>
<td>57.4</td>
</tr>
<tr>
<td>Motor vehicle accidents (V03, V28-V29, V-40-V49, V50-V59, V86-V87)</td>
<td>82</td>
<td>52.9</td>
</tr>
<tr>
<td>Assaults (X85-Y09)</td>
<td>43</td>
<td>27.7</td>
</tr>
<tr>
<td>Intentional self-harm (X60-X84)</td>
<td>17</td>
<td>11.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other health conditions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac diseases (I20-I52)</td>
<td>37</td>
<td>24.3</td>
</tr>
<tr>
<td>Cardiomiopathy (not pregnancy related) (I42)</td>
<td>11</td>
<td>7.2</td>
</tr>
<tr>
<td>Malignant neoplasms (C00-C97)</td>
<td>35</td>
<td>23.0</td>
</tr>
<tr>
<td>Mental and behavioral disorders due to substance use (F10-F19)</td>
<td>12</td>
<td>7.9</td>
</tr>
</tbody>
</table>
A maternal death is identified either from the Maternal Death Reporting Form or the data linkage process.

The corresponding death certificate of the mother and the birth or fetal death certificate of the infant is requested from Vital Statistics.

The certificates provide information on hospitals where the mother or infant was a patient; demographic data, the county of birth and death, whether the medical examiner was involved and if the death also included law enforcement or emergency medical services.
Records are requested from these providers accompanied by a memo from the Director of the Michigan Department of Community Health (MDCH), Janet Olszewski, which sites the statutory authority of MDCH to obtain the records for public health surveillance.

Hospital records are reviewed for the women’s health conditions prior to the delivery and/or her death and information on the woman’s attending and consulting physician(s) so that the prenatal care and other records can be obtained.
The Medical Examiner’s report provides the cause and manner of death as well as facts about the woman’s physical condition.

The death certificate, the Medical Examiner’s report and the hospital records provide information on the involvement of emergency medical services, police or fire personnel so that these records are then requested.
After all records are obtained, a de-identified abstract of the records and information is completed as well as a case summary.

This information is then reviewed either by: the Medical Committee, for the deaths that are attributed to a medical cause or to the Injury Committee, for deaths with a non medical cause (suicide, homicide, drug overdose, motor vehicle accident).
After the review, the Committees determine the preventability of the maternal death, causal factors and recommendations for future prevention activities.

Prevention activities from the individual reviews are then prioritized to develop the Committee’s final recommendations.
Examples of MMMS Recommendations &
Update on Progress
Injury Committee

Recommendation

- Develop a brief report on the pregnancy outcomes of maternal deaths that meet the criteria for surveillance that would be used as a white paper for future study and recommendations. (i.e., review the cause/effect or association between maternal deaths and fetal/infant deaths and look at possible sharing of information with Infant Mortality Coalitions, FIMR and other interested groups in the near future.
- Responsible: Dr. Moore and Dr. Grigorescu

Update

- Dr. Grigorescu completed an analysis of 1999-2005 maternal and infant deaths linkages.
  - Findings: 39 infant deaths of mothers who died between 1999-2006
- Dr. Moore is very interested to explore strategies for fruitful collaboration between these two death reviews.
- Cases of both, maternal and infant deaths will be reviewed and findings reported to FIMR.
# Injury Committee

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact counties to inquire why autopsies weren’t performed in the event of a pregnancy-related death.</td>
<td>R. Asman, Drs. J. Moore, J. Gell and L.J. Dragovic had a conference call and discussed the issues surrounding maternal autopsies</td>
</tr>
<tr>
<td>Present MMMS at the annual Medical Examiners’ Association meeting</td>
<td>The MMMS 1999-2004 report developed by Dr. Violanda Grigorescu was sent to all county Medical Examiners</td>
</tr>
<tr>
<td></td>
<td>Drs. J. Gell and L.J. Dragovic presented at the 2007 fall Medical Examiners’ Association meeting</td>
</tr>
</tbody>
</table>
**Recommendation**

- Convene subcommittee (Depression Subcommittee) to review the issues of substance abuse, domestic violence, mental health services and data collection in maternal deaths.

- Evaluate the substance abuse, domestic violence and mental health information that is already available from existing data sources such as PRAMS; seek additional information from other data sources: and provide information to other groups that may interact with pregnant and postpartum women.

- The subcommittee will provide feedback to both the Medical and Injury Committee at their first meetings in 2008.

**Update**

- Enter information from reviews into MMMS database

- Review of the domestic violence, substance abuse, and mental health questions on the Injury Committee and abstract developed

- Abstract revised to capture the information that members requested.

- The Injury Committee recommends additional emphasis and work on these issues for next year.
Recommendation

- Review existing depression screening questionnaires/tools, their validity and frequency of use.

- Examine programs using the screening questionnaires/tools and based on these findings make additional recommendations.

Update

- Undertaken by the Junior Fellows from the Michigan Section of ACOG.

- From the minutes from the September 25 meeting of the Michigan Section of ACOG: “The Junior fellows have taken on the task of coming up with a program that will identify women at risk for depression and suicide in the antenatal period. …There is a tool called the Edinburgh post Natal Depression Scale which is already used by several states for post partum screening in the Medicaid population. The proposed idea is to come up with a program that institutes the screening in the first trimester to identify these women at risk of suicide.
**Medical Committee (cont.)**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Find and evaluate alternative funding sources for submission of a proposal for the Cardiac Disease Registry project</td>
<td>• Two proposals were submitted to MSMS by Dr. Mariona in collaboration with Dr. Ansbacher and Dr. Grigorescu. Neither one was approved for funding.</td>
</tr>
<tr>
<td></td>
<td>• Other funding sources will be explored.</td>
</tr>
</tbody>
</table>
## Medical Committee (cont.)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send information to ACOG from the Ectopic Pregnancy Maternal Mortality Study in Michigan with the following recommendations:</td>
<td>Dr. Ansbacher stated that the Ectopic Pregnancy Recommendations were shared with ACOG.</td>
</tr>
<tr>
<td>- Access to prenatal care should be available to all women at the first sign of pregnancy, i.e., after the first missed menses or if any suspicion of pregnancy.</td>
<td>- The Committee agreed that they would like to see the Ectopic Pregnancy Recommendations remain one of the issues for the Interdisciplinary Committee to review.</td>
</tr>
<tr>
<td>- Education about early pregnancy complications, such as ectopic pregnancy, should be provided to all medical care providers.</td>
<td></td>
</tr>
<tr>
<td>- Screening tests for ectopic pregnancy, i.e., serial beta HCG’s and vaginal ultrasounds, should be available to all who provide care to women in their reproductive years.</td>
<td></td>
</tr>
</tbody>
</table>
Medical Committee (cont.)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Anesthesia related study published. The findings used for developing new professional guidelines.</td>
<td>- Rose Mary Asman and Debra Kimball have distributed the reprints of the article to the Departments of Obstetrics and Anesthesiology at every birthing hospital in Michigan</td>
</tr>
<tr>
<td>- Send reprints of the Anesthesia Study to each hospital department of obstetrics and anesthesia in the state. Include a questionnaire developed by MMMS with the journal reprint.</td>
<td></td>
</tr>
</tbody>
</table>
### Medical Committee (cont.)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review a percentage of maternal cancer deaths to understand or determine any patterns in diagnosis and treatment.</td>
<td>A few cases were reviewed</td>
</tr>
<tr>
<td></td>
<td>Recommendation to cancer registry to produce report on women of reproductive age</td>
</tr>
<tr>
<td></td>
<td>MMMS will follow up with the cancer registry and develop collaboration to thus assure continued reporting and increase awareness of cancers in women of reproductive age</td>
</tr>
</tbody>
</table>
Continued Actions

- Improve and expand case reviews
- Add Interdisciplinary expertise for reviews
- Implement recommendations from the Interdisciplinary committee into action
- Explore further the serious life-threatening complications of pregnancy
- Consider development of registries for different health conditions
- Analyze maternal morbidity – a public health problem that affects nearly 1.7 million women annually in U.S.; develop recommendations
Interdisciplinary Committee

- Chair: Alethia Carr
- Members: all from the Medical and Injury Committees
- Responsibilities:
  - review the recommendations from the other two committees,
  - prioritize them
  - assign responsibility for implementation,
  - review the action taken and provide assistance or feedback as needed
Acknowledgments
Medical Review Committee

James Gell, FACOG, M.D., Chair
Frank Anderson, M.D.
Rudi Ansbacher, M.D.
Rose Mary Asman R.N., MPA.
Robert Austin M.D.
Roger Beyer, M.D.
Sharlene Day, M.D.
L.J. Dragovic, M.D.
Debra Duquette, M.S., CGC
Renee Dwaihy, M.D.
William Fales, M.D., FACEP

Margaret Gorman, Ph.D., R.N.
Violanda Grigorescu, M.D., MSPH
Debra Kimball, M.S.N, R.N.
Mary Lewis, C.N.M
Robert Lorenz, M.D.
Federico Mariona, M.D.
Michael Marsh, MBBS
Joel Maurer, FACOG, M.D.
Joseph S. Moore, FACOG, M.D.
Maureen Sander, M.D.
Robert Sokol, M.D.
## Acknowledgments

**Injury Review Committee**

<table>
<thead>
<tr>
<th>Joseph Moore, M.D., FACOG, Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank Anderson, M.D.</td>
</tr>
<tr>
<td>Rose Mary Asman, R.N., MPA</td>
</tr>
<tr>
<td>John Bechinski, D.O.</td>
</tr>
<tr>
<td>Stacie Dubay, LMSW</td>
</tr>
<tr>
<td>Gwendolyn Franklin, M.S.N, R.N.</td>
</tr>
<tr>
<td>Margaret M. Gorman, Ph.D., R.N.C</td>
</tr>
<tr>
<td>Violanda Grigorescu, M.D., MSPH</td>
</tr>
<tr>
<td>Jessica Grzywacz, Injury Prevention</td>
</tr>
<tr>
<td>Mark Hall, M.D., MPH</td>
</tr>
<tr>
<td>Heather Hockanson, Injury Prevention</td>
</tr>
</tbody>
</table>

| Sgt. Greg Jones, MI. State Police |
| Judy Karandjeff, Women’s Commission |
| Debra Kimball, M.S.N., R.N.       |
| Linda Maloney, Ingham Co. Prosecutor |
| Sgt. David Moore, Detroit Police  |
| Mary W. Roberts, M.D.             |
| Deborah Schild, Ph.D., MSW, MPH   |
| Alicia Sledge, Highway Safety     |
| Angela Smith, Substance Abuse     |
| Deborah Wagner, B.S.N, R.N., CNM  |
Mortality: the tip of the iceberg

Morbidity (Burden of Disease):
an emerging issue that needs to be further explored
1995-2001 live birth records linked with hospital discharge data: all hospitalizations one year prior and after delivery

All ICD-9 codes were used to classify in categories: 1/non-pregnancy related, 2/pregnancy related, 3/pregnancy, delivery, postpartum and 4/others (not classified elsewhere)

Analysis performed using SAS
Findings: Non-Pregnancy related

- Breast: 2%
- Endocrine: 3%
- Bronchitis: 3%
- Lung Dz: 0%
- Pneumonia: 1%
- Anomaly: 1%
- Cancer: 0%
- Cardio-Vasc: 0%
- Fibroids: 0%
- Renal: 0%
- Obesity: 0%
- Upper Respiratory: 0%
- Diabetes: 0%
- Blood Dz: 0%
- Hypertension: 0%
- Nervous System: 0%
- Thyroid: 0%
- Gastro-intestina: 0%
- Cardiac: 0%
- Asthma: 0%
Findings: Pregnancy related

- Ecclampsia
- Previa
- Severe preeclampsia
- 1st Trimester
- Abruption
- Mild preeclampsia
- PIH
- Gest. Diabetes
- Preg Complication
- Premature Labor
Acknowledgments

Division of Family and Community Health

- Rose Mary Asman, R.N., MPA
  Perinatal Health Unit Manager

- Debra Kimball, M.S.N., R.N.
  Maternal Health Nurse Consultant

Division of Genomics, Perinatal Health and Chronic Disease Epidemiology

- Dr. Violanda Grigorescu, M.D., MSPH
  Division Director and State MCH Epidemiologist

- Students / Interns
Michigan Maternal Mortality Surveillance (MMMS) - 1999-2004 Report can be found at: