Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

J Perinatol. Author manuscript; available in PMC 2023 May 30.

Published in final edited form as:

J Perinatol. 2021 September ; 41(9): 2141–2146. doi:10.1038/s41372-021-00935-9.

Maternal transport: an opportunity to improve the system of risk-appropriate care

Carla L. DeSisto[1], **Reena Oza-Frank**[2], **David Goodman**[1], **Elizabeth Conrey**[1,2], **Cynthia Shellhaas**[2,3]

[1]Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, GA, USA

[2]Bureau of Maternal, Child and Family Health, Ohio Department of Health, Columbus, OH, USA

[3]Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, The Ohio State University Wexner Medical Center, Columbus, OH, USA

Abstract

Objective—To assess how often maternal transport preceded pregnancy-related deaths and describe contributing factors and recommendations related to maternal transport.

Study design—We used Ohio maternal mortality review committee (MMRC) data from 2010 to 2016. We defined two transport types among pregnancy-related deaths: field to hospital and hospital to hospital. We examined deaths determined by the MMRC to be potentially preventable by transfer to a higher level of care and described contributing factors and recommendations.

Result—Among 136 pregnancy-related deaths, 56 (41.2%) were transported. Among 15 deaths identified as potentially preventable by transfer to a higher level of care, 5 were transported between hospitals. Contributing factors for 14 deaths included inadequate response by Emergency Medical Services and lack of transport to a higher level of care.

Conclusion—Our results suggest opportunities for examining modification and adherence to existing protocols. Improving risk-appropriate maternal care systems is important for preventing pregnancy-related deaths.

Introduction

Perinatal regionalization, or the concept of coordinating regional systems for perinatal care, has been a well-recognized strategy for improving maternal and neonatal outcomes in the United States for more than four decades [1]. The promotion of maternal transport to facilities with more specialized care to improve neonatal outcomes is well-established [2]. Published data support the use of these regionalized systems to save the lives of high-risk infants [3].

✉Carla L. DeSisto, wup5@cdc.gov.

Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conflict of interest The authors declare that they have no conflict of interest.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

However, similar regionalized systems focused on improving maternal outcomes are not well-defined or established in many areas of the United States [2]. This is particularly troubling given that the pregnancy-related mortality ratio has not improved over the past decade [4]. Non-Hispanic black and American Indian/Alaska Native women have pregnancy-related mortality ratios 3.2 and 2.3 times as high, respectively, as non-Hispanic white women [5]. Approximately 60% of pregnancy-related deaths are preventable [6]. These data underscore the need to focus on the quality, accessibility, and safety of systems of maternal care [2].

In 2015, the American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine (SMFM) published the Obstetric Care Consensus: Levels of Maternal Care [7]. This publication was revised and reissued in 2019 [2]. The structure of levels of maternal care recommendations is similar to the well-established neonatal levels, whereby each level has a minimum capability related to facility staffing and equipment. The goal is to have adequate information on maternal and neonatal levels of care so that a pregnant woman receives care in the facility that can best meet the needs of both her and her infant. Maternal transport is often required to meet this goal [2].

Maternal mortality review committees (MMRCs) comprehensively assess deaths among women during pregnancy and the year after the end of pregnancy [8, 9]. MMRCs can use vital records data, medical and social service records, and maternal transport records to understand the course of events and decide if the deaths were pregnancy-related and preventable [8, 10, 11]. For preventable deaths, the committee identifies factors that contributed to the death and makes case-specific recommendations that may have prevented the death from occurring [8]. The Maternal Mortality Review Information Application (MMRIA) was created by the Centers for Disease Control and Prevention (CDC) to support consistent case abstraction and review and data analysis for MMRCs.

Maternal transport is a key underpinning of risk-appropriate care, as it provides the opportunity for women to receive care in the level of facility that meets their specific needs. One of the 12 data forms within MMRIA specifically focuses on maternal transport, making it a key consideration during the maternal death review [12]. However, to date, there are no published analyses of maternal transport among pregnancy-related deaths. In this study, we used data on pregnancy-related deaths that occurred during 2010–2016 in Ohio to answer the following questions: (1) How often and what types of maternal transport occurred before a pregnancy-related death? (2) Among maternal deaths where the MMRC reported a transport may have prevented death, how many were not preceded by a maternal transport? (3) What contributing factors and recommendations related to maternal transport were identified?

Methods

The Ohio MMRC retrospectively abstracted and reviewed pregnancy-associated deaths that occurred during 2010–2016 [13]. The Ohio MMRC then entered data on these deaths in MMRIA [12]. This analysis focused on the subset of these deaths that were pregnancy-related. A pregnancy-related death is defined as the death of a woman during pregnancy or

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

within 1 year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy [14].

We examined two types of maternal transport: transport from the field (e.g., their home, vehicle, or workplace) to a hospital by emergency medical service (EMS) and transport from one hospital to another. Women who were transported from the field to a hospital and then transported to another hospital were included in the latter group. We also examined if women were transported before their death overall, defined as the combination of the two types of transport. Maternal transports were identified from deidentified data in MMRIA, including case narratives, the maternal transport form, and other forms in the application [12].

We examined characteristics of the women, including age, race/ethnicity, county geography, and timing of death, overall and by whether they were transported before their death. We used Pearson chi-square tests to assess for differences. Among women who were transported, we also examined the same characteristics by type of transport. However, we did not perform any tests to assess for differences due to small cell sizes.

After reviewing each death, the Ohio MMRC completes a separate form that asks the question, “Would transfer to a higher level of care have improved the outcome/changed the course of events?” We examined pregnancy-related deaths for which the MMRC answered “yes” or “maybe” to this question and assessed whether those women were transported prior to their deaths.

The Ohio MMRC also documented in MMRIA the factors that contributed to the death (“contributing factors”) and, for deaths with at least some degree of preventability, the recommendations that may have prevented the death (“recommendations”). We assessed the contributing factors and recommendations related to maternal transport identified by the MMRC. Because the variable in MMRIA that captures preventability had substantial missing data, we assessed the contributing factors and recommendations related to maternal transport regardless of whether preventability was noted by the MMRC.

We then examined the characteristics of interest among the women with maternal transport considerations, which we defined as those for whom transfer to a higher level of care might have improved the outcome/changed the course of events and/or those who had a contributing factor or recommendation related to maternal transport.

CDC Human Subjects Review determined these data are exempt from review.

Results

During 2010–2016, there were 136 pregnancy-related deaths in Ohio; 56 (41.2%) had a maternal transport documented. Of the 56 maternal transports, 40 (71.4%) were transported by EMS from the field to a hospital, 13 (23.2%) were transported from one hospital to another, and 3 (5.4%) were transported from the field to a hospital and then transported to another hospital. Maternal transport did not statistically significantly vary by maternal age

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

group, maternal race/ethnicity, whether Medicaid was used for the woman's prenatal care or delivery, the geography of the county of death, or the timing of death (Table 1). Because the total number of women transported from one hospital to another was small ($n = 16$), it is unclear whether the type of maternal transport varied significantly by any of these maternal characteristics (Table 2).

The MMRC reported that transfer to a higher level of care might have improved the outcome/changed the course of events for 15 (11.0%) of all pregnancy-related deaths (Table 3). Of these 15 deaths, 6 (40%) had a maternal transport documented in MMRIA: 1 was transported from the field and 5 were transported from one hospital to another. In these instances, the committee recommended earlier transfers to a higher level of care and noted "inadequately trained personnel" as a contributing factor to the death.

Contributing factors and recommendations related to maternal transport were separately identified by the MMRC for 14 (10.3%) of the total number of pregnancy-related deaths. Four of these women were not among the 15 pregnancy-related deaths described in the previous paragraph, giving a total of 19 women with maternal transport consideration. Contributing factors fell into two groups: (1) inadequate response by EMS, and (2) lack of transport to a hospital with a higher level of care, either not at all or not in a timely manner. Examples of contributing factors related to maternal transport include:

- Unavailable or inadequate response by EMS to transport patient from the field to a hospital.
- Unable to transfer patient from hospital to a hospital with higher level of care.

The MMRC recommended implementation of EMS trainings and policies and hospital maternal transport protocols. Examples of recommendations related to maternal transport include:

- Earlier transfer of care to higher level of care.
- Establish protocol or guidelines to transfer to a tertiary care center.
- Policy regarding inadvisability of EMS transporting a pregnant woman to an emergency department that is without obstetric care.

Of these 19 total women with maternal transport consideration, 7 were non-Hispanic black, 11 were non-Hispanic white, and 1 was another race/ethnicity. Their median age was 31. Their deaths occurred across the entire study period (2010–2016). They died in diverse parts of Ohio: 12 in urban counties, 4 in Appalachian counties [15], 2 in suburban counties, 1 in a rural county. They also died of a variety of causes: 4 died of preeclampsia/eclampsia, 4 of hemorrhage, 3 of cardiomyopathy, 3 of infections, 1 of pulmonary conditions, 1 of cardiovascular and coronary conditions, 1 of anesthesia complications, 1 of an embolism, and 1 due to an autoimmune disease. Their timings of death ranged from pregnant at the time of death to 43–365 days postpartum, with the majority (12/19, 63%) being 1–6 days postpartum.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Discussion

Results from Ohio suggest that improvements in maternal transport can support risk-appropriate maternal care to prevent maternal deaths. During 2010–2016, there were 19 women who died for whom the Ohio MMRC said that transfer might have prevented death and/or who had a contributing factor or recommendation related to maternal transport. The contributing factors and recommendations made by the MMRC were primarily related to inadequate response by EMS and lack of transport to a hospital with a higher level of care, either at all or in a timely manner. Our results suggest opportunities for assessing and improving existing EMS and hospital protocols and examining adherence to these protocols. Although this study focused only on data from Ohio, we do not believe that these results are unique. Across the country, there is a need to improve the system of risk-appropriate maternal care. The system of levels of maternal care and the network of entities that support the system—including individual healthcare providers, hospitals, and first responders—are an integral part of the prevention of maternal mortality [2].

Women with high-risk conditions likely benefit from giving birth in hospitals that offer specialty and subspecialty services [16]. However, pregnancy-related deaths can also occur up to 1 year postpartum; recognizing postpartum complications and appropriately providing care is equally important to reducing pregnancy-related deaths. Protocols for EMS are needed to ensure that postpartum women are also treated in facilities with the appropriate specialists that can care for their unique needs, such as EMS asking about pregnancy status in the past year, especially in instances when a woman is found non-responsive or has another type of cardio-respiratory complaint.

Urgent situations that require transport to higher levels of care can happen in rural and urban communities. Facilities need to have clear plans to transport women who require it, with an understanding of how they will facilitate the transport and how long it will take for the woman to arrive at the facility with the higher level of care. In emergency situations, the ACOG and SMFM Obstetric Care Consensus recommends that the nearest level-appropriate hospital be used if added travel to a farther level-appropriate hospital increases risk [2]. Facilities in rural communities might be further from the highest level facilities, and therefore might need to plan accordingly, including planning for the use of telemedicine or telephone consults with subspecialists when maternal transport is not a viable option. An essential component of regionalized maternal care is for the highest level facilities to provide education and consultation to other hospitals in their region [2].

To provide standardized assessments that align with the levels of care guidance from ACOG and SMFM, the CDC developed the Levels of Care Assessment Tool (CDC LOCATe®) [17]. States that have not yet implemented CDC LOCATe® might consider this assessment to facilitate efforts to ensure that women receive care in the facility that best meets their needs. Each facility needs to have a clear understanding of its capability to handle increasingly complex levels of maternal care and needs to have a well-defined threshold to transfer women to facilities that offer a higher level of care [2]. CDC LOCATe® provides a standardized and unbiased assessment of facility levels of care, based on national guidelines

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

[17]. The results from CDC LOCATe® are a starting point for discussions about how states can improve health outcomes for women and infants.

The Ohio Bureau of Survey and Certification has regulatory oversight of maternity units, birthing centers, and maternity homes [18]. The maternity licensure rules became effective in October 2019 and incorporate four new levels of obstetric care, consistent with those recommended by ACOG and SMFM. Maternity units and maternity homes are inspected every 3 years to ensure compliance with the rules. Ongoing assessment of levels of maternal care can identify gaps and areas for improvements in regionalized systems. Because the levels of obstetric care had not yet been designated during our study period, we were unable to look at the specific levels of care of the facilities in this study; however, this is an opportunity for future research.

This analysis is subject to a few important limitations. Both the composition of the Ohio MMRC and the data entry into MMRIA changed over time. This may have resulted in differences in points of view, determination of contributing factors, development and documentation of recommendations, and consideration of the question about whether transfer would have prevented death. For example, although contributing factors and recommendations are typically only developed for deaths with some degree of preventability, the variable in MMRIA that captures preventability was more likely to have missing data at the beginning of the time period for this study compared to the end, precluding us from using preventable pregnancy-related deaths as the denominator. Related to this, we combined the answers of “yes” and “maybe” to the question, “Would transfer to a higher level of care have improved the outcome/changed the course of events?” When the answer was “maybe,” it is possible that the MMRC did not have enough information available to answer the question with more certainty. Similarly, it is unclear why there are some cases for whom there is discordance between whether the MMRC said that transfer might have prevented death and whether there was a contributing factor or recommendation related to maternal transport. This suggests a need for improving the quality of MMRC data, while also demonstrating the importance of triangulating these data sources. Further, although we did not detect differences in any maternal transport, studies with a larger number of maternal deaths are needed to confirm these findings. We were unable to test for differences in type of maternal transport due to small cell sizes. Finally, incomplete maternal medical transport records are a challenge because abstractors often have trouble accessing EMS records. When maternal transport records are not documented, it is unclear whether a transport truly did not happen or if the record was missing.

In conclusion, improvements to the system of risk-appropriate maternal care are an important step in preventing pregnancy-related deaths in the U.S. As part of this process, jurisdictions might consider implementing CDC LOCATe® to better understand the region’s system of perinatal care capabilities. In addition, public health partners might consider assessing existing hospital maternal transport protocols and EMS protocols for caring for and transporting pregnant or postpartum women. Since ~60% of pregnancy-related deaths are considered preventable [6], improving the system of risk-appropriate maternal care is a key part of preventing these deaths.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

References

1. March of Dimes Committee on Perinatal Health. Toward improving the outcome of pregnancy: recommendations for the regional development of maternal and perinatal health services. White Plains, NY: March of Dimes National Foundation; 1976.
2. American College of Obstetricians and Gynecologists, Society for Maternal-Fetal Medicine, Kilpatrick SJ, Menard MK, Zahn CM, Callaghan WM. Obstetric Care Consensus #9: Levels of Maternal Care: (Replaces Obstetric Care Consensus Number 2, February 2015). Am J Obstet Gynecol. 2019;221: B19–30. [PubMed: 31351999]
3. Lasswell SM, Barfield WD, Rochat RW, Blackmon L. Perinatal regionalization for very low-birth-weight and very preterm infants: a meta-analysis. JAMA 2010;304:992–1000. [PubMed: 20810377]
4. Centers for Disease Control & Prevention. Pregnancy Mortality Surveillance System Atlanta, GA: CDC; 2020 https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm.
5. Petersen EE, Davis NL, Goodman D, Cox S, Syverson C, Seed K, et al. Racial/Ethnic Disparities in Pregnancy-Related Deaths - United States, 2007–2016. MMWR Morb Mortal Wkly Rep. 2019;68:762–5. [PubMed: 31487273]
6. Petersen EE, Davis NL, Goodman D, Cox S, Mayes N, Johnston E, et al. Vital Signs: pregnancy-Related Deaths, United States, 2011–2015, and Strategies for Prevention, 13 States, 2013–2017. MMWR Morb Mortal Wkly Rep. 2019;68:423–9. [PubMed: 31071074]
7. American College of Obstetricians and Gynecologists, Society for Maternal-Fetal Medicine, Menard MK, Kilpatrick S, Saade G, Hollier LM, et al. Levels of maternal care. Am J Obstet Gynecol. 2015;212:259–71. [PubMed: 25620372]
8. Zaharatos J, St Pierre A, Cornell A, Pasalic E, Goodman D. Building U.S. Capacity to Review and Prevent Maternal Deaths. J Women's Health (Larchmt). 2018;27:1–5.
9. St Pierre A, Zaharatos J, Goodman D, Callaghan WM. Challenges and Opportunities in Identifying, Reviewing, and Preventing Maternal Deaths. Obstet Gynecol. 2018;131:138–42. [PubMed: 29215526]
10. Callaghan WM. Overview of maternal mortality in the United States. Semin Perinatol. 2012;36:2–6. [PubMed: 22280858]
11. Goodman D, Stampfel C, Creanga AA, Callaghan WM, Callahan T, Bonzon E, et al. Revival of a core public health function: state-and urban-based maternal death review processes. J Women's Health (Larchmt). 2013;22:395–8. [PubMed: 23600436]
12. Review to Action. Maternal Mortality Review Information Application https://reviewtoaction.org/implement/mmria.
13. Ohio Department of Health. Pregnancy-Associated Mortality Review 2020 https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/pregnancy-associated-mortality-review/welcome/.
14. Davis N, Smoots A, Goodman D. Pregnancy-Related Deaths: data from 14 U.S. Maternal Mortality Review Committees, 2008–2017 Atlanta, GA: Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2019.
15. Appalachian Regional Commission. The Appalachian Region https://www.arc.gov/appalachian_region/TheAppalachianRegion.asp.
16. Clapp MA, James KE, Kaimal AJ. The effect of hospital acuity on severe maternal morbidity in high-risk patients. Am J Obstet Gynecol. 2018;219:111. e1–e7.
17. Catalano A, Bennett A, Busacker A, Carr A, Goodman D, Kroelinger C, et al. Implementing CDC's Level of Care Assessment Tool (LOCATe): a National Collaboration to Improve Maternal and Child Health. J Women's Health (Larchmt). 2017;26:1265–9. [PubMed: 29240547]
18. Ohio Department of Health. Maternity and Newborn Facilities https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/maternity-and-newborn-facilities/maternityadnnewbornfacilities.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 1

Summary of characteristics of pregnancy-related deaths in Ohio, stratified by whether the women were transported, 2010–2016.

	Overall (*N* = 136), *n* (%)	**Transported (*N* = 56), *n* (%)**	**Not transported (*N* = 80), *n* (%)**	**Chi-square *p* value**
Age group				0.11
≤24	37 (27.2)	14 (25.0)	23 (28.8)	
25–29	25 (18.4)	14 (25.0)	11 (13.8)	
30–34	40 (29.4)	19 (33.9)	21 (26.3)	
≥35	34 (25.0)	9 (16.1)	25 (31.3)	
Maternal race/ethnicity				0.35
Non-Hispanic Black	50 (36.8)	18 (32.1)	32 (40.0)	
Non-Hispanic White	78 (57.4)	33 (58.9)	45 (56.3)	
Other	8 (5.9)	5 (8.9)	3 (3.4)	
Medicaid used for prenatal care or delivery				0.12
Yes	84 (61.8)	39 (69.6)	45 (56.3)	
No	52 (38.2)	17 (30.4)	35 (43.8)	
Geography				0.48
Urban	91 (66.9)	39 (69.6)	52 (65.0)	
Suburban	23 (16.9)	8 (14.3)	15 (18.8)	
Rural	6 (4.4)	1 (1.8)	5 (6.3)	
Appalachia [15]	16 (11.8)	8 (14.3)	8 (10.0)	
Timing of death				0.19
During pregnancy	24 (17.7)	12 (21.4)	12 (15.0)	
Day of delivery	18 (13.2)	5 (8.9)	13 (16.3)	
1–6 days postpartum	27 (19.9)	11 (19.6)	16 (20.0)	
7–2 days postpartum	27 (19.9)	15 (26.8)	12 (15.0)	
43–365 days postpartum	25 (18.4)	7 (12.5)	18 (22.5)	
Missing	15 (11.0)	6 (10.7)	9 (11.3)	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Summary of characteristics of pregnancy-related deaths in Ohio, stratified by type of transport, among women who were transported (*N* = 56), 2010–2016.

	Transported between hospitals (*N* = 16), *n* (%)	**Transported by EMS (*N* = 40), *n* (%)**
Age group		
≤24	6 (37.5)	8 (20.0)
25–29	6 (37.5)	8 (20.0)
30–34	3 (18.8)	16 (40.0)
≥35	1 (6.3)	8 (20.0)
Maternal race/ethnicity		
Non-Hispanic Black	4 (25.0)	14 (35.0)
Non-Hispanic White	9 (56.3)	24 (60.0)
Other	3 (18.8)	2 (5.0)
Medicaid used for prenatal care or delivery		
Yes	13 (81.3)	26 (65.0)
No	3 (18.8)	14 (35.0)
Geography		
Urban	11 (68.8)	28 (70.0)
Suburban	3 (18.8)	5 (12.5)
Rural	0	1 (2.5)
Appalachia [15]	2 (12.5)	6 (15.0)
Timing of death		
During pregnancy	0	12 (30.0)
Day of delivery	1 (6.3)	4 (10.0)
1–6 days postpartum	6 (37.5)	5 (12.5)
7–42 days postpartum	4 (25.0)	11 (27.5)
43–365 days postpartum	2 (12.5)	5 (12.5)
Missing	3 (18.8)	3 (7.5)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 3

Summary of Ohio deaths with maternal transport consideration[a], 2010–2016.

Age group	Geography	Cause of death	Timing of death	Transfer might have prevented death[b]	Contributing factor (CF)/recommendation (R) related to maternal transport[c]	Transported[d]
25–29	Urban	Infection	1–6 days postpartum	Yes	R: Earlier transfer of care to higher level of care	From one hospital to another
≤ 24	Appalachia	Preeclampsia and Eclampsia	1–6 days postpartum	Yes	No	From one hospital to another
30–34	Urban	Preeclampsia and Eclampsia	1–6 days postpartum	Yes	CF: Inadequately trained personnel	From one hospital to another
30–34	Urban	Preeclampsia and Eclampsia	1–6 days postpartum	Yes	R: Protocol to transfer to a tertiary care center	From one hospital to another
≤24	Urban	Anesthesia Complications	7–42 days postpartum	Yes	No	From one hospital to another
≤24	Urban	Pulmonary Conditions	1–6 days postpartum	Yes	No	From the field to a hospital
30–34	Urban	Infection	1–6 days postpartum	No	CF: Unavailable or inadequate response by EMS; Inadequately trained/ unavailable personnel or services	From the field to a hospital
30–34	Urban	Infection	43–365 days postpartum	Missing	R: Policy regarding EMS transporting a pregnant woman to an ED without OB care	From the field to a hospital
30–34	Appalachia	Hemorrhage	During pregnancy	No	CF: Unavailable or inadequate response by EMS; Inadequately trained/ unavailable personnel or services	No
30–34	Urban	Embolism	Day of delivery	Yes	R: When Amniotic Fluid Embolism occurs, transfer to facility where ECMO can be started	No
30–34	Urban	Hemorrhage	Day of delivery	Yes	No	No
≥35	Urban	Preeclampsia and Eclampsia	1–6 days postpartum	Yes	CF: Inadequately trained/ unavailable personnel or services	No
≥35	Urban	Hemorrhage	1–6 days postpartum	Yes	CF: Inadequately trained/ unavailable personnel or services	No
30–34	Appalachia[e]	Cardiomyopathy	1–6 days postpartum	Yes	CF: Inadequate availability of personnel	No
≥35	Appalachia	Cardiovascular and Coronary Conditions	1–6 days postpartum	Missing	CF: Unable to transfer to higher level of care	No
≥35	Rural	Hemorrhage	1–6 days postpartum	Yes	CF: Inadequately trained/ unavailable personnel or services	No
25–29	Suburban	Cardiomyopathy	1–6 days postpartum	Yes	CF: EMS declared dead on scene instead of transporting to hospital	No
≤24	Urban	Cardiomyopathy	43–365 days postpartum	Yes	CF: Lack of transferring patient to better care	No
30–34	Suburban	Autoimmune Diseases	43–365 days postpartum	Yes	No	No

[a]Includes those for whom the Ohio Maternal Mortality Review Committee said that transfer might have prevented death and/or who had a contributing factor or recommendation related to maternal transport.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

[b] The Ohio Maternal Mortality Review Committee answered the question, "Would transfer to a higher level of care have improved the outcome/changed the course of events?" We combined the answers of "yes" and "maybe" here.

[c] The Ohio Maternal Mortality Review Committee documented the factors that contributed to the death and/or the recommendations that may have prevented the death. We note whether these were related to maternal transport for each woman.

[d] Was the woman transported from the field (e.g., their home or workplace) to a hospital by emergency medical service, transported from one hospital to another, or not transported at all in the time preceding her death?

[e] Appalachian counties maybe urban, suburban, or rural [15].