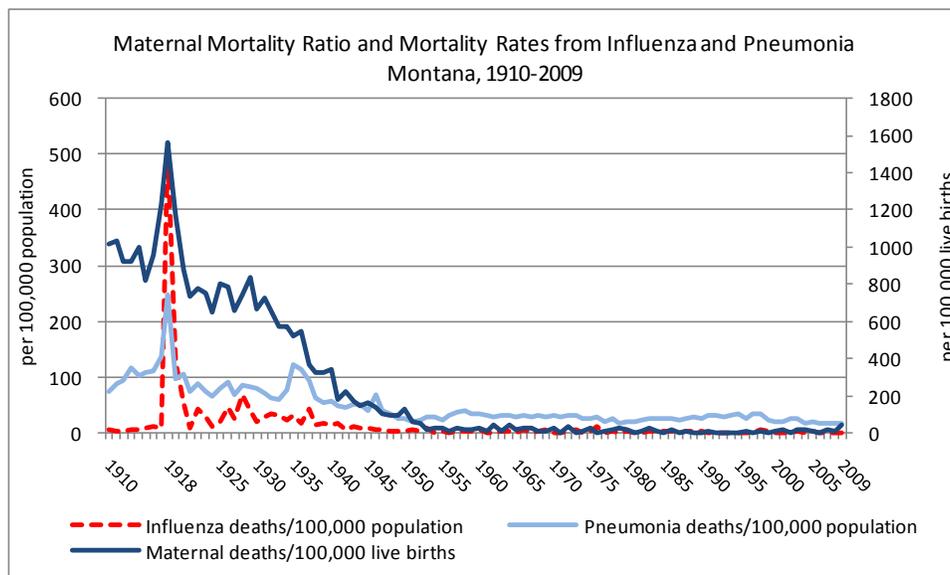


PREGNANCY-ASSOCIATED DEATHS IN MONTANA, 2003 - 2009

Maternal mortality has declined dramatically in industrialized nations in the past century. There were approximately 850 maternal deaths per 100,000 live births in the US in 1900.¹ Maternal mortality rose to 916/100,000 in 1918, coincident with spikes in influenza and pneumonia deaths during the influenza pandemic of 1918. The Maternal Mortality Ratio[‡] for Montana residents reached a high of 1,559/100,000 in 1918, 70% higher than the national ratio, possibly reflecting the rural and isolated status of the state at the time (Figure 1).

Figure 1



Nationally, Maternal Mortality Ratios declined to 376/100,000 in 1940, to 37/100,000 in 1960, and to 9/100,000 in 1980. Montana's Maternal Mortality Ratio shared in this dramatic decline. The decline plateaued in the early 1980s. Between 1991 and 1999, there was an apparent increase in the Maternal Mortality Ratio in Montana, from 10.3/100,000 in 1991 to 13.2/100,000 in 1999. Similar increases occurred throughout the US and are attributed to enhanced surveillance and improved ascertainment under the auspices of the Pregnancy Mortality Surveillance System initiated in 1987 as a collaboration between state departments of health, the Centers for Disease Control and Prevention (CDC), and the Maternal Mortality Study Group of the American College of Obstetricians and Gynecologists (ACOG).²

Maternal mortality is now a rare event in Montana and is not accurately conveyed by annual Maternal Mortality Ratios because of the instability of ratios computed from small numbers of events. Montana has a population of approximately 1,000,000 and an average of 12,500 births per year. There was an average of one maternal death per year between 1980 and 2009 (Figure 2), and in 13 of those years there were no maternal deaths at all. In

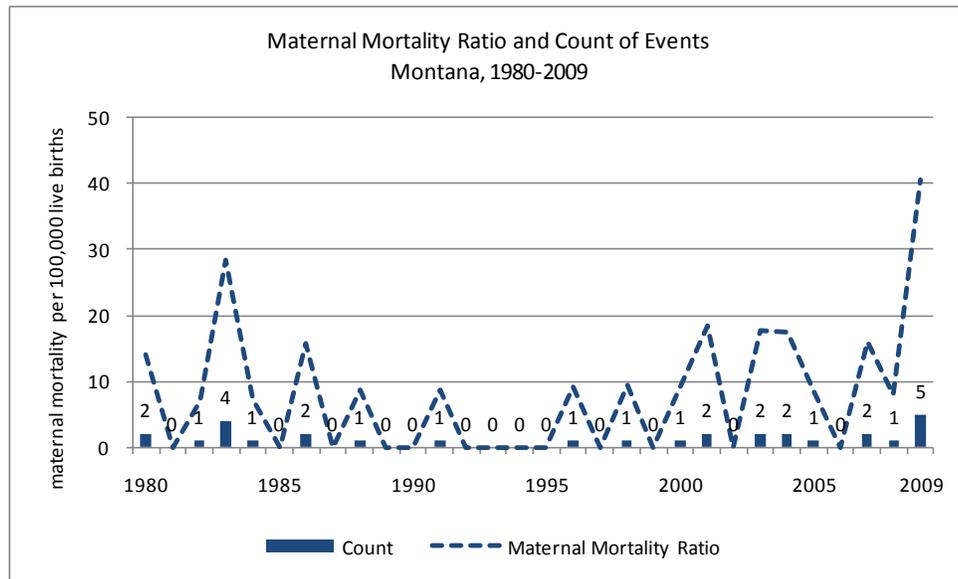
¹ Hoyert DL. *Maternal mortality and related concepts*. National Center for Health Statistics. Vital Health Statistics 3(33), 2007.

[‡] Maternal mortality is expressed as a *ratio* of the number of maternal deaths per 100,000 live births. It is considered a ratio rather than a rate because maternal deaths may be associated with other pregnancy outcomes besides live births so the denominator is only an approximation of the population of women at risk.

² <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5202a1.htm>

most years there are one or two maternal deaths, but in 1983 there were four and in 2009 there were five. As a result, the computed Maternal Mortality Ratio fluctuates substantially from year to year. The ten-year average for 2000-2009 was 13.7/100,000 consistent with the national experience.¹ The CDC's Healthy People 2020 goal is to reduce the Maternal Mortality Ratio to 11.4 deaths per 100,000 live births.³

Figure 2



METHODS

Case Definitions

There are a number of definitions of maternal mortality. The basic definition is from the *International Classification of Diseases Tenth Revision (ICD-10)*:⁴

"A maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by pregnancy or its management but not from accidental or incidental causes." This is the definition used to ascertain deaths to be included in the computation of the Maternal Mortality Ratio.

ICD-10 also defines late maternal death as a death causally related to pregnancy, as above, but occurring within 43 and 365 days after the termination of pregnancy.

Finally, ICD-10 defines pregnancy-related death as a death occurring during pregnancy or within 42 days postpartum which may or may not be causally related to pregnancy.

The National Center for Health Statistics (NCHS) uses the ICD-10 definitions above and adds two subcategories which may apply to either maternal or late maternal deaths:⁵

³ <https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives>

⁴ <http://www.cdc.gov/nchs/icd/icd10cm.htm>

⁵ National Center for Health Statistics. *Physicians' Handbook on Medical Certification of Death*. Hyattsville, MD: Public Health Service, 1996.

Direct obstetric death is a death resulting from obstetric complications of the pregnant state (pregnancy, labor and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above.

Indirect obstetric death is a death resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy.

The American College of Obstetricians and Gynecologists (ACOG) and the Centers for Disease Control and Prevention (CDC), who collaborate in the Maternal Mortality Study Group, created broader definitions:⁶

Pregnancy-related death: death while pregnant or within one year of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by pregnancy or its management, but not from accidental or incidental causes.

Pregnancy-associated death: death of a woman while pregnant or within one year of termination of pregnancy, irrespective of cause.

This report is based on the most inclusive category, pregnancy-associated deaths, in Montana between 2003 (when a new version of the Montana death certificate was implemented) through 2009 (the most recent year available for analysis).

Case Ascertainment

The Montana Office of Vital Statistics documents all deaths, including fetal deaths, and all live births in the state. Prior to 2003, the medical certifier's assessment of the causes of death was the only information available to identify pregnancy-associated deaths. This assessment includes evaluation of the immediate and underlying causes of death listed on the death certificate and review of the narrative section describing "significant conditions contributing to the death but not resulting in the underlying cause."

In 2003, Montana added a series of check boxes about pregnancy status to the Death Certificate:

If Female:

- Not pregnant within past year
- Not pregnant but pregnant within 42 days of death
- Not pregnant but pregnant 43 days to one year before death
- Pregnant at time of death
- Unknown if pregnant within past year

Although nosologists take the fact of pregnancy at the time of death or within one year of the time of death into consideration in determining the underlying cause of death, not all pregnancy-associated deaths will eventually be determined to be pregnancy-related.

In order to capture all potentially relevant pregnancy-associated deaths, Montana reviews the death certificates of all women who die, regardless of age, for underlying cause of death codes and completion of the pregnancy check boxes. In addition, linkage by mother's name is performed with all fetal death records and birth certificates for events occurring within one year of the woman's death.

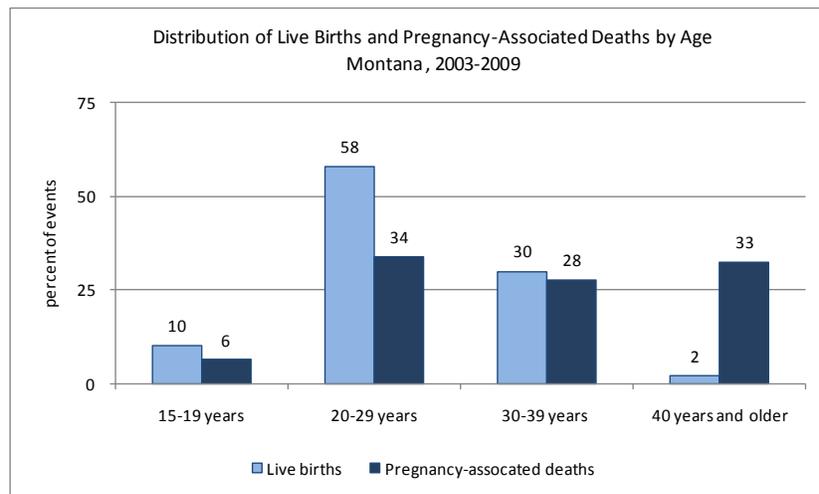
⁶ Berg C, Danel I, Atrash H, Zane S, Bartlett L (eds). *Strategies to reduce pregnancy-related deaths: From identification and review to action*. Atlanta, GA: Centers for Disease Control and Prevention. 2001.

RESULTS

We initially identified 86 pregnancy-associated deaths. Out-of-state residents were excluded (n=3), as were cases with apparent miscoding of sex or age that could not be resolved by detailed record review (n=3), leaving 80 records for this analysis.

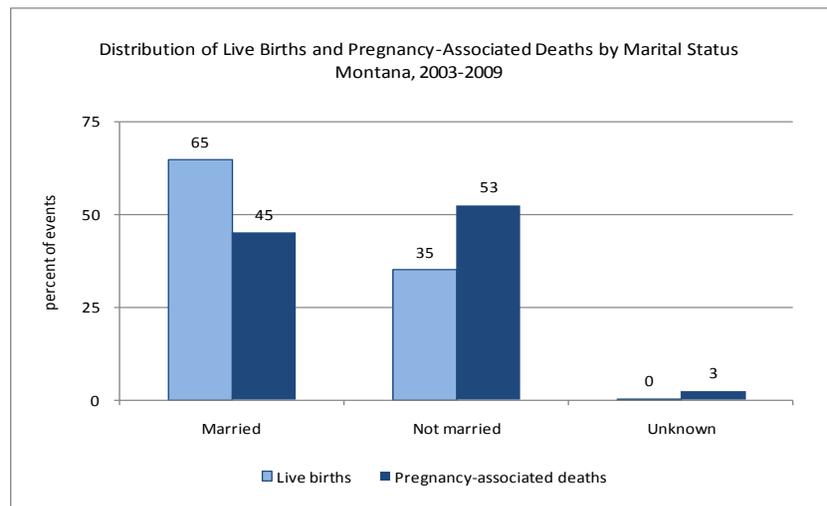
Pregnancy-associated deaths were distributed disproportionately by age (Figure 3). Women age 40 years and older accounted for only 2% of all live births but 33% of pregnancy-associated deaths. In contrast, women age 20 to 29 years accounted for 58% of live births but only 34% of pregnancy-associated deaths.

Figure 3



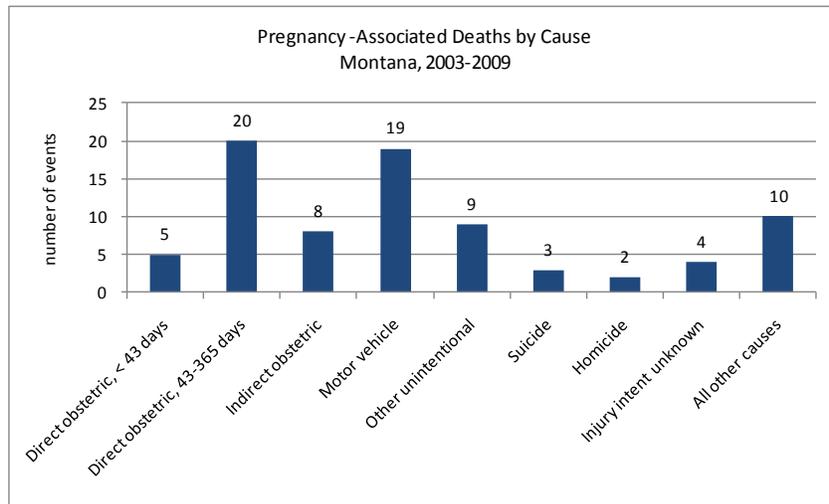
Pregnancy-associated deaths were distributed disproportionately by marital status (Figure 4). Women who were not married (single, divorced, separated, widowed) accounted for 35% of live births but 53% of pregnancy-associated deaths.

Figure 4



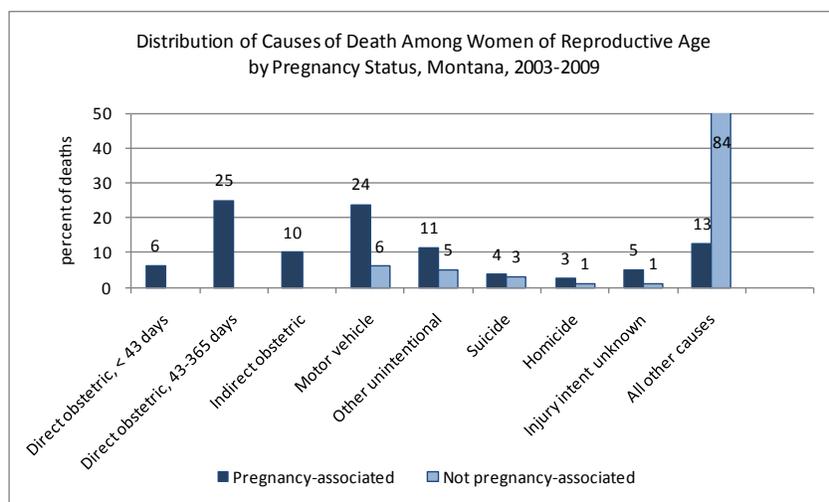
Forty-one percent of the pregnancy-associated deaths were obstetric in nature, either direct obstetric deaths occurring during or within 42 days of pregnancy (n=5), direct obstetric deaths occurring between 43 and 365 days after the end of pregnancy (n=20), or indirect obstetric deaths in which pregnancy contributed to the aggravation of other health problems (n=8) (Figure 5). Another third of the pregnancy-associated deaths were caused by unintentional injuries: 19 by motor vehicle crashes and 9 by other unintentional injuries. Three deaths were attributed to suicide, two to homicide, and four were caused by injuries of unknown intent. The remaining 10 pregnancy-associated deaths were attributed to diseases that were determined not to be related, directly or indirectly, to pregnancy or its sequelae.

Figure 5



The large number of pregnancy-associated deaths caused by unintentional injuries, particularly to motor vehicle crashes, is startling. While these deaths may not be caused by pregnancy in any strict sense, this cause appears to be affecting new mothers disproportionately. Deaths from motor vehicle crashes were four times more common among pregnancy-associated deaths than among deaths to women in the same age range who were not and had not recently been pregnant (Figure 6), and other unintentional injuries were twice as common. There were also slightly more suicides, homicides, and injuries of unknown intent among the pregnancy-associated deaths although the number of events for both pregnancy-associated and non-pregnancy-associated deaths for these categories were too small for rigorous comparison.

Figure 6



DISCUSSION

The univariate associations between maternal mortality and demographic factors such as age and marital status are probably not independent of each other. In addition, the associations between these factors and the particular causes of death probably vary substantially. However, with only 80 pregnancy-associated deaths, it is not possible to conduct a complex multivariate analysis that might further elucidate the constellations of factors associated with specific causes of death. In addition, this approach would not be very informative because each maternal death was probably the result of unique factors and should be assessed with reference to the medical record and other ancillary data. This is the role of a Maternal Mortality Review Committee, which would consider each case in detail.

Most hospitals and many states have formal maternal mortality review processes. Hospital-based review committees generally evaluate the medical aspects of each case and might have disciplinary or legal functions. Statewide expert review committees operate outside of the specific treatment environment of individual hospitals and examine the broad context of maternal deaths. Statewide committees generally do not address disciplinary or legal ramifications of specific cases. Rather, they attempt to identify ways to reduce maternal mortality across an entire range of issues, starting with access to and utilization of care.

Montana does not have a statewide expert review committee for maternal deaths at this time, although the legal infrastructure appears to be in place to permit such a peer committee made up of members of health care professional societies and the health department to operate (Montana Code Section 37-2-201, Section 50-16-102, and Section 50-16-201 through Section 50-16-205).⁷

States that have added pregnancy check boxes to their death certificates have seen up to a 70% increase in ascertainment of pregnancy-associated deaths.¹ However, these deaths are still underestimated by passive surveillance systems such as Vital Statistics. Ascertainment is increased by an additional 35% or more by active surveillance such as physician reporting.¹

RECOMMENDATIONS

The following internal and external initiatives would increase the ascertainment of pregnancy-associated deaths in Montana and would support the development of a rigorous review process that could ultimately contribute to the reduction such deaths in the future.

Internal Initiatives

- Create a comprehensive data base of pregnancy-associated deaths to be updated quarterly.
- Enhance current matching algorithms to improve case ascertainment.
- Include linkage with Medicaid databases to supplement data available from death certificates.
- Advocate for the inclusion of personal identifiers in the Montana Hospital Discharge Data System to support linkage with death certificates to supplement data available from death certificates.
- Explore avenues to access data on pregnancy-associated morbidity, particularly through Medicaid, the Montana Hospital Discharge Data System, and Direct Entry Midwives.
- Develop a secure electronic system to receive reports of pregnancy-associated morbidity and mortality from health care providers.

⁷https://leg.mt.gov/bills/mca/title_0500/chapter_0190/part_0040/sections_index.html

External Initiatives

- Encourage active reporting by health care providers to supplement current passive ascertainment of pregnancy-associated deaths.
- Request that existing hospital-based Maternal Mortality Review Committees report to the state maternal mortality data base.
- Establish a Pregnancy-Associated Mortality Review Committee in collaboration with partners such as the Montana Medical Association, the Montana Section of ACOG, and others to be identified to conduct quarterly case reviews.
- Encourage providers to report serious pregnancy-associated morbid conditions as well as deaths.

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