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Pregnancy-Associated Mortality: Assessing the Effectiveness of the Pregnancy Check Box and Vital Records Linkage using Montana Death Certificates, 2004-2013

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Maternal mortality remains a rare but persistent public health challenge in the United States and Montana. Efforts to address this issue began in 1986 when the Centers for Disease Control and Prevention (CDC) started a national surveillance system to collect more information on maternal deaths but studies following the program's inception indicated that the death certificate may only capture pregnancy or recent pregnancy in fewer than half of these cases.^{1,2} To improve under-reporting of maternal deaths, the US Standard Certificate of Death added a series of pregnancy check boxes during its latest revision.³ In 2003, Montana adopted these additions for female decedents. This report examines the process of ascertaining maternal deaths and the effectiveness of the pregnancy check boxes and vital records linkage to identify these deaths in Montana residents between 2004 and 2013. The most widely used definition of a *maternal death* is from the World Health Organization's International Classification of Diseases, Tenth Revision (ICD-10): the death of any woman while pregnant or within 42 days (less than 43 days) of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.⁴ A special working group with representatives from the CDC and the American Congress of Obstetricians and Gynecologists (ACOG) expanded this definition to include all pregnancies and capture additional maternal deaths. They define a *pregnancy-associated death* as the death of a woman, from any cause, while pregnant or within one year of termination of pregnancy, regardless of the duration and site of pregnancy.⁵ The Montana Department of Public Health and Human Services have adopted this definition of a maternal death for its Fetal, Infant, Child, and Maternal Mortality Review program and it is this definition that is used when identifying maternal deaths in the state, unless otherwise indicated.

Methods

The ascertainment process was divided into several discreet steps, beginning with identifying all female decedents between 2004-2013. The list of decedents was then matched separately with all birth and fetal death certificates, beginning with events occurring one year prior to the study period. Maternal deaths were matched using fields common to these three certificates. The matching routine used the decedents first name, maiden name, date of birth, social security number, and several variations of the last name based fields from both certificates. The date of death field is also used to exclude decedents whose delivery date exceeds one year. Maternal deaths were also ascertained using

¹ Horon, I. and Cheng, D. Enhanced Surveillance for Pregnancy-Associated Mortality—Maryland, 1993-1998. *JAMA* 2001; 285(11): 1455-1459.

² Centers for Disease Control and Prevention. Pregnancy-Related Mortality—Georgia, 1990-1992. *Morbidity and Mortality Weekly Report* 1995; 44(5): 93-96.

³ Centers for Disease Control and Prevention. Pregnancy Mortality Surveillance System; Accessed February 25, 2015 <http://www.cdc.gov/reproductivehealth/MaternalInfantHealth/PMSS.html>

⁴ World Health Organization. International Classification of Diseases and Related Health Problems, 10th Revision. 2nd ed. Geneva: WHO; 2010.

⁵ Atrash, H., Rowley, D., and Hogue C. Maternal and Perinatal Mortality. *Current Opinion in Obstetrics and Gynecology* 1992; 4: 61-71.

the pregnancy check box, ICD-10 codes for Underlying Cause of Death (A34, O00-O99),⁶ and literal search for the partial word fragment “preg” on the death certificate. Both lists of maternal deaths—linked using the birth or fetal death certificates or ascertained solely using the death certificate—were combined and manually reviewed. This resulted in identifying 131 pregnancy-associated deaths in Montana residents between 2004 and 2013.

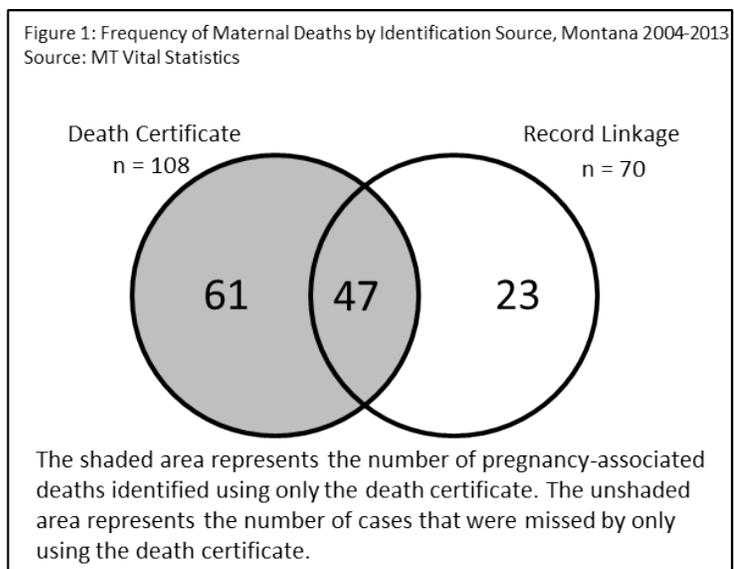
Results

When examining indicators of maternal death exclusively from the death certificate, 108 pregnancy-associated deaths were identified. The pregnancy check box alone captured 62 pregnancy-associated deaths while the death certificates in the remaining 46 cases contained both the Underlying Cause of Death code and pregnancy checkbox was marked (data not shown). There were no cases in which the cause of death field alone (ICD-10 codes) identified any maternal death.

Linking the death certificate to either a birth or fetal death certificate captured an additional 23 pregnancy-associated deaths. In these deaths, the pregnancy check box was marked as either unknown, not pregnant, not applicable, or the cause of death was non-maternal or the literal search did not indicate pregnancy. Sixty-one pregnancy-associated deaths were ascertained using the death certificate alone and the remaining 47 cases were identified by both the death certificate and linking routine (Figure 1).

Discussion

When ascertaining pregnancy-associated deaths, the pregnancy check box identified 82% of the cases using only the death certificate. The check box alone identified an additional 47% of pregnancy-associated deaths that would not have been ascertained by using only the Underlying Cause of Death code from the death certificate. Prior to the addition of the pregnancy check box, maternal deaths could only be identified using ICD-10 codes or mention of pregnancy on the death certificate. The pregnancy check box increased identification of maternal deaths by 55% which is consistent with other reports following its introduction.⁷ While ICD-10 does not include a classification for a pregnancy-associated death, it does define a late maternal death as a death causally related to pregnancy but occurring between 43 and 365 days after the termination of pregnancy. Therefore, ascertaining all pregnancy-associated deaths, in the absence of a check box or linking routine, is not possible from the death certificate alone.



⁶ World Health Organization. International Statistical Classification of Diseases and Related Health Problems, 10th Revision. 4th Edition. Geneva: WHO; 2010.

⁷ Atrash H, Alexander S, and Berg C. Maternal Mortality in Developed Countries: Not Just a Concern of the Past. *Obstetrics and Gynecology*. 1995; 86: 700-705.

Overall, 53% of the pregnancy-associated deaths were matched with a corresponding birth or fetal death certificate, which identified an additional 18% of pregnancy-associated deaths not found by the check boxes. Similar publications have stated that linkage can increase maternal death identification by up to 150%, but no additional cases of maternal deaths were ascertained by linkage in this study and in a report by Horon and Cheng, only two additional maternal deaths were ascertained through linkage.^{8,9}

There are limitations to the various methods of ascertaining maternal mortality.^{10,11} It is not possible to enumerate all pregnancies. Only pregnancies that result in a documented outcome such as a live birth or fetal death, or those pregnancies that are identified through autopsy findings, can be ascertained using the mother's death certificate or linked to another record. States do not have access to records of all vital events that may occur to residents while out of state, so records and linkage of female decedents to corresponding birth or fetal death records is limited to situations where all relevant events occur in the state. Errors completing the death certificate also affect identifying maternal deaths. The Vital Statistics Analysis Unit supplies lists of pregnancy-associated deaths to local Fetal, Infant, Child, and Maternal Mortality Review (FICMMR) team teams. In one instance, a local team determined that a female decedent had not in fact been pregnant. The case had been ascertained solely on the basis of the pregnancy check box, not linked to a birth or fetal death certificate, so we believe the pregnancy check box was mistakenly checked. While this error can be identified, its reverse cannot.

Pregnancy check boxes and vital records linkage greatly improve the ascertainment of pregnancy-associated deaths in Montana. While the identification of maternal deaths has its limitations, the thoroughness of the local FICMMR review process ensures the development of quality public health recommendations for each of these preventable deaths.

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⁸ Horon I. and Cheng D. Effectiveness of Pregnancy Check Boxes on Death Certificates in Identifying Pregnancy-Associated Mortality. *Public Health Reports*. 2011; 126: 195-200.

⁹ Horon I. Underreporting Maternal Deaths on Death Certificates and the Magnitude of the Problem of Maternal Mortality. *American Journal of Public Health*. 2005; 95(3): 478-482.

¹⁰ MacKay A. et al. An Assessment of Pregnancy-Related Mortality in the United States. *Paediatric and Perinatal Epidemiology*. 2005; 19: 2006-214

¹¹ Jocums S and Mitchel E. Monitoring Maternal Mortality Using Vital Records Linkage. *American Journal of Preventive Medicine*. 1995; 11(2): 75-78.