The California Pregnancy-Associated Mortality Review

California is using data from its Pregnancy Assisted Mortality Review (CA-PAMR) to investigate maternal deaths and associated racial/ethnic disparities. The major goals of CA-PAMR are to identify pregnancy-related deaths, the causes and contributing factors, and identify public health prevention and quality improvement (QI) strategies.

The California Department of Public Health's (CDPH) Maternal, Child and Adolescent Health (MCAH) Division established the CA-PAMR in 2006 in response to a rise in maternal mortality after many years of declining rates. In 1999, the maternal death rate was 8 per 100,000 live births. However, by 2008, the rate jumped to 14 per 100,000 live births.[1] MCAH also noted a substantial racial disparity in pregnancy-related deaths with African-American women dying at three to four times the rate of white, non-Hispanic; Hispanic; or Asian women.[2] California is a populous state with more than 500,000 births per year, so an organized and streamlined approach to investigate a potentially high number of maternal deaths was required. Improved vital statistics data reporting may account for up to one-third of the rise in maternal deaths, leaving the majority of the increase unexplained.

Steps Taken:

Using federal Title V MCH block grant funds:

- In 2006 California convened its pregnancy-associated mortality review team, a multidisciplinary group including obstetricians, midwives, labor and delivery nurses, and specialists in maternal-fetal medicine, cardiology, anesthesia, and emergency medicine. The composition of the group was intentionally diverse in terms of geographic distribution, urban vs. rural, public vs. private, and university vs. clinical settings.
- MCAH partnered with Stanford University's California Maternal Quality Care Collaborative (CMQCC), an organization with expertise in hospital quality improvement, to chair and staff the review committee and integrate the committee's findings into QI efforts for maternity care. This was similar to work initiated by the California Perinatal Quality Care Collaborative (CPQCC), which focused on improving neonatal outcomes in California neonatal intensive care units.
- MCAH also partnered with the Public Health Institute (PHI) for their expertise in supporting medical record reviews and demonstrated ability to obtain prenatal, hospital, and postpartum medical records.
- The CA-PAMR embraced key quality improvement principles by explicitly making its focus identifying opportunities for improvement, rather than assigning judgment or blame. This contributed to widespread engagement of clinicians and 280 birth hospitals across the state.
- The CA-PAMR team began its first reviews in 2007, after establishing a methodological approach to the daunting task of reviewing potentially hundreds of cases each year. The team developed a screening algorithm to identify medical cases that were likely pregnancy-related and decided to

CA PAMR focused on four key components:

1. *Enhanced surveillance* of maternal deaths using linked birth, death, hospital data files, and coroner reports.
2. *Medical record review* to summarize events culminating in the death of each woman.
3. *Case review by a multidisciplinary team* of maternal health experts to determine causality and preventability.
4. *Translation of findings* into specific, prioritized quality improvement initiatives to improve maternal care and decrease preventable maternal deaths.

exclude violent or accidental pregnancy-related deaths such as those from suicide, homicide, motor vehicle deaths, and drug overdoses in the initial phase of CA-PAMR.[3]

- Due to the substantial number of cases related to cardiovascular disease or involving critical care outside the labor and delivery setting, CA-PAMR increased cardiology and emergency medicine expert participation on the team.
- Among the benefits of establishing an enhanced surveillance strategy, two were key. There was increased detection of pregnancy-related deaths beyond those reported on the death certificate, and better specification of the causes of the pregnancy-related deaths. The CA-PAMR review team concluded that 25% of deaths determined to be pregnancy-related were not identified as such based solely on death certificate data.
- In quarterly, day-long meetings, the CA-PAMR team reviewed in-depth summarized medical records and identified contributing factors and quality improvement opportunities for every case, which informed priority areas for public health and maternity care QI efforts.

Results:

- The CA-PAMR team identified contributing factors to pregnancy-related deaths on a form structured in three categories, which informed how the QI opportunities were noted and analyzed:
    - *Patient factors*, such as underlying significant medical conditions, obesity, substance use, complications from prior cesarean sections, delays in or failure to seek care, or follow up.
    - *Healthcare provider factors*, such as inadequate response to or management of clinical triggers, ineffective or inappropriate treatment, failure to refer or seek consultation.
    - *Healthcare facility factors*, such as inadequate or unavailable equipment or services, inadequate treatment or delay due to facility systems, or inter-facility transfer issues.
- The CA-PAMR team classified the overall chance to alter the fatal outcome across four categories: strong, good, some, or none, depending on the number, degree of severity, and cumulative impact the factors played in definitely or probably contributing to death. Those cases in which there was a strong or good chance to alter outcome had specific and feasible opportunities for improvement in care and were then prioritized for development of public health prevention and clinical QI toolkits and strategies.
- Based on their analyses of preventability, the CA-PAMR team concluded there was a strong or good chance to prevent the fatal outcome in 41 percent of the 333 cases reviewed from 2002 to 2007.[4]
- Due to the high preventability of maternal deaths related to obstetrical hemorrhage and because specific actions were identified that could be taken, the CA-PAMR team determined this was a good first QI topic and CA-PAMR collaborators published the first toolkit with clinical guidance focused on institutional readiness, early recognition and rapid response to obstetrical hemorrhage.
- The toolkit was made freely available on the CMQCC website and two additional strategies were used to encourage adoption: (1) nurse coordinators for each of the Regionalized Perinatal Programs of California personally introduced the toolkit to each delivery hospital and provided technical assistance to support institutional change, and; (2) the CMQCC convened learning collaboratives of hospitals committed to implementation which provided critical data on quality improvement efforts.
- The CA-PAMR team identified cardiovascular conditions as the leading cause of pregnancy-related deaths,[5,6] which would not have been known without enhanced surveillance and the medical record review that reclassified many deaths as pregnancy-related. Prior to the review, preeclampsia would have been designated as the leading cause of pregnancy-related death. Both preeclampsia and cardiovascular disease were subsequent toolkits developed to support hospital quality improvement efforts.

- The CA-PAMR data demonstrated substantial disparities in maternal mortality by race and ethnicity, education level and insurance status. African-American women, women who had not completed high school, and women who used Medi-Cal as their payer source all had statistically significant higher rates of mortality.
- Title V funds were used to release a series of California Toolkits to Transform Maternity Care developed by CMQCC, beginning with the toolkit on obstetric hemorrhage (initially released in 2010 and updated in 2015).[7] Other toolkits addressed eliminating non-medically indicated, elective deliveries before 39 weeks (2011), as well as toolkits arising from CA-PAMR for preeclampsia identification and management (2014)[8], improved detection and management of cardiovascular disease in pregnancy, and maternal venous thromboembolism (both available in 2017).

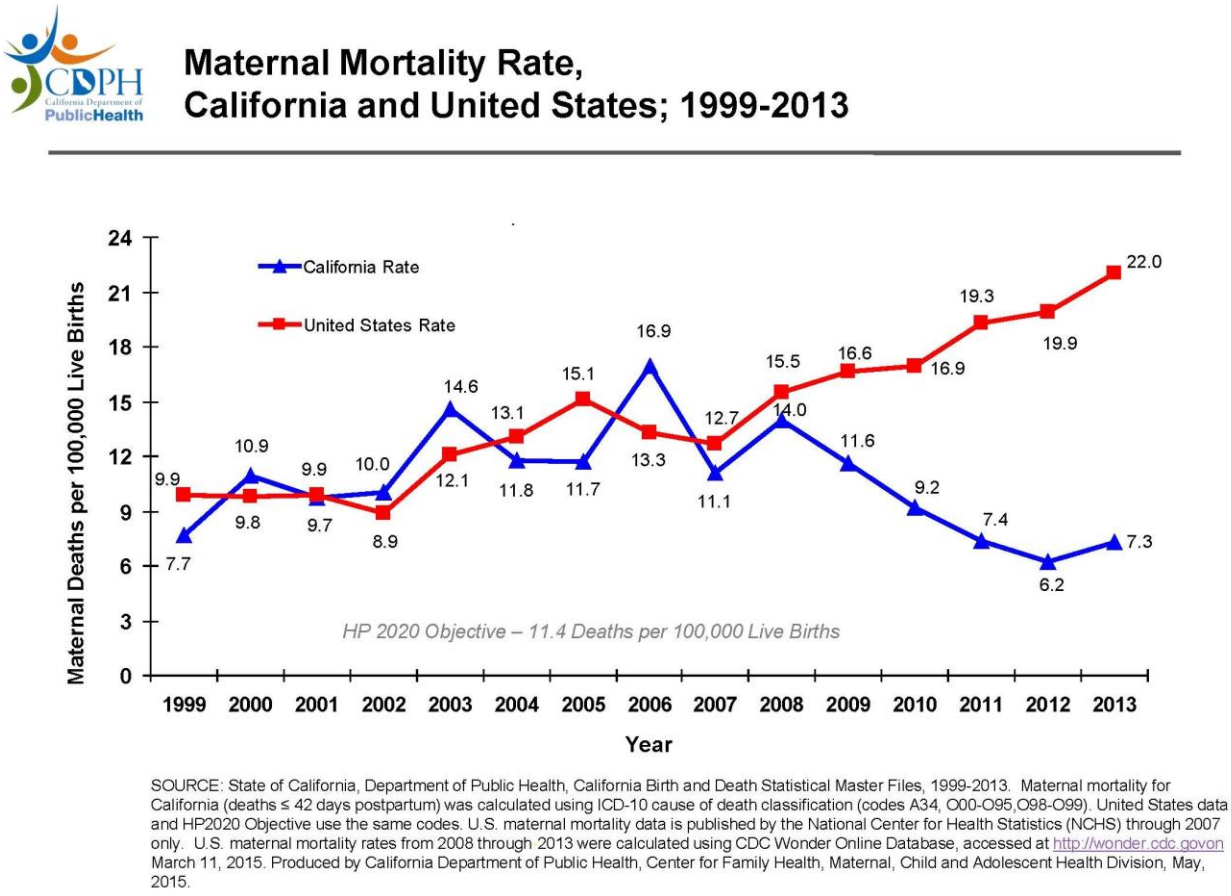

Figure 1: California's maternal mortality rates declined while U.S. maternal mortality rates increased, even though California accounts for one in eight births nationally.

Lessons Learned:

- The California Department of Public Health visibly embraced the role of convener to make statewide recommendations and allow for a statewide approach. The department was able to be inclusive and assert its authority, while avoiding a heavy-handed approach that might have alienated stakeholders.

- The CA-PAMR process was designed to integrate with the CMQCC, which grew out of the work of an existing, well-recognized, and experienced quality improvement effort on the part of CPQCC. The partnership linked surveillance with a quality improvement strategy.
- Medical record review provided information that is often not included on population-based datasets and is important for understanding the nature of the maternal deaths as well as determining preventability.
- MCAH shared the CA-PAMR findings with other areas within the California Department of Public Health to inform the work of other related programs. For example finding that cardiovascular disease is the leading cause of pregnancy-related deaths has implications for both the Chronic Disease program as well as the Black Infant Health program. Recommendations about family planning and the appropriate type of birth control for women with cardiovascular disease (CVD) are incorporated in the toolkit. Additionally, findings on high rates of obesity have informed efforts by the Preconception Health Program and the Nutrition and Physical Activity Initiative to educate women on the importance of attaining an optimal weight prior to pregnancy.
- Statewide learning collaboratives focusing on implementing the hemorrhage and preeclampsia toolkits were effective at getting 'early adopters' at participating hospitals to adopt quality improvement strategies. Their success, in turn, encouraged further participation throughout the state.
- The CA-PAMR's explicit focus on identifying causes and finding quality improvement opportunities, rather than assigning blame, allowed for vigorous engagement of key partners, including clinicians and hospitals. Success at obtaining medical records from hospitals and providers was a testament to this buy-in. Not only were patients' identities kept confidential, providers and healthcare facilities were also not identified. This approach, along with measures approved by the institutional review board to protect the confidentiality of the data, have led to high rates of provider engagement.
- Maternal morbidities are far more common than maternal mortality, so findings from CA-PAMR that positively influence the care of other medical conditions may affect the health of all childbearing women in California, in addition to reducing both morbidity and mortality.
- Since 2008, California has experienced a sustained decline in maternal mortality to 7.3 deaths per 100,000 live births, well below the Healthy People 2020 Objective of 11.4 deaths per 100,000 live births.

California Maternal Quality Care Collaborative (CMQCC) efforts link review to effective interventions:

- Convened obstetric hemorrhage task force to develop tool kit based on the findings of the CA PAMR efforts
- Launched two statewide QI collaboratives to implement the toolkit
- Approximately 70 percent of CA maternity hospitals have implemented the hemorrhage toolkit
- Preliminary data indicates that the number of women with transfusions has increased while the total number of units of blood products have decreased. Although more analysis is underway, this early finding may suggest that more women who needed intervention received it quicker, thereby reducing the need for more blood.

The toolkits are freely available on the CMQCC website at: https://www.cmqcc.org

- Maternal deaths occurring after six weeks and up to one year postpartum are not included in the standard U.S. maternal mortality calculation. If these 'late' deaths are included, declines in maternal mortality remain in California, although they are not as dramatic and lack statistical significance. Maternal deaths may be shifting to chronic and less acute causes which will require different prevention strategies.
- Reductions in California's maternal mortality are likely the result of the investment of Title V MCH funds in CA-PAMR and numerous initiatives to improve maternal health and strong partnerships with care providers statewide.[9] For example, Title V funds were used by CMQCC to convene and inform multiple organizations engaged in strategies for quality improvement. Additionally, the widely acclaimed effort by California to reduce the incidence of non-medically indicated births prior to 39 weeks was only possible because of the strong support and investment of March of Dimes, American Congress of Obstetricians and Gynecologists (ACOG), hospitals associations, medical insurers and advocacy organizations. The power of all groups, working in the same direction, is likely a powerful contributor to declining maternal mortality rates in California.

Future Steps:

- The CA-PAMR team has begun review of pregnancy-associated violent and accidental deaths, including homicide, suicide, and drug overdose, which will link to CDPH's work on injury and violence prevention.
- A follow-up report containing findings from a case review of maternal deaths from 2002 to 2007 is under preparation.
- CDPH MCAH, CMQCC, and PHI recognize its PAMR reviews of 2002 to 2007 deaths were geared to identify clinical causative factors due to the review approach and the composition of the team. There is a desire for future analyses to improve our understanding of the role of social determinants on maternal mortality and severe maternal morbidity in an effort to identify additional opportunities for prevention.

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