Drug and Pregnancy Related Deaths: levels, trends, and geographic differentials During the Recent Drug Epidemic

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Maternal mortality is a well-utilized indicator of health worldwide. It reflects the effectiveness of a country or state's healthcare delivery system and the ability of women to access maternal and other health care services as well as broader resources including nutrition (King, 2012). Globally, maternal mortality has reduced 44% since 1990 when the United Nations placed more focus on it through the Millennium Development Goals. Although this reduction has been seen across the globe, maternal mortality in the United States appears to be increasing (Marian F. MacDorman et al., 2017) . Simultaneously, public health authorities have reported an opioid and heroin crisis in America. Use of opioids has doubled since 2000 and the opioid-related overdose death rate has nearly quadrupled, producing what the Center of Disease Control and Prevention calls the "worst drug overdose epidemic in US history" (Kolodny et al., 2015; Paulozzi, 2010). Though drug-related mortality is lower in women than in men, women, especially those in the reproductive age group, have experienced a similar trend, with a tripling of the age-standardized mortality rate between 2000 and 2016 (Barbieri, 2018) The purpose of this paper is to investigate the relationship between the two phenomena.

In 1998, 2.8% of pregnant women and 6.4% of non-pregnant women of reproductive age reported using illicit drugs. Marijuana accounted for three-fourths of illicit drug use, and cocaine accounted for one-tenth of illicit drug use. Of those who used illicit drugs, over half of the pregnant and two-thirds of the non-pregnant women also used cigarettes and alcohol (Ebrahim and Gfroerer, 2003). Substance use may even continue during pregnancy, though it typically

attenuates as the pregnancy progresses and restarts once the pregnancy ends (Salas-Wright, Vaughn, Uglade and Todic, 2015). Unintended pregnancy made up 86% of pregnancies among opioid-abusing women, suggesting a complicated relationship between pregnancy and drug use (Heil et al 2011).

Figure 1 shows the female age-standardized mortality rates from maternal mortality on one line and mortality rates from drug overdoses (using Case-Deaton's definition) on the other. This figure shows the coincidence in the trends for both series of rates. Note that we used the 1996 bridge-coding study (which coded all US deaths in 1996 to both the 9th and 10th ICDs) to redistribute ICD-9 deaths into ICD-10 categories for increased consistency). The time frame was selected because 1979 is when ICD-9 was first applied.

The drug and opioid epidemics in the US are affecting pregnant women, and the trends in mortality for both pregnancy and substance abuse are following the same pattern (figure 1). Few, if any studies have systematically examined the relationship between maternal mortality and substance use in the United States. We aim to look at multiple causes of death involving both a maternal mortality cause and drug use (both prescription and illegal), considering maternal age, geographic variation by state, and change over time. Employing death certificates available from the Center for Disease Control and Prevention (CDC) between 1979 and 2016, paying particular attention to the start of the drug epidemic, we will map where these deaths are occurring, at what rate, and how this has changed over time. The continued burden of maternal mortality in the US and the increasing (mis-)use of drugs among women of reproductive age warrant a better understanding of the relationship between pregnancy-related and drug-related deaths in the US. Understanding this relationship by state will further direct policy, pregnancy care, and substance abuse treatment to unify their efforts to reduce deaths from pregnancy and drug use.

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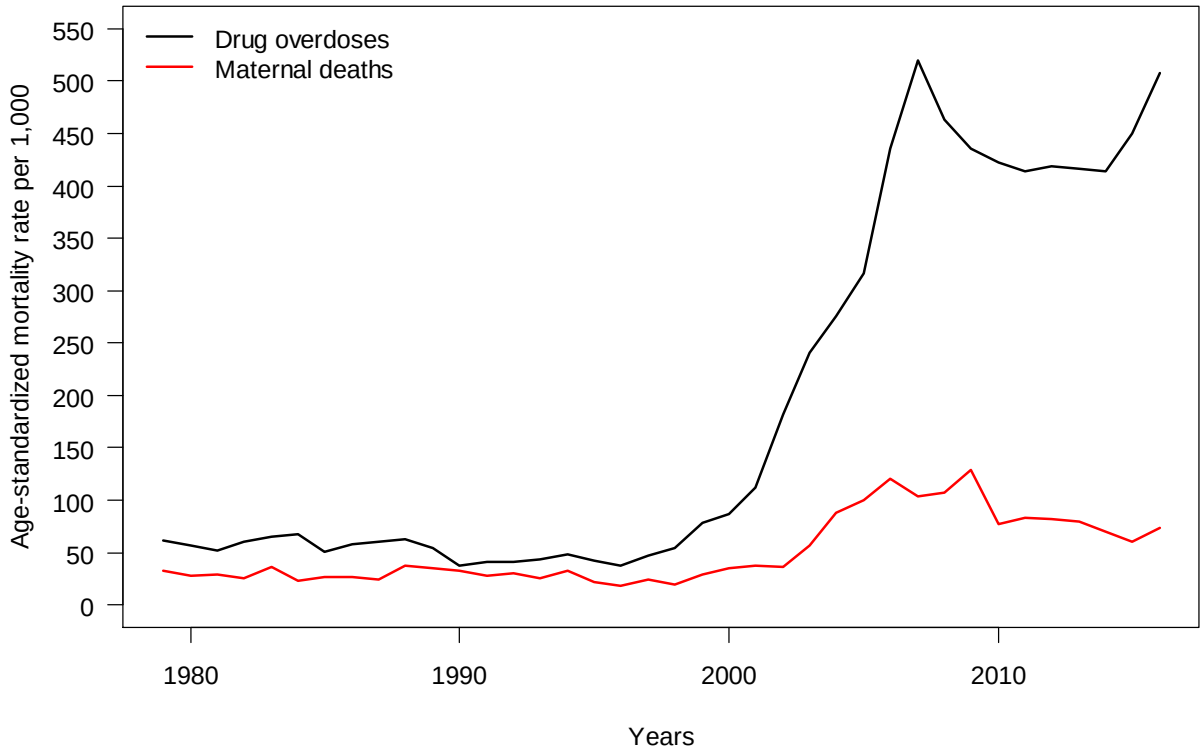
Figure 1. Female age-standardized death rates per 1,000 women from maternal mortality and drug overdoses, United States, 1979-2016



Source: Mortality Multiple Cause Files, National Center for Health Statistics, 1979-2016 (available at https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm and accessed September 13, 2018)

Note: Deaths classified under the 9th Revision of the International Classification of Diseases (i.e., ICD-9, implemented in years 1979-1998) have been allocated to ICD-10 codes using the 1996 US bridge-coding study. The ICD-10 codes identifying maternal deaths are all those in Chapter XV (O00-O99). The ICD-10 codes identifying drug overdoses are included in Chapter XX (X40-X44, X85, Y10-Y14, Y45, Y47, Y49).