REVIEW ARTICLE

PREGNANCY RELATED MATERNAL MORTALITY - CONTEMPORARY PERSPECTIVES

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Summary

Pregnancy related maternal mortality defines the state of maternal health. The increasing incidence of maternal death in the U.S indicates that this complex issue is not unique only to developing countries. It is obvious that improvements are needed to reinsure appropriate healthcare for all pregnant women. Without precise methodical data collection and data evaluation advancement of this important determinant of maternal health can't be achieved.

The aim of this paper is to provide contemporary perspective on pregnancy related maternal mortality. In addition, this paper will discuss common ethnical disparities that underline maternal deaths. Furthermore, this paper will address the confusing inconsistencies of maternal death terminology and variations in disease classification. Finally, this paper will propose improvements in defining terminology and data collection that influence the understanding of pregnancy related morbidity.

Quick Points
1. Maternal mortality is a determining characteristic of existing maternal health in a given geographical region.
2. While it is impossible to completely eliminate all maternal deaths, preventable pregnancy complications resulting in injury or death need to be reduced across the world.
3. Healthcare leaders need to work on identification of maternal mortality trends and development of strategies to sustainably improve rates of maternal mortality.

Key words: maternal mortality; pregnancy related death; maternal mortality review committee

INTRODUCTION

Maternal mortality is a major global health problem that affects victim's families, community and society (12). Addressing this complex issue is in the best interest of every nation including the U.S. Unification and simplification of globally recognized definition and improvements in data collection are the necessary first steps to effectively improve rates of maternal mortality. Understanding maternal mortality and its underlying ethnic diversity is important to accomplish sustainable and efficient prevention of maternal mortality.

The lack of systematic data collection prevents understanding of maternal mortality trends that should be utilized to develop strategies to improve rates of maternal deaths.

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Surveillance Data

Maternal mortality is often used as a determining characteristic of existing maternal healthcare in a given geographical region. While the life expectancy is improving globally, mother's chance to survive pregnancy and delivery of her infant is not always equivalent to the available medical care. The U. S. Government (21) identified that 385,000 women die globally every year as a result of pregnancy or childbirth. Approximately every two minutes a woman dies as a result of pregnancy or delivery complications (13). According to the Centers for Disease Control and Prevention (CDC) approximately 650 women die annually within the Unites States as a result of these complications (4). The rate of pregnancy related death in the U.S. increased from 7.2 deaths per 100,000 live births in 1987 to 17.8 deaths per 100,000 live births in 2011. To illustrate this serious situation, 702 women died in the U.S. during 2011 due to pregnancy related complications while 1,751 women died within a year of pregnancy termination (5). When the U.S. maternal mortality is compared to other countries the results are not positive. While the CDC (4) concludes that an exact cause of the overall increase in the pregnancy-related mortality is unknown, they suspect that recent change in the death certificate form codes and addition of the pregnancy check box may have resulted in improved detection of the pregnancy-related deaths. Finally, the CDC (4) concedes that growing number of pregnant women in the United States suffer from chronic health conditions that significantly increase their risk for pregnancy related complication including death.

Based on maternal mortality data from 2010, the U.S. ranks 50th out of 240 countries. Within the U.S. the state of Georgia continues to have the highest maternal mortality rates. In this specific region the pregnancy related maternal mortality rate in 2011 was 28.7 of maternal deaths per 100,000 live births where as the national average is 17.8 deaths per 100,000 live births in 2011 (10). However, these statistics may not be completely accurate as there are inconsistencies in maternal death terminology as well as variations in disease classification.

Measuring and Defining Maternal Mortality

Maternal mortality can be measured and evaluated by several methods. These include the most commonly used maternal mortality rates and maternal mortality ratios. Holtz (12) indicates that maternal mortality rate is the number of maternal deaths per 100,000 women of reproductive age during one year. Maternal mortality ratio represents a woman's lifetime risk of dying from complications associated with pregnancy and delivery within her own nation. These statistical data can be used to indicate the state of national health in a given area (12).

Understanding definitions used to describe maternal mortality is important to correctly comprehend the concept of this problem, collect data in a unified way, and to effectively learn from these unfortunate situations in order to improve maternal mortality. The World Health Organization (WHO) (23) provides the following definitions: 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, resulting from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. To facilitate the identification of maternal deaths in circumstances in which cause of death attribution is inadequate, a new category has been introduced. Pregnancy-related death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death. Live birth refers to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles.

In many cases women may die as a result of a pregnancy aggravated complications much later than within the defined 42 days. To address these situations the CDC uses the definition of pregnancy-associated death. It identifies women that died from any cause while pregnant or within 12 months after the end of her pregnancy, regardless the duration or site of the pregnancy (8). This definition doesn't require linking the pregnancy to a cause of death, even though it provides adequate timeframe and therefor it may be helpful to capture data especially in developing countries where medical records are not always available or adequate. Finally, Edwards and Hanke (8) identified pregnancy related death as "pregnancy-associated death resulting from the complication of pregnancy itself; the chain of events initiated by the pregnancy that led to death or the aggravation of an unrelated condition by the physiologic or pharmacologic effects of the pregnancy that subsequently cause the death". It is safe to say that these definitions can be confusing and may lead to misinterpretation.

Tools for Epidemiology and Analysis of Maternal Mortality in Population

In an attempt to improve monitoring of incidence and prevalence of health problems including national mortality and morbidity statistics the WHO (22) in 1990 issued the International Classification of Diseases (ICD). This classification serves as a standard diagnostic tool for epidemiology and analysis of the general health situation of population groups including maternal mortality.

Ultimately, the ICD is used as a resource tool when deciding and allocating funds to different countries (22). Unfortunately, the ICD codes are not always adequate determinants of true numbers of maternal mortality. For example, Burlingame, et al. (3) identified that some homicides and suicides are caused and exacerbated by pregnancy. More specifically, they found that rates of partner violence are much higher during the pregnancy and during the postpartum period. In addition, some maternal suicides can be results of postpartum depression. Not including these causes of maternal mortality in the overall statistics may result in significant under-reporting of maternal deaths (3).

To improve identification of pregnancy related deaths within the U.S. the CDC (4) created the Pregnancy Mortality Surveillance System (PMSS). Through this system the CDC collects data from all individual states. For this reporting system, maternal mortality is identified as the death of a woman while pregnant or within one year of pregnancy termination, regardless of the duration or site of the pregnancy. In addition reporting states have to link the case of maternal death to pregnancy or pregnancy management by matching birth or fetal death certificates, while accidental or incidental causes are excluded (4). However, some states use different methodologies and definitions to collect data and these different practices result in inaccuracies when the data are analyzed (3). Finally, not all states have death and birth certificates in linked electronic databases, making the detection of the required information even more challenging and inconsistent.

Many of the U.S. states, in attempt to improve their maternal mortality rates, decided to create Maternal Mortality Review Boards. One of the states, Georgia, generally has the highest maternal mortality rates in the country. As a result of these unfortunate indicators the GDPH (10) in coordination with the CDC and Georgia Obstetric and Gynecological Society founded the Maternal Mortality Review Committee (MMRC). The purpose of this committee is to identify pregnancy-associated deaths and review the individual cases. Once contributing factors are identified, interventions that can efficiently reduce pregnancy-associated deaths are proposed and applied (10).

Maternal Mortality Statistics

Based on the presented information it is important to recognize that the reported maternal mortality statistics are undoubtedly miscalculated regardless if they originated in developing or developed countries. Main (14) acknowledged that U.S. maternal mortality data still show significant underreporting. Burlingame et al. [3] further identified that maternal mortality is underestimated and often misclassified due to inconsistent practices in reporting and changes of disease classification.

It is estimated that 515,000 women die annually as a result of pregnancy or childbirth complication (12). Furthermore, 15.5 million women suffer from maternal injuries, infections, and disabilities. While in some parts of the world women have 1 in 13 chance of death during pregnancy or postpartum, in the Untied States this risk is 200 times smaller (12). To provide a different perspective, the Central Intelligence Agency (CIA) (6) reports that in 2010 the maternal mortality rate was the highest in South Sudan where it reached 2054 deaths per 100,000 life births. During the same time the maternal mortality in the Unites States was 21 deaths per 100,000 life births. In comparison, the Republic of Estonia reached the best maternal mortality rate of 2 deaths per 100,000 life births (6).

The most compelling evidence of increasing mortality rates in the Unites States are statistics provided by CDC. While individual states' rates are not available as they are protected under the Assurance of Confidentiality, the overall increase of maternal mortality rates is undeniable. Between 1987 and 2011 the maternal mortality rate increased from 7.2 deaths per 100,000 life births to 17.8 deaths (5). While some attribute this significant increase to improved reporting systems, it is disturbing that the most current maternal mortality rate is 10.5 times higher than the rate of former Soviet Union Republic of Estonia.

Equally important are the maternal mortality rates from the state of Georgia, which was identified as the state with the highest mortality rates by the 2010 Amnesty International Report (10). Prior to this report the Georgia maternal mortality rate during 2001-2006 was 20.6 deaths per 100,000 live births. Unfortunately through 2009 this rate continued to grow to 24.8 and by 2011 the rate increased even more to 28.7 of maternal deaths per 100,000 live births (10).

Factors Influencing Maternal Mortality

Ethnic and cultural diversity plays an important role when comparing populations and the racial diversity in Georgia is a great example to represent these important differences. The GDPH (10) recognized that between 2001 and 2011 the rate of maternal mortality was four times higher in black women than in white females. More specifically the rate was 39.1 and 9.6 deaths per 100,000 live births respectively (10). To accommodate for racial diversity white and black population are usually compared, but there are other ethnic groups that need to be taken into consideration. According to Edwards and Hanke (8) the incidence of maternal death is significantly higher in women of all races when compared to white women. Furthermore, Burlingame et al. (3) noted that Hawaiian Pacific Islanders suffer from unusually high maternal mortality due to cardiomyopathies that are common in this specific population. To demonstrate this point even further the recent analyses of the U.S. pregnancy related mortality has showed that all foreign born races, except foreign born white women, are at higher risk of pregnancy or child birth related complications than American born white women (7).

Besides ethnic diversity, there are numbers of other contributing factors that influence maternal mortality. While these conditions and characteristics are not the direct causes of maternal death they may significantly contribute to the cause of pregnancy and childbirth related complications. These aspects may include obesity, underlying major illness, lack of prenatal care and previous cesarean section (14). Particularly the rising rates of cesarean sections contribute to medical complications in future pregnancies. Solheim et al. (20) associated cesarean deliveries with significantly increased rates of placenta previa and placenta accretta in subsequent pregnancies, which consecutively may results in serious medical complications as hysterectomy, massive hemorrhage and maternal death. According to Morton (16), cesarean delivery may be considered in maternal morbidity as the woman's body was exposed to major physical trauma during delivery. To illustrate other aspect of factors contributing to maternal mortality Creanga et al. (7) indicated that within the U.S. many expectant mothers suffer from chronic medical conditions and such lifelong illnesses put them at higher risk of adverse outcomes during pregnancy, delivery and postpartum. Chronic illnesses undoubtedly represent substantial risks for expectant mothers especially if these diseases are unidentified and untreated.

Causes of Maternal Mortality

Causes of maternal mortality are diverse when comparing the world, U.S. and Georgia. According to Holtz (12) the global causes of maternal mortality include hemorrhage, sepsis, hypertensive disorders, abortion complications and obstructive labor. These complications are common in developing countries, especially rural areas, and are related to limited access to appropriate medical care, medications, blood products and well equipped medical facilities.

Within the U.S. the leading causes of maternal mortality include thromboembolism, hemorrhage, pre-eclampsia and eclampsia, infection and cardiomyopathy (8). The frequency of thromboembolism in pregnant or postpartum patients caused this serious medical condition to become the leading cause of maternal mortality in the U.S. In a population based study of 8 million births, Abbasi, et al. (1) identified that even though venous thromboembolism (VTE) is still considered a rare condition, the seriousness of its consequences and increasing incidence significantly influence maternal mortality in the U.S. Black race, cardiovascular disease, hypertension, caesarean section and transfusion are common predictors of VTE mortality. However, the most significant VTE risks include maternal obesity and use of blood products (1).

In the state of Georgia the most common causes of pregnancy related deaths include hemorrhage, hypertensive disorders, cardiac disorders, embolism, and seizures (10). In addition, the Georgia MMRC linked motor vehicle crashes, homicides and suicides as the most prevalent causes of pregnancy-associated deaths within the state. Finally, the MMRC identified obesity, chronic medical conditions and poor provision of medical care as significant compounding factors influencing maternal mortality (10). Determining patient's body weigh is an important part

of medical care, especially during pregnancy, as obesity is significant risk factor for multiple medical conditions. Upon evaluation of pregnancy related deaths in Georgia, Gober (11) found that nearly 50% of prenatal records were missing pre-maternal weight and BMI calculations while nearly 58% of the death records revealed that the mothers were either overweigh or obese at the time of death. This discrepancy in records of maternal weight confirms the indicated compounding factor of poor provision of medical care.

Ultimately, there are other factors influencing rates of maternal mortality that are not recognized or identified as pregnancy related and are omitted from statistical data. Some of these excluded causes of deaths involve car accidents, homicides, or suicides (17). Furthermore, early pregnancy deaths, resulting specifically from ectopic pregnancy may not be correctly identified and reported as maternal death. Maternal death resulting from abortion may also not be reported as pregnancy related as in these specific cases the deaths certificates often omit to note the history of pregnancy (17). Finally, within the ICD10 classification an induced abortion can't be identified as proximal cause of death (19). All these factors contribute to underestimation of true numbers of pregnancy related maternal mortality.

Implications for Leadership and Advanced Practice
Maternal Mortality and the Role of Advanced Practice Nursing

Pregnancy related maternal mortality is a major global health problem that affects victims' families, community and society (12). Complications from pregnancy and childbirth are the most common causes of death in women of reproductive age. Most of these complications are preventable when early indications are recognized and skilled health personnel are available (12). The impact of maternal death on the individual family, community and society is dramatic.

The most compelling pieces of evidence are children whose mothers died due to pregnancy related complications in developing countries. These children are more likely to face nutrition deficits and are less likely to receive healthcare than children with living mothers within the same geographic region (15). Older children in this situation often drop out of school to care for younger siblings or migrate to find better financial opportunities that may be beyond their age and physical capacity. Maternal death often results in family fragmentation, as the children may be separated and placed with various relatives, which contributes to tenuous relationships within the remaining household (15).

The important question is not necessarily how maternal mortality impacts the advanced practice-nursing role. It is however crucial to know how the healthcare leaders can improve maternal health while considering the social impact of maternal health on vulnerable children and their families. Improvement can be achieved by enhancements in delivery of emergency obstetric and neonatal care, availability of skilled birth attendance, and increased use of contraceptive methods (15).

Best Course of Action to Improve Maternal Mortality

Rates of maternal mortality are receiving increasing governmental attention, as according to Holtz (12) these statistics indicate effectiveness of healthcare systems within the given country. Healthcare leaders have the ability to develop strategies that would improve maternal health but their success depends heavily on international and governmental support as well as on a comprehensive understanding of multiple aspects influencing maternal mortality in individual geographic regions. Unification and simplification of globally recognized definitions and improvements in data collection are the necessary first steps to effectively improve rates of maternal mortality.

Simple yet specific definition of maternal mortality is important as many different terms are currently used. Ideally, the globally recognized maternal mortality definition would link pregnancy to mother's death and would take into consideration that the death may not necessary occur within 42 days after the end of the pregnancy. Additionally, the defining element of live birth should be omitted, as mothers are even more vulnerable to pregnancy and delivery related complications when the embryo, fetus or infant did not survive. Equally important is to include maternal suicide in global statistics as according Burlingame et al. (3) these deaths are frequently exacerbated by pregnancy.

Measuring and evaluating maternal mortality is a complex issue and improvements in data collection are critically needed. Precise data need to be especially collected in areas with high or increasing maternal mortality, but the reality is different. In systematic analysis of 23 studies, Say et al. (18) identified two major concerns affecting the development of needed policies and practices. In countries with the highest maternal mortality rates, the data are not available and estimates are based on data modeling. Even when data are available they are often incomplete and have low quality especially when attributing the correct cause of death (18). Accurate and routine data about causes of maternal deaths are crucial to appropriately implement interventions and to identify gaps that needed additional attention (17).

Improving terminology defining maternal mortality as well as quality of data collection may result in sudden increase of maternal mortality rates, but accurate data will improve the understanding of co-founding attributes and will allow healthcare leaders to more effectively develop region specific plans to improve maternal health. Regardless the geographical location these strategies should always include: recognition of danger signs during pregnancy; ability to seek medical care and reach a healthcare facility; and finally to receive appropriate care when at the medical facility (12).

Relevance to Leadership and Advanced Practice Nursing

Relevance of maternal mortality to leadership and advanced practice nursing is very apparent, because improving rates of maternal mortality and eliminating health disparities are global public health priorities. Poor and inadequate reproductive health contributes to nearly one third of the global burden of disease for women of reproductive age, accounting for one fifth of the total world population (12). While it is impossible to completely eliminate all maternal deaths, preventable pregnancy complications resulting in injury or death need to be considerably reduced across the world.

Better understanding of some causes of maternal deaths is still needed. These reasons mainly include hemorrhage, hypertensive disorders and indirect causes of maternal mortality as HIV, cardiac and endocrine diseases, diabetes, chronic respiratory diseases and STDs (18). When evidence related to maternal mortality is identified and analyzed, healthcare leaders can create local, national and international collaborative networks and partnerships to publish new knowledge. Besides direct patient care, nurses have the additional potential to improve maternal mortality. They can advocate locally for improvements in prevention of maternal mortality and gain governmental attention (8). In addition nurses can educate women on risks associated with maternal mortality and morbidity. Finally nurses with in the U.S. have the opportunity to lobby within their states for creation of Maternal Mortality Review Boards (8). Globally, healthcare leaders need to insure improvement and development of social welfare programs. These programs are crucial in strengthening protection and addressing needs of vulnerable children who experience the negative impact of maternal death first hand (15).

Conclusion

In conclusion, maternal death will remain a human tragedy, especially as these deaths are often preventable. Addressing these complex issues is however in the best interest of every nation including the U.S. It is important that healthcare leaders continue to work with local governments and international health agencies on identification of maternal mortality trends, while they utilize the findings in developing strategies to improve rates of maternal mortality.

Disclosure statement

The authors proclaim that they have no competing interests.

References

1. Abbasi N, Balayla J, Laporta D P, Kezouh A, Abenhaim H H. Trends, risk factors and mortality among women with venous thromboembolism during labor and delivery: A population-based study of 8 million births. Archives of Gynecology and Obstetrics. 2012;289(2):275-284.

2. Bhutta Z A, Cabral S, Chan C, Keenan W J. Reducing maternal, newborn, and infant mortality globally: An integrated action agenda. International Journal of Gynecology and Obstetrics. 2012;119:S13-S17.

3. Burlingame J, Horiuchi B, Ohana P, Onaka A, Sauvage L M. The contribution of heart disease to pregnancy-related mortalityaccording to the pregnancy mortality surveillance system. Journal of Perinatology. 2012;32:163-169.

4. Centers for Disease Control and Prevention. (2015a). Pregnancy mortality surveillance system. Retrieved from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html

5. Centers for Disease Control and Prevention. (2015b). Pregnancy-related deaths. Retrieved from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-relatedmortality.htm

6. Central Intelligence Agency. (2015). The world fact book. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2223rank.html

7. Creanga A A, Berg C J, Syverson C, Seed K, Bruce F C, Callaghan W M. Race, ethnicity, and nativity differentials in pregnancy-related mortality in the U.S.: 1993–2006. Obstetrics & Gynecology. 2012;120(2):261-268.

8. Edwards J E, Hanke J C. An update on maternal mortality and morbidity in the U.S. Nursing for Women's Health. 2013;17(5):376-388.

9. Estes L J. (2011). Maternal mortality in Texas 2001-2006 (Doctoral dissertation, University of Texas). Retrieved from http://search.proquest.com/docview/886734324

10. Georgia Department of Public Health. (2015). Georgia maternal mortality [2012 case review]. Retrieved from https://dph.georgia.gov/sites/dph.georgia.gov/files/MCH/MMR_2012

11. Gober M. (2015). The state of the state maternal & infant health in Georgia: Where we have been, where are we now and what we can do. Atlanta, GA: Healthy Mothers, Healthy Babies Coalition.

12. Holtz C. Global health care: Issues and policies (2nd ed.). Sudbury, MA: Jones & Bartlett Publishers.

13. Lawson G W, Keirse M J. (2013). Reflections on the maternal mortality millennium goal. Birth. 2013;40(2):96-102.

14. Main E K. Decisions required for operating a maternal mortality review committee: The California experience. Seminars in Perinatology. 2012;36(1):37-41.

15. Molla M, Mitiku I, Worku A, Yamin A E. (2015). Impacts of maternal mortality on living children and families: A qualitative study from Butajira, Ethiopia. Reproductive Health. 2015;12(1):1-9.

16. Morton C H. (2014). The problem of increasing maternal morbidity: Integrating normality and risk in maternity care in the U.S. Birth. 2014;41(2):119-121.

17. Piot P. (2008). Nutrition and health in developing countries (2nd ed.). Baltimore, MD: Humana Press.

18. Say L, Chou D, Gemmill A, Tunçalp O, Moller A, Daniels, J, ... Alkema L. (2014). Global causes of maternal death: A WHO systematic analysis. Lancet Global Health. 2008;2(6):e323-e333.

19. Schaible J. Improving accuracy of maternal mortality and pregnancy related death. Issues in Law & Medicine. 2014;29(2):231-242.

20. Solheim K N, Esakoff T F, Little S E, Cheng W Y, Sparks T N, Caughey A B. The effect of cesarean delivery rates on the future incidence of placenta previa, placenta accreta, and maternal mortality. Journal of Maternal-Fetal & Neonatal Medicine. 2011;23(11):1341-1346.

21. U. S. Government. (n.d.). Global health initiative [Strategy document]. Retrieved from http://www.pepfar.gov/documents/organization/136504.pdf

22. World Health Organization . (2015a). International classification of diseases. Retrieved from http://www.who.int/classifications/icd/en/

23. World Health Organization. (2015b). Maternal mortality ratio (per 100 000 live births). Retrieved from http://www.who.int/healthinfo/statistics/indmaternalmortality/en/