Reducing Maternal Deaths Through State Maternal Mortality Review

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Abstract

Background: Illinois has one of the highest rates of maternal death in the United States, and in 2000, the Illinois Maternal Mortality Review Committee (MMRC) was created to address this high rate of maternal death.

Methods: This is a detailed description of the development of the MMRC, its process of review, its impact on the state's attention to maternal mortality and its obstetric hospitals, and a summary of its initial findings.

Results: The Illinois MMRC, specifically designed to be multidisciplinary, was created to provide secondary review of select maternal deaths. Between 2000 and 2010, 45 of the 93 deaths reviewed had complete analysis. Hemorrhage was the leading cause of death, and 69% of all cases were deemed potentially avoidable. Compared to the primary required review conducted by the State Perinatal Center, the secondary review by the MMRC changed the cause of death in 20% of cases and changed the determination of avoidability in 36% of cases. Based on these findings and advocacy by the MMRC, in 2008, Illinois mandated that every M.D. and R.N. provider working in the obstetric unit of every obstetric hospital must complete the maternal hemorrhage education program.

Conclusions: The MMRC has had a positive impact on Illinois' approach to reducing maternal deaths by being instrumental in getting the state to mandate that every obstetric hospital must comply with the Obstetric Hemorrhage Education Project to maintain its credentials. Further, the high rates at which cause of death and potential avoidability of death were changed by the MMRC underscore the need for multidisciplinary independent review of maternal deaths to achieve more accurate data and, hence, ultimately institute focused interventions to decrease preventable deaths.

Introduction

AFTER REACHING A NADIR in the 1980–1990s, maternal death is increasing in the United States. The maternal mortality ratio (MMR) (maternal deaths within 6 weeks of pregnancy) in the United States increased to 12.7/100,000 in 2007 from 8.5/100,000 in 1996.^{1–3} Similarly, the Centers for Disease Control and Prevention (CDC) pregnancy-related mortality ratio (PRMR), defined as a pregnancy-related death within 1 year of pregnancy due to a complication of pregnancy, a chain of events initiated by pregnancy, or aggravation of an unrelated condition by the physiologic effects of pregnancy, has also increased to 15.4/100,000 in 2005 from 10.3/100,000 in 1991.^{4,5} It is clear that even the latest CDC data likely underrepresent actual maternal deaths.^{6,7} By the late 1990s, it was apparent that maternal mortality in the United States was no longer declining, was underestimated, and was disproportionately affecting certain groups of women, and as

many as 37%–54% of the deaths were likely preventable.^{6,8,9} A large black/white disparity in maternal deaths continues.^{1,7,10}

The state of Illinois faces similar challenges. Overall, in 2006, Illinois ranked 23rd among U.S. states in its total MMR of 9.1/100,000.¹¹ The state also had the 6th worst black/white disparity in maternal deaths, with a black MMR of 21.3/100,000 and white MMR of 4.3/100,000 in 1987–1996, the most recent data available.¹⁰ Similarly, one Chicago perinatal center reported an MMR of 31.9/100,000 for 1992–1998.⁶ In 2000, women's health researchers and providers in Illinois recognized that its high MMR required attention and worked with the Illinois Department of Public Health (IDPH) to create the Illinois Maternal Mortality Review Committee (MMRC) to conduct reviews of pregnancy-related maternal deaths. The aims of this report were to describe the evolution of the MMRC and its impact on the state's attention to maternal mortality and to present initial findings from the committee's first 10 years from 2000 to 2010.

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Materials and Methods

History and evolution of maternal death review in Illinois

Regionalized perinatal care began in Illinois in 1976 with the formation of 10 state perinatal centers. Six of these centers are in the Chicago metropolitan area, with the remaining four in more rural portions of the state. By the 1980s, the state mandated that each perinatal center must do a primary review of maternal deaths in their network with the hospital where the death occurred. The findings of these reviews were discussed at the hospital where the maternal death occurred in a protected format.

Since 1982, Illinois has required that maternal deaths be reported to the IDPH. In 2001, it was additionally required that the report of a death must be made to the Illinois Center for Health Statistics within 24 hours of death. Between 1982 and 2000, the Illinois section of American College of Obstetricians and Gynecologists (ACOG) also participated in maternal mortality reviews, although these reviews were neither consistent, nor were adequate records kept. Based on the increasing recognition of the high Illinois MMR, the large black/white disparity in maternal mortality, and the large proportion of potentially preventable deaths, the MMRC was formed in 2000 to provide a more consistent and organized approach to maternal death reviews. The purpose of the new committee was to reduce avoidable maternal deaths and improve maternal care in Illinois. The specific initial goals of the MMRC were as follows:

1. To review selected maternal deaths that occurred within 1 year of pregnancy
2. To review statistical reports regarding maternal death to determine possible trends and establish a uniform process for case review statewide
3. To make recommendations for improvement in maternal care
4. To work with IDPH to insure wide dissemination of the committee's findings and educational recommendations

It was immediately apparent that to achieve these goals, it would be necessary to have a multidisciplinary group with representatives from across Illinois who had the imprimatur of the state as well as the protection of the state. To ultimately reduce preventable deaths, it would be necessary to meet in an environment that promoted open but not discoverable discussion about quality of care as well as to have the authority to demand change when needed. Toward this end, IDPH agreed to support the committee and be the agency to which the MMRC reported. The membership included the following:

1. A representative from each of the Office of Family Health, Office of Prevention, and Chicago Department of Public Health
2. The State Perinatal Division Program director
3. A family medicine physician
4. Two maternal fetal medicine specialists
5. An obstetrician/gynecologist (generalist)
6. A perinatal network administrator
7. A maternal nursing representative from the Association of Women's Health Obstetric and Neonatal Nurses

8. A certified nurse midwife
9. A maternal health Ph.D. from a school of public health versed in principles of epidemiology and public policy

In addition, *ex-officio* members were identified to provide specific expertise in select cases. *Ex-officio* members included a medical record coder, an anesthesiologist, a medical examiner or pathologist, a hospital administrator from a nontertiary hospital, an internist and a toxicologist.

A multidisciplinary nominating committee appointed by the Illinois State Quality Council (SQC) was responsible for selecting members and ensuring multidisciplinary and geographic representation on the MMRC. All committee members were volunteers, with no financial support from the state. However, IDPH created a position in the Illinois Center for Health Statistics for a data analyst to manage mortality data from the perinatal centers.

The obstetrician/gynecologist was selected to be the committee chair. The chair and the committee administrator were charged with coordinating the committee's activities, maintaining minutes, and reporting to SQC. In 2010, a change in the Illinois state regionalized code made the MMRC a standing committee that could report directly to the Illinois Perinatal Advisory Committee (PAC). This new reporting structure allowed recommendations from MMRC to be processed more efficiently because they no longer have to go through SQC to PAC.

The committee has met quarterly over the past 11 years. All committee case review discussions are conducted under the protection of the Illinois Administrative Code in a closed meeting format.¹² Therefore, the discussions and findings of the MMRC are protected from discovery and use in legal proceedings under the State of Illinois Medical Studies Act. All MMRC members signed a confidentiality agreement.

By 2002, in part because of pressure from the MMRC, the Maternal Death Review section of the code was amended to modify the definition and reporting of maternal deaths.¹² Maternal death was redefined as the death of any woman of any cause while pregnant or within 1 year of termination of the pregnancy irrespective of the duration of the pregnancy at the time of the termination or the nature of its termination. The previous legal definition of maternal death included deaths during or within 90 days of pregnancy. In addition, this section required that all providers, hospitals, and coroners having had contact with the deceased must, when requested, provide a complete copy of the medical records within 30 days of the request. Despite this legal requirement, obtaining complete records was often difficult and took extensive time.

Review process

The initial meetings in the first few years were used to develop the process whereby the committee could receive identified complete medical records of maternal deaths to be reviewed. The initial criteria for case selection included the following:

1. All pregnancy-related deaths within 1 year of pregnancy
2. All maternal deaths deemed potentially avoidable by the perinatal center review committee
3. Any cases forwarded for review by a perinatal center

The committee used the guidelines from the CDC to organize the reviews.¹³ The committee administrator and chair reviewed the original chart with all pertinent records to create a de-identified summary (names of hospital, patient, providers removed) in a case abstract form developed for these purposes, which was sent to all committee members for review before the meeting (Fig. 1, supplemental material available on line at www.liebertonline.com). This review and summary were time-consuming, often taking over 5 hours per case.

At each meeting, the cases were discussed with the full chart available to the administrator and chair to answer questions. During the meeting, an MMRC case assessment form was filled out by the committee after group discussion (Fig. 2, supplemental material available online at www.liebertonline.com). This form required the following:

1. Determination of cause of death (immediate and underlying) as well as contributing factors affecting death
2. Determination of whether the death was directly, indirectly, or not related to the pregnancy
3. Disposition of the mortality (whether the death was unavoidable, potentially avoidable, or undetermined) based on a previously validated model of preventability^{14,15}

If deemed potentially avoidable, it was then determined if the potential avoidable factors were related to the patient (e.g., failure to seek care, noncompliance with treatment, and drug/alcohol/cigarette use), provider (e.g., no identification of high risk, no referral to higher level of care, and incomplete or inappropriate management by any clinician who cared for the woman), or system (e.g., a factor related to the larger structure of healthcare delivery, such as staff knowledge/training deficits, inadequate equipment) and if they occurred antepartum, intrapartum, or postpartum. After determining the disposition of the mortality, if appropriate, the committee would make recommendations for improvement (Fig. 2, supplemental material available online at www.liebertonline.com).

The advantage of the multidisciplinary committee was important in determining cause of death and potential avoidability and identifying areas of improvement that included provider, system, and patient. After the committee completed the MMRC case assessment form, it was compared to the maternal mortality review form (Fig. 3, supplementary material available online at www.liebertonline.com) that was filled out by the perinatal center at its primary review. Differences between these forms became the basis of the summary educational and policy recommendations made by the MMRC.

Because of the large number of maternal deaths in Illinois (>60 per year), the detailed review process, and relative lack of resources available to the committee, it quickly became apparent that the MMRC would not be able to achieve its original goal to review all deaths. The MMRC decided that it would review deaths when there was disagreement between the site of death hospital and the perinatal center review with respect to cause of death and whether the death was avoidable. In addition, any maternal death requested to be reviewed by the perinatal center would be reviewed.

Between 2000 and 2006, only simple reports of the number of deaths by site of occurrence and perinatal center were generated and were sent only to the individual perinatal center. Despite completion of MMRC reviews, including conclusions and recommendations for improved care, the committee was restricted by the state for legal reasons from

TABLE 1. FINAL CAUSES OF DEATH (N=45)

<i>Causes of death</i>	n	%
Hemorrhage	11	24
Other	9	20
Hypertensive diseases	8	18
Infection	8	18
Pulmonary embolism	3	7
Unknown	3	7
Cardiac	2	4
Amniotic fluid embolism	1	2

providing specific feedback about maternal deaths to individual providers or hospitals. Beginning in 2006, data and case assessments from reviewed cases were shared with individual perinatal centers in a meeting format between the perinatal center and the administrator of the MMRC. However, the MMRC believed that it was extremely important to be able to provide feedback to the perinatal centers more directly and advocated for such a change in policy. Beginning in 2010, IDPH was able to send the MMRC review and an official letter describing the key findings and recommendations made by the MMRC to the perinatal center administrator and to the hospital CEO, all protected under the Illinois Medical Studies Act. IDPH also now uses the MMRC analysis for the mandated IDPH review of each obstetric hospital.

Results

The MMRC reviewed 93 maternal deaths between 2000 and 2010, but because of a lack of resources, the MMRC has complete analysis on only 45 of these deaths, all of which occurred between 2000 and 2006. Despite this small number, the detailed reviews highlighted important areas that could impact future clinical practice and policy. As seen in Table 1, hemorrhage was the most common cause of death, accounting for 24% of the deaths. Other deaths, hypertension-related deaths, and sepsis were the next most frequent etiologies of death. The other category included anesthesia-related death, trauma, aspiration, pancreatitis, and brainstem infarct not related to hypertension. The MMRC made a different determination from the perinatal center as to the final cause of death in 9 (20%) cases (Table 2). Of note, 2 of the cases' original causes of death were undetermined, but the MMRC was able to agree on a cause of death. In most of the cases where the MMRC determination of cause of death differed from the perinatal center's determination, there was no change in the avoidability. However, in the 3 cases where original diagnosis of amniotic fluid embolus was deemed incorrect, the committee changed the original assessment of not avoidable to potentially avoidable (Table 2).

The MMRC also disagreed with the original perinatal center's disposition of avoidability in 36% of the cases (16/45). In the perinatal centers' initial disposition, 47% cases were deemed potentially avoidable and 38% were deemed not avoidable. In contrast, review by the MMRC rated 31 (69%) cases potentially avoidable and only 18% not avoidable. Of the 31 potentially avoidable cases, provider, system, and patient factors were implicated in 84%, 48%, and 19% of the cases, respectively. A case could have more than one preventable factor listed, and 45% of the cases had multiple

TABLE 2. CASES WHERE CAUSE OF DEATH WAS CHANGED (N=9/45)

<i>Original cause of death</i>	<i>Final cause of death</i>	<i>Avoidability changed</i>
Undetermined	Septic shock, multisystem organ failure	No
Vascular disease	Pulmonary emboli, DIC	No
Cerebral disorders in puerperium, ventricular fibrillation, unclassified intracranial hemorrhage	HELLP syndrome, intracranial hemorrhage	No
Infection	Neglect, trauma	No
Undetermined	Hemorrhage, multiorgan system failure	No
DIC	Hemorrhage, chorioamnionitis, sepsis, DIC	Yes to potentially avoidable
Amniotic fluid embolus	Sepsis, ARDS, DIC	Yes to potentially avoidable
Amniotic fluid embolus	Hemorrhage, DIC	Yes to potentially avoidable
Amniotic fluid embolus	Abruption, DIC	Yes to potentially avoidable

ARDS, acute respiratory distress syndrome; DIC, disseminating intravascular coagulation; HELLP, hemolysis, elevated liver enzymes, and low platelet (count).

potentially avoidable factors noted. As seen in Table 3, the cause of death in over half of the potentially avoidable cases was either hemorrhage or infection.

The MMRC has also had an important impact on promoting educational and policy initiatives. By 2007, it was clear that hemorrhage was the leading cause of death. Delayed recognition and, hence, delayed management of the hemorrhage were frequently noted in potentially avoidable deaths. To address this issue, a state obstetric hemorrhage education project (OBHEP) subcommittee was created that developed a statewide OBHEP for all obstetric providers.

The comprehensive education program, including lectures, skill stations for volume of blood loss estimation, simulation, and debriefing sessions, was implemented from July 2008 through December 2009. Over 48,000 providers completed this program, including physicians (obstetricians, maternal-fetal medicine, family practice physicians who deliver babies, and anesthesia attendings), midwives, obstetric nurses, and some ancillary personnel. A pretest to assess knowledge was administered to all providers before the education intervention, and a subsequent posttest assessment was completed in 2010, within 6 months of completing the educational requirements. This program was made mandatory by the state and partially funded by the Illinois Perinatal Obstetric Hemorrhage Project Grant for FY2009–2010 that provided 1 million dollars (\$100,000 per perinatal center) for implementation of activities. Each perinatal center was responsible for facilitating the training in each of its network hospitals. All Illinois hospitals completed this process by 2010, and currently all hospitals have rapid response teams trained to respond to hemorrhage. Data analysis as to the effectiveness of the program in increasing provider knowledge and reducing preventable deaths due to hemorrhage is pending.

Discussion

Similar to other reports, a high proportion of the maternal deaths reviewed in Illinois were potentially avoidable¹³, and hemorrhage was the leading cause of maternal mortality as well as the leading cause of the potentially avoidable deaths.^{6,9,16,17} Given the fact that 48,000 clinicians received training through the OBHEP, the Illinois MMRC has had a positive impact on the state's greater awareness and attention to maternal morbidity and death. The multidisciplinary makeup of the MMRC enhanced its ability to better understand the etiologies of maternal death and influence the state to mandate the hemorrhage education project for all members of a hospital's obstetric team. We believe that Illinois is the only state to require a hemorrhage education program for every obstetric hospital and provider.

That the MMRC changed the cause of death in a high proportion (20%) of cases is a new finding and likely reflects the benefit of the broader multidisciplinary independent review team over what any individual hospital or perinatal center can amass. It might also reflect the fact that the MMRC reviewed the more complex cases. Not surprisingly with the high percent of altered causes of death, the MMRC changed whether the case had avoidable factors or not in more than one third of cases, resulting in 69% of deaths being judged as potentially avoidable. The more distant reviewers, the blinded cases and hospitals, likely allow a more objective view of care, which may account for the large change from not avoidable to potentially avoidable assessments. When a death is deemed potentially avoidable, the MMRC identifies areas where improvements in maternal care could reduce future deaths in similar circumstances. The perinatal center is required to respond to the MMRC report and describe any corrective actions implemented as the result of the review.

Despite the benefits of the MMRC process (the state-mandated hemorrhage project and more accurate determination of cause of death), there remain weaknesses and challenges in the review process. The most obvious one is the low number of total cases reviewed and analyzed by the committee. The committee is dependent on geographically dispersed volunteers, and resources for data collection, analysis, and report writing are scarce. Additionally, a portion of every meeting is spent on discussions about educational and policy issues, and therefore, the resulting select sample may not accurately reflect the remaining Illinois maternal deaths. The high

TABLE 3. CAUSES OF DEATH IN FINAL POTENTIALLY AVOIDABLE DEATHS (N=31)

<i>Cause Of death</i>	<i>n</i>	<i>%</i>
Hemorrhage	11	36
Infection	7	23
Hypertensive diseases	6	19
Other	5	16
Pulmonary embolism	2	6

rates of change in cause of death and avoidability rating, however, warrant sharing these data to increase attention to reducing avoidable maternal deaths and to urge other state mortality review teams to embrace this approach of detailed, independent, multidisciplinary review of maternal deaths.

As part of the committee's discussions about cases, it identified several ongoing systems issues that impacted access to appropriate care and the ability to obtain needed information to fully assess a death. For example, in Illinois, ambulances must take a patient to the nearest hospital; even if the patient is pregnant, she could be taken to a hospital that has no obstetrics department or no in-house obstetrician. This situation negatively impacted at least one case reviewed by the committee. Beginning in 2009 in response to MMRC concerns, ambulances in Chicago must take pregnant patients to a hospital that provides obstetric care. There is an ongoing effort to direct ambulances to take all pregnant patients to the nearest level III hospital.

The committee noted not only that autopsies are not required for maternal deaths but also that in multiple cases when autopsies were requested, the coroner's office refused. Further, the quality of some autopsies was insufficient to determine cause of death. This led the committee to create an autopsy checklist that was approved in 2011. The plan is to offer the checklist to all medical examiners and pathologists who perform autopsies in Illinois (Fig. 4, supplemental material available online at www.liebertonline.com).

Several conclusions potentially pertinent to other states can be drawn from the experience of the Illinois MMRC. A multidisciplinary, dedicated, and experienced group of people can make a difference in the health outcomes of women. Advocacy to the state to implement an intervention focused on maternal hemorrhage was successful in Illinois. The existing strong perinatal system in Illinois was key to the implementation of the state hemorrhage project. However, a lack of resources limits data collection, analysis, and the ability of the committee to review more deaths. The high proportion of potentially avoidable deaths due to infection was a surprising finding and one that the state has yet to evaluate fully.

Despite the many challenges facing the MMRC, significant interventions have been instituted to address maternal mortality. The State of Illinois should be lauded for its support and maintenance of the MMRC in this time of the state's underfunding, particularly for mandating the OBHEP. The question remains, however, of whether the State of Illinois has reduced preventable deaths and near miss cases by any of these interventions. This will not be known until the committee has resources to analyze the data.

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Disclosure Statement

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