

North Carolina Leverages a Long History of Maternal Mortality Review

North Carolina’s approach to conducting maternal mortality reviews began in the 1940s with a voluntary public-private partnership between the North Carolina Division of Public Health and the Wake Forest School of Medicine. In 1988, North Carolina instituted a population-based, statewide, enhanced surveillance system that links death files with the files for live births and fetal deaths. The North Carolina State Center for Health Statistics, within the division of public health, was one of the pioneers in establishing this linkage model, which resulted in a roughly 30 percent increase in successfully identifying the drivers for pregnancy-related deaths across the state. This improvement strengthens North Carolina’s ability to [evaluate](#) the full array of possible causes for these deaths.

Steps Taken:

- The North Carolina Maternal Mortality Review Committee (NC MMRC) is composed of an interdisciplinary team with statewide representatives. The committee reviews de-identified case summaries of all deaths.
- The review committee includes representatives from the nurse midwifery, obstetrics and gynecology, clinical social work, and labor and delivery nursing professions, as well as the Office of the State Medical Examiner. The committee also includes representatives from psychiatry, cardiology, anesthesiology, and other specialties as needed.
- NC MMRC instituted an enhanced linkage process that includes four computerized datasets: death, birth and fetal death certificate files, and the statewide computerized hospital discharge database. NC MMRC employs three methods of identifying all possible pregnancy-related deaths, including using specific pregnancy-related cause of death codes; using linked birth, death, and fetal death files to identify all deaths occurring within one year of a live birth or still birth; and reviewing the hospital discharge database for all cases with diagnostic or procedures codes related to pregnancy and a discharge code of deceased.

In 2005, North Carolina [studied](#) how many of the state’s pregnancy-related deaths were preventable. The findings revealed that 40 percent of these deaths (41 of 102) could have been avoided. Of these pregnancy-related deaths:

- 20 percent were attributed to lack of preconception care (e.g., family planning for women with known chronic medical conditions).
- 34 percent were attributed to patient actions or lack of action (e.g., adhering to medical advice).
- 53 percent were attributed to medical care that was below the standard expected for the level of facility.
- 10 percent were attributed to non-optimal organization of the healthcare system.
- Among African American women, 46 percent of deaths were preventable, compared to 33 percent of deaths among white women.
- The proportion of preventability also varied by cause of death, with 90 percent of deaths due to hemorrhage determined to be preventable, compared to 43 percent of deaths due to infection and 22 percent of those related to cardiomyopathy.

- From 2001-2005, NC MMRC undertook a five-year study of preventability funded by CDC, which resulted in a landmark publication (see above).
- NC MMRC developed a definition of preventability adapted from the one used by Massachusetts' maternal mortality and morbidity review committee and declared deaths to be preventable if "the death may have been averted by one or more changes in the health care system related to clinical care, facility infrastructure, public health infrastructure and/or patient factors."
- The pregnancy-related deaths determined by the committee to be preventable were further categorized by four domains that encompass several underlying factors and actions that could have potentially averted the death, including:
 1. *Preconception care and counseling* – when the woman had any of a set of serious medical conditions before her pregnancy without evidence that she had been informed, prior to conception, about the risk of pregnancy, given her condition.
 2. *Patient actions* – when the patient had not complied with medical advice or recommended treatment.
 3. *Systemic factors* – when there were problems in the overall functioning of the healthcare system.
 4. *Quality of care* – when the care provided did not meet standards that could be reasonably expected given facility's level.

Results:

- After carefully reviewing factors related to causation, NC MMRC identified peripartum cardiomyopathy (PPCM) as the leading cause of death. Overall, from 2005-2011, PPCM caused 18 percent of deaths and other cardiovascular conditions caused another 13 percent. Other top causes of mortality included infection (16%), pulmonary embolus (12%), and hypertensive disorders of pregnancy (12%). Hemorrhage was less common, causing 7 percent of pregnancy-related deaths.
- While not definitively causally related to North Carolina's renewed efforts to stem maternal mortality, the state saw a substantial decrease in the number and proportion of pregnancy-related deaths due to PPCM. For the 15-year period from 1993-2008, the rate of PPCM deaths was steady at approximately 3.5 deaths per 100,000 live births. However, in the period 2009-2012, there was a two-thirds reduction in PPCM deaths—declining to a rate of 1.2 per 100,000 live births. Between the 2005-2008 and the 2009-2012 periods, the percentage of pregnancy-related deaths due to cardiomyopathy decreased from 27 percent to 8 percent.
 - 70 percent of deaths occurred within one year of birth and the median time between delivery and death was four months.
 - 50 percent of deaths were determined to be due to PPCM only at autopsy, highlighting the importance of using an enhanced pregnancy-related mortality database to identify potential cases.

- The review committee identified significant racial disparities in poor outcomes and highlighted the importance of non-medical issues in exacerbating these disparities. North Carolina’s efforts have been associated with a reduction in disparities in pregnancy-related deaths over a 10-year period. Specifically:
 - There was a substantial narrowing of the gap between the rate of pregnancy-related deaths for white and black women in the period of 2002 to 2012.
 - In 2002, the relative risk of pregnancy-related deaths for black women was 5.5 times higher than for white women. However, in 2012, the relative risk decreased to 1.8.
 - Despite this impressive achievement, all the stakeholders involved in North Carolina’s work recognize that additional steps must be taken to confront the remaining 80 percent increased risk of pregnancy-related deaths for black women.
- NC MMRC disseminates its findings in numerous ways, including multiple peer-reviewed articles on topics such as [postpartum mortality and cesarean delivery](#) and [peripartum cardiomyopathy](#). In addition, the State Center for Health Statistics [posted](#) pregnancy-related mortality data on its website to ensure that the data is widely accessible.
- NC MMRC developed an educational outreach effort to increase awareness of the need for early identification and management of women with symptoms of PPCM. The review committee obtained funding from CDC to pay for mailing the materials to primary care providers, obstetricians, cardiologists, and emergency medicine physicians.
- The extensive data and experience from decades of maternal mortality review helped to inform North Carolina’s [Preconception Health Strategic Plan, September 2008-2013](#) and the [Preconception Health Strategic Plan Supplement 2014-2019](#). The original strategic plan includes a focus on obtaining and maintaining a healthy weight, smoking cessation, and identifying and managing chronic conditions. The supplement adds an emphasis on promoting mental wellness and improving access to clinical and community services. The supplement also expands the priority population by including men. Importantly, the health department’s women’s health branch worked with partners in the division of public health’s chronic disease and injury prevention section and other external partners in developing the strategic plan.
- This partnership also produced [Looking Back, Moving Forward: North Carolina’s Path to Healthier Women and Babies](#), a comprehensive document to aid public health partners in improving preconception health and birth outcomes. In 2016, the North Carolina Department of Health and Human Services released a collaborative [Perinatal Health Strategic Plan](#) developed with numerous entities in the state. This plan addresses infant mortality, maternal health, maternal morbidity and the health of men and women of reproductive age. With over 100 thought leaders engaged, this plan is based on a health equity and social determinants of health framework.

Lessons Learned:

- The North Carolina Division of Public Health’s dedication to this effort has been vital to its success. Staff need protected time to implement the work of this initiative. This has been particularly important for the State Center for Health Statistics, which has been integral to the process and has taken ownership of the data.

- During the pilot phase, NC MMRC realized that complex care managers may not have the skill set necessary to address reproductive health in their work, which is often focused on management of chronic disease with acute needs. The division of public health felt the pilot showed gaps in care in terms of what occurs within primary care for women with significant cardiovascular risk factors in terms of having their reproductive health needs addressed.
- The division of public health recognized the importance of the collaboration between women's health and chronic disease to link efforts and expand their reach to previously untargeted populations. This partnership ensures women of reproductive age are reached through social marketing and other efforts to address heart disease and stroke.
- With Medicaid claims data, even after excluding women with a history of hysterectomy and sterilization, NC MMRC realized that more women were identified for the pilot program than could be served. The team prioritized women based on severity of disease or recent hospital utilization.
- Several care managers provided feedback that primary care providers were not having discussions with this particular group of women about contraception. Some women appeared open to these conversations when raised by the care manager, while others were not interested.
- North Carolina has demonstrated a commitment to sharing the data resulting from NC MMRC's reviews widely across the state, with diverse audiences, through publications, presentations, the State Center for Health Statistics' website, and the child fatality task force, a legislative study commission which makes recommendations to the governor and the North Carolina General Assembly.
- The collaboration among the vital statistics team (statistical services branch of the State Center for Health Statistics), the women's and children's health section, and the Office of the Chief Medical Examiner substantially increased the quality and quantity of data available for the committee to review. The data on the scope and impact of PPCM resulting from that important work has been successfully incorporated into the state's preconception health strategic plan and a statewide education plan. Had this review been prevented, none of the resulting efforts would have been possible.

Moving Forward:

NC MMRC, along with the women's health branch within the North Carolina Division of Public Health, is launching several new efforts, including:

- Using Merck for Mothers funding awarded by the Association of Maternal and Child Health Programs, the women's health branch, in collaboration with Community Care of North Carolina, started a pilot project as part of the Pregnancy Medical Home program. Women of reproductive age with cardiovascular risk factors (including congenital or acquired heart disease, hypertension, morbid obesity, and sleep apnea) received education and evaluation prior to pregnancy about their risks, how to maximize their preconception health to decrease these risks and, in the case of women who did not desire conception, options for contraception. The success of this program will be measured in patient surveys and trends in outcomes.

- Identifying accidental drug overdoses is an important focus area for future evaluation. The division of public health and the division of mental health, developmental disabilities, and substance abuse services currently partner and co-fund a perinatal substance use specialist position. This position will serve as a resource to these efforts.
- Through these efforts, the North Carolina Division of Public Health is working to strengthen relationships between community providers and substance use treatment efforts pertaining to increased access for effective contraception.
- NC MMRC worked with the perinatal health committee of the child fatality task force and the state's OB/GYN society to encourage legislation that would permit access to hospital records and provide protection from discovery of the proceedings of the committee. This legislation was enacted Dec. 1, 2015. This nine-member team is charged with reviewing all maternal deaths and making recommendations for improvements.

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Additional data is available on the North Carolina State Center for Health Statistics website:
www.schs.state.nc.us/schs/deaths/maternal.