2019 DC Public Health Case Challenge

Reducing Health Disparities in Maternal Mortality by Addressing Unmet Health-Related Social Needs

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Acknowledgments

Disclaimer

All characters and organizations in the case are fictional and do not reflect the views of actual organizations or specific individuals. The case scenario is complex and does not necessarily have a single correct or perfect solution, thus encouraging teams to develop a judicious balance of creative, interdisciplinary, and evidence-based approaches. The authors of this case study have provided facts and figures within the case as well as appendices with resources and references to help teams create their solutions. The data provided are derived from independent sources, may have been adapted for use in this case, and are clearly cited such that teams can verify or contest the findings within their recommendations whenever pertinent. Teams are responsible for justifying the accuracy and validity of all data and calculations that are used in their presentations, as well as supporting their assertions in front of a panel of subject matter experts who will serve as judges representing different stakeholders. Sections of this case have been adapted from previous DC Public Health Case Challenge cases.

Instructions

Task: Develop a feasible and creative proposal of an intervention or interventions that could address disparities in maternal mortality by responding to unmet health-related social needs of women (and their families) in Washington, DC. Present your proposed solution(s) at the Case Challenge competition that will be held on October 18, 2019.

Scope: The proposed activities should reflect a budget of $3 million to be used over 5 years. Your proposal and presentation should specify and provide a justification for the sector(s), groups of people, and/or organizations your intervention(s) will engage. Staff salaries for the intervention (as well as program administration and evaluation) should be included in the budget.

Case information: The case includes some initial background statistics and information relevant to the case topic. However, your presentation does not need to include all the information presented in the case. Rather you should use the provided materials as a reference to help guide your response.

Outside resources: Teams should also consider outside resources for a deeper understanding of the problem and to develop a stronger proposal. However, team members must generate the case solution independently. Faculty advisors and other individuals who serve as a resource should not generate ideas for the case solutions, but they can provide relevant supportive information, guide students to resources, provide feedback on ideas and proposals for case solutions and recommendations generated by the students, and provide feedback on draft slides and practice presentations.

Judging: Refer to the judging rubric (see Appendix E) to see the criteria on which you will be assessed. Judges are drawn from organizations working with DC residents, academic and clinical medicine, and various nonprofit organizations.

If you have questions about the case, please email Sophie Yang (syang@nas.edu) prior to 9:00 a.m. on Thursday, October 17. She will forward your question and the answer to all of the participating teams.

On the day of the presentation, please remember the following:
- Arrive at the National Academy of Sciences Building (2101 Constitution Avenue, NW, Washington, DC) between 8:00 a.m. and 8:30 a.m. on October 18, 2019. The security guard can direct you to Room 125 to check in.
- Bring a copy of your presentation in PowerPoint format on a flash drive and give it to the Case Challenge organizers in Room 125 by 8:30 a.m.
- Your presentation should be no longer than 15 minutes and will be followed by a 10-minute period of questions and answers with the judges.
- Dress in professional attire, and avoid anything that would identify your school.

For more information on the Case Challenge guidelines and logistics, refer to the guide for student teams and faculty advisors in Appendix G. If you have questions about the event, please email Sophie Yang (syang@nas.edu).

We look forward to hearing your ideas for contributing to a thriving DC community.

Case

Reducing Health Disparities in Maternal Mortality by Addressing Unmet Health-Related Social Needs

Problem Statement[1]

There are approximately 700 pregnancy-related deaths in the United States each year, with disproportionately high rates among low-income women and women of color.[2,3] DC has the highest total maternal mortality ratio in the nation, with 38.8 pregnancy-related deaths per 100,000 live births from 2005 to 2014, compared to 17.2 deaths per 100,000 live births nationally. In the same time period, the maternal mortality ratio for black women in DC was 70.6 pregnancy-related deaths per 100,000 live births.[4] Comparatively, the maternal mortality ratio for white women in DC was 0 pregnancy-related deaths per 100,000 live births.[5] A myriad of social factors including socioeconomic status (including education) and access to health care contribute to disparities in maternal morbidity and mortality.

The leading causes of pregnancy-related death in the United States are cardiovascular disease, noncardiovascular medical conditions, infection, and hemorrhage. An estimated three out of five pregnancy-related deaths in the United States could be prevented with interventions at the systems, local, and individual levels.[6] Proposed solutions may span multiple levels of the social ecological model of health (see "Theoretical Background" section for more information on this model) and therefore may offer many potential points of intervention.

Funding Announcement

The Foundation for Innovation in Maternal and Newborn Health is excited to announce a grant funding opportunity for nonprofit organizations working to address the underlying causes of disparities in rates of maternal mortality and related morbidities for residents of DC. This grant focuses on addressing unmet health-related social needs. The foundation is searching for innovative approaches that recognize the variety of underlying factors that contribute to these disparities and offer novel strategies, meaning approaches that go beyond recommendations for routine prenatal and obstetric care.

This grant will last 5 years and has a total budget of $3 million. The award will go to the organization that develops a multifaceted, interdisciplinary, innovative, and evidence-based

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[1] Throughout the case, citations are provided as footnotes. For a complete list of these citations, please see Appendix C.

[2] Petersen, E. E., N. L. Davis, D. Goodman, S. Cox, N. Mayes, E. Johnston, C. Syverson, K. Seed, C. K. Shapiro-Mendoza, W. M. Callaghan, and W. Barfield. (2019). Vital signs: pregnancy-related deaths, United States, 2011–2015, and strategies for prevention, 13 states, 2013–2017. *Morbidity and Mortality Weekly Report* 68:423-429. http://dx.doi.org/10.15585/mmwr.mm6818e1.

[3] Petersen, E., N. Davis, D. Goodman, S. Cox, C. Syverson, K. Seed, C. K. Shapiro-Mendoza, W. Callaghan, and W. Barfield. (2019). Racial/ethnic disparities in pregnancy-related deaths --United States, 2007–2016. *Morbidity and Mortality Weekly Report*. https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6835a3-H.pdf.

[4] Moaddab, A., G. A. Dildy, H. L. Brown, Z. H. Bateni, M. A. Belfort, H. Sangi-Haghpeykar, and S. Clark. (October 2016). Health care disparity and state-specific pregnancy-related mortality in the United States, 2005-2014. *Obstetrics and Gynecology* 128(4):869-975.

[5] Ibid

[6] Ibid

solution. At least one element of the solution must incorporate technology or an innovative use of data to address disparities in maternal mortality. A successful proposal will provide a feasible and sustainable intervention that the organization can implement readily or one that builds on existing resources and has the potential for long-lasting population health effects. Proposals should prioritize the specific health effects and causal factors to be addressed, justify the choice of intervention(s), specify the implementation and evaluation strategy, and provide budget estimates for the use of funds within the time frame specified in the request for proposal. Specific attention should be paid to structural and historical factors that influence these issues.

In this funding opportunity, the foundation is looking for new and innovative ideas that differ from common, contemporary interventions. Proposals should employ novel approaches that incorporate practical aspects of technology or innovative uses of data. These may include, but should not be limited to, the use of mobile or web-based applications.

A program funded previously by a different division of the foundation offers an example of how a solution could include two or more components and target more than one dimension of a challenge. The program focused on infant health and well-being, with specific attention to breastfeeding promotion and early childhood nutrition. The successful grant applicant provided three primary intervention points, all implemented through an early childhood home visiting program. First, from the birth of the infants to their first 6 months, mothers received free lactation support and breastfeeding education during weekly home visits. Professionals who conducted the home visits assisted mothers in breastfeeding techniques and proper infant care. If the mother expressed interest in weaning or alternative feeding methods, the program and education strategies shifted to offer other types of support for breastfeeding, if appropriate, and to reinforce healthy options as infants transitioned to formula or solid foods. Finally, when the children were 3 years old, the program screened for building blocks of healthy eating and physical activity and provided interventions as needed.

The foundation solicits submissions through an open, competitive process to eligible nonprofit organizations working to address the root causes of disparities in rates of maternal mortality and related morbidities for residents of the DC area. Applicants will present their proposals to the foundation's panel of reviewers on October 18, 2019. For more detailed judging criteria, please see Appendix E.

The Challenge

You work for a nonprofit organization focused on advocating for women's health in the District of Columbia (DC). Your organization is submitting a proposal for an intervention to reduce disparities in maternal mortality, which is well aligned with your organization's mission. After pitching the idea to your executive director who expresses enthusiasm, she asks you to organize a group of coworkers to respond to the request for proposal. The deadline for submission is in 2 weeks. When writing your proposal, note that your director has given approval for your team to hire qualified personnel as needed to help implement your proposed solution(s) and meet this challenge. The salaries of any additional personnel must be within the total funding allotted above and must be accounted for in your budget estimates.

This grant will fund proposals focused on solutions to reduce disparities in maternal mortality. Winning proposals will effectively incorporate technology or an innovative use of data in their solutions. Since ongoing investments in mobile/web applications and mobile clinics are fairly common, solutions should not consist primarily of these types of approaches. Solutions should

also use a multifaceted, interdisciplinary approach and consider the effects of systemic and institutional racism on society and their effects on health outcomes.

Proposals should be innovative, feasible, and sustainable. They will be evaluated by representatives from relevant DC government agencies, local policy makers (if appropriate), potential partner organizations, and community stakeholders.

Illustrative Scenarios

The following vignettes describe individuals experiencing maternal health issues likely to benefit from interventions such as those proposed by your team. Although the cases do not describe instances of pregnancy-related deaths, they highlight the complex and varying social factors that contribute to women's health. The following scenarios are adapted from real-life experiences shared by DC residents in a *Washington City Paper* article from August 2018. These varied experiences reflect some of the circumstances commonly faced by some residents of DC, especially those from marginalized groups.

You are not limited to directing your solution(s) to the specific types of issues presented in these examples. Rather, these examples are meant to guide your solutions and do not have to be directly addressed.

Scenario 1:
Sharnita B., a 24-year-old black woman, gave birth to her first child in 2015. She had planned to deliver at a birthing center, rather than at a hospital, in order to have more agency over the birth and less pressure for unnecessary medical intervention. However, because of insurance restrictions, she could only go to a birthing center in Arnold, Maryland, that was not equipped for emergency cesarean sections. During labor, she had to be transferred by ambulance to Anne Arundel Medical Center. This experience was traumatic for her and resulted in postpartum depression.[7]

Scenario 2:
Danielle L., 33, was pregnant and living in the Capitol View area of southeast DC. Because of the maternal care desert in her area of DC, she had to travel from her home to Sibley Memorial Hospital in northwest DC to be induced and give birth to her daughter. Without traffic, the trip would be about 40 minutes. By metro or bus, it could take more than an hour. "It was scary because if I went into labor at home in the middle of the day, we might have a problem," said Danielle. Additionally, good nutrition is especially important in pregnancy, but Danielle lived in a neighborhood of DC that was not close to any supermarkets. Instead, she often depended on corner markets that offered few healthy options. Danielle was able to go to Maryland and other parts of DC for groceries, but doing so was time consuming.[8]

Scenario 3:
Jessica C., 28, a white woman who gave birth to her child in August 2018, faced housing instability throughout her pregnancy. She lived in transitional housing at Mary Claire House in northeast DC through a nonprofit organization that serves low-income DC residents. It took two bus rides to get to her appointments at MedStar Georgetown. After the birth of her daughter,

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[7] Randall, K., and K. Vembar. (2018). *Women in D.C. face obstacles at every step of pregnancy and childbirth.* https://www.washingtoncitypaper.com/news/article/21020181/women-in-dc-face-obstacles-at-every-step-of-pregnancy-and-childbirth.
[8] Ibid

she had to leave Mary Claire House. An apartment was secured by a caseworker but would not become available until weeks after delivery. "To be moving around after birth and with a newborn is stressful," she said. "I know I'm going to be a good mother if I have available resources. The problem is they can give me job training and education programs, but if I don't have stable housing none of that is going to be helpful."[9]

Scenario 4:
Renikia S., 33, was a resident of southeast DC when she delivered her sixth child at Unity Health Care in northwest DC. Renikia informed her doctor that she wanted a tubal ligation to prevent future pregnancy. Her doctor said that she had to go to a Pilates class, so Renikia would need to wait until the next morning for a tubal ligation. Renikia never received the tubal ligation and ended up giving birth to her seventh child about a year later. Now, Renikia receives prenatal and medical care through Community of Hope's health and resource center for expecting parents, which is also located in southeast DC. Renikia also participates in pregnancy centering groups at the center. "It's like family," she said.[10]

Logic Model

The logic model depicted in Figure 1 provides an example of how the reduction of health disparities in maternal mortality and morbidity requires intervention on a variety of upstream risk factors. Such risk factors include unmet basic needs, such as housing, access to health care, nutrition, and safety. Not having access to these basic needs can result in intermediate effects or conditions, such as toxic stress, postpartum depression, and cardiovascular disease, all of which increases the risk of maternal mortality.

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[9] Ibid
[10] Ibid
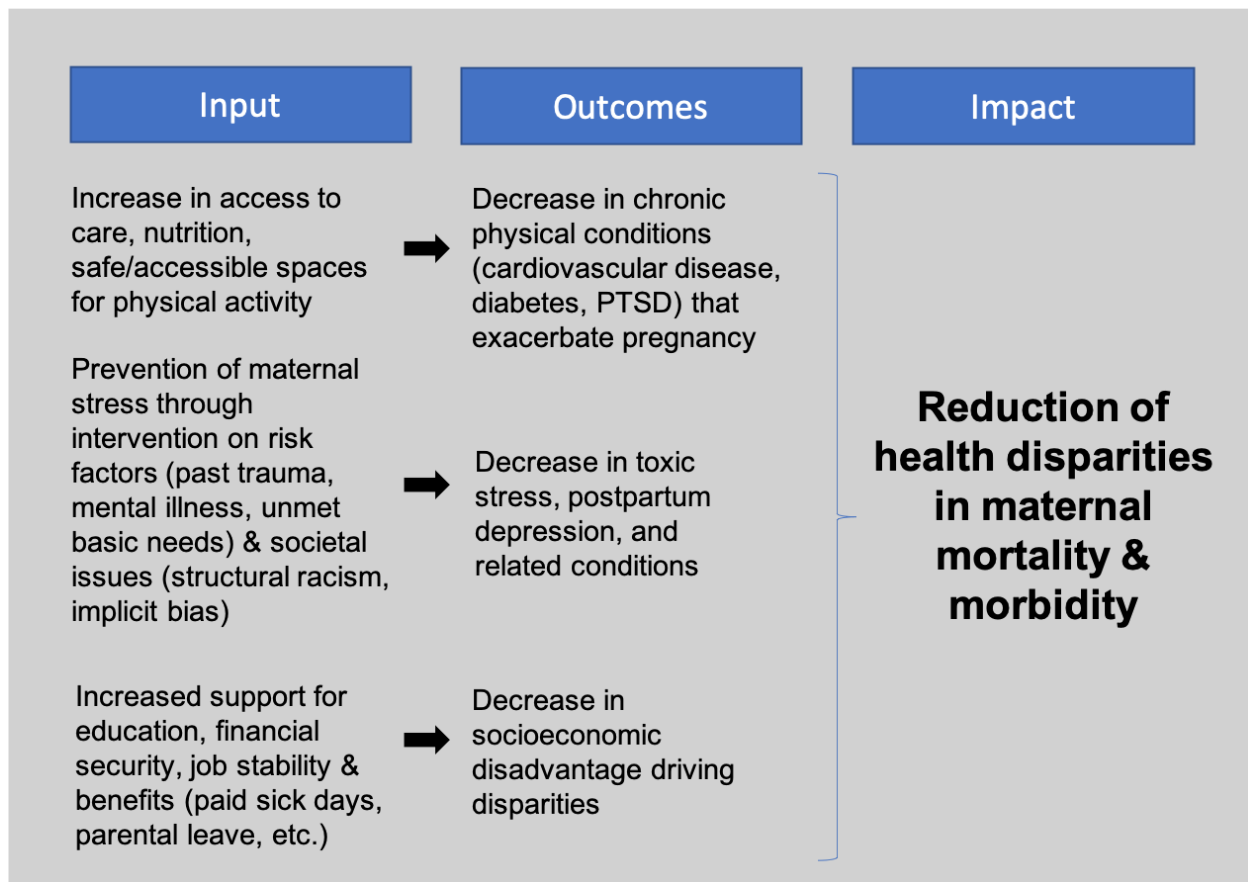
Figure 1: The logic model depicts how certain inputs, such as increasing access to care, prevention of maternal stress, and increased maternal support, can lead to a variety of outcomes that in turn play a role in reducing health disparities in maternal mortality and morbidity.
NOTE: PTSD = post-traumatic stress disorder.

Clinical Background

Stages of Pregnancy

A normal pregnancy lasts around 40 weeks from the first day of the last menstrual period to delivery. Pregnancy is often divided into three roughly 3-month trimesters that correlate with gestational age.[11] The trimesters are characterized by the developmental changes that occur throughout the maturation of the fetus, as well as the physical changes that the pregnant

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[11] American College of Obstetricians and Gynecologists. (April 2018). How your fetus grows during pregnancy. *American College of Obstetricians and Gynecologists: Women's Health Care Physicians.* https://www.acog.org/Patients/FAQs/How-Your-Fetus-Grows-During-Pregnancy?IsMobileSet=false.

individual experiences.[12] Health status during the preconception, prenatal, and postpartum periods contributes to maternal and infant outcomes.[13]

Preconception

Preconception care can be viewed as an aspect of health care for men and women that optimizes their health for any choices they make pertaining to pregnancy. Preconception care, as laid out by the Centers for Disease Control and Prevention (CDC), includes evaluation of overall health, including screening for sexually transmitted infections (STIs), smoking, alcohol and illicit drug use, and diet and exercise.[14] Although these health conditions and behaviors could negatively affect a future pregnancy, they could also harm a person who never becomes pregnant and should be addressed regardless of pregnancy intentions. For instance, monitoring and management of chronic diseases is considered a component of preconception care since certain conditions such as heart disease and diabetes may be exacerbated during pregnancy. However, if a person had no pregnancy intentions, monitoring and management of these chronic diseases would still be crucial. Despite its importance, preconception care is often overlooked as a necessary component of pregnancy care.

For those who plan to become pregnant, identification of chronic diseases that could result in a high-risk pregnancy is necessary before they can be educated about risks, make informed decisions, and receive appropriate care based on their individual needs.[15] Sexually active individuals who do not wish to become pregnant could benefit from being counseled on contraceptive methods to prevent pregnancy. Approximately 45 percent of pregnancies in the United States are unintended.[16] Unintended pregnancies have a higher risk of poor outcomes, such as low birth weight and prematurity.[17] Community- and social-level interventions, such as fortifying grains with folic acid to reduce neural tube defects during pregnancy and education about local resources, also play a role in preconception care, and general health care as well.[18] [19]

Prenatal

Prenatal care is a type of preventive health care for pregnant individuals. Medical, nursing, and allied health professionals, such as nurses, doctors, and midwives, as well as members of the

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[12] Stöppler, M. C. (23 January 2019). Stages of pregnancy: Week by week. *OnHealth: Women's Health*. https://www.onhealth.com/content/1/pregnancy_stages_trimesters.

[13] DeVoe, J. E., A. Geller, and Y. Negussie. (2019). Vibrant and healthy kids: Aligning science, practice and policy to advance health equity. Ch. 2. *The National Academies Press*. https://www.nap.edu/read/25466/chapter/2.

[14] Centers for Disease Control and Prevention. (23 January 2018). *Preconception health and health care*. . https://www.cdc.gov/preconception/index.html.

[15] Farahi, N., and A. Zolotor. (15 October 2013). Recommendations for preconception counseling and care. *American Family Physician Journal* 88(8):499-506. https://www.aafp.org/afp/2013/1015/p499.html.

[16] Guttmacher Institute. (2019). *Unintended pregnancy in the United States*. https://www.guttmacher.org/fact-sheet/unintended-pregnancy-united-states.

[17] Ibid

[18] Crider, K. S., L. B. Bailey, and R. J. Berry. (2011, March). *Folic acid food fortification-its history, effect, concerns, and future directions.* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257747/.

[19] Shartzer, A., N. Garr, C. Pellegrini, and S. K. Long. (October 2015). *Health reform monitoring survey: Changes in insurance coverage, access to care, and health care affordability for women of childbearing age.* Urban Institute: Health Policy Center. https://www.marchofdimes.org/materials/MOD-UrbanAlliance-Changes-in-Insurance-Coverage-Access-to-Care-and-Health-Care-Affordability-for-Women-of-Childbearing-Age-October-2015.pdf.

immediate family, may be involved in prenatal care. The main goals of prenatal care include screening and treatment of pregnancy-associated conditions such as preeclampsia and gestational diabetes, ensuring fetal viability and health, and encouraging health behavior modifications as needed.[20] Pregnancy outcomes are directly influenced by maternal health characteristics and health behaviors during pregnancy, with maternal race and ethnicity being determinants of certain health outcomes as demonstrated in Table 1.[21]

Table 1: Pregnancy characteristics of women who had live births, overall and by maternal race and ethnicity in the District of Columbia for 2015–2016. Source: Perinatal: District of Columbia Department of Health Perinatal Health and Infant Mortality Report (Bowser, 2018).

| | Maternal Race/Ethnicity [a] | | | | | | | | | |
| | DC Overall | | non-Hispanic, White | | non-Hispanic, Black | | Hispanic | | non-Hispanic, Asian/Pacific Islander | |
	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent
Total Births	19,425	100.00	6,050	100.00	9,650	100.00	2,670	100.00	903	100.00
Trimester prenatal care initiated										
First Trimester	12,759	65.68	5,213	86.17	5,027	52.09	1,718	64.34	705	78.07
Second Trimester	4,343	22.36	619	10.23	2,857	29.61	694	25.99	152	16.83
Third Trimester	1,232	6.34	113	1.87	941	9.75	135	5.06	30	3.32
No Prenatal Care	464	2.39	14	0.23	411	4.26	33	1.24	2	0.22
Plurality of birth										
Singleton	18,586	95.68	5,768	95.34	9,183	95.16	2,611	97.79	875	96.90
Twin	825	4.25	282	4.66	453	4.69	59	2.21	28	3.10
Triplet	9	0.05	0	0	9	0.09	0	0	0	0
Quadruplet	4	0.02	0	0	4	0.04	0	0	0	0
Smoking during pregnancy										
Did not smoke during pregnancy	18,546	95.47	5,844	96.60	9,066	93.95	2,629	98.46	879	97.34
Smoked during pregnancy	487	2.51	26	0.43	444	4.60	15	0.56	2	0.22
Gestational diabetes										
Absent	18,737	96.46	5,910	97.69	9,319	96.57	2,517	94.27	850	94.13
Present	662	3.41	138	2.28	314	3.25	153	5.73	53	5.87
Gestational hypertension										
Absent	18,327	94.35	5,692	94.08	9,060	93.89	2,564	96.03	871	96.46
Present	1,072	5.52	356	5.88	573	5.94	106	3.97	32	3.54
Eclampsia										
Absent	19,306	99.39	6,021	99.52	9,583	99.31	2,657	99.51	900	99.67
Present	81	0.42	19	0.31	48	0.50	12	0.45	2	0.22

[a] Other non-Hispanic race-ethnic categories are not presented due to small sample size.

Data Source: DC Birth Data, Vital Records Division, Center for Policy, Planning and Evaluation, D.C. Department of Health

Postpartum Care

The postpartum period is the time following pregnancy and is often overlooked as an essential component for maternal and newborn health. As many as 40 percent of women do not receive postpartum care visits and services, with low-income women being less likely to receive these

[20] Planned Parenthood. (2019). *Prenatal care: Health care during pregnancy.* https://www.plannedparenthood.org/learn/pregnancy/prenatal-care.
[21] Bowser, M., L. S. Nesbitt, F. Johnson-Clarke, P. Lloyd, A. Talwalkar, D. Lindsay, and E. Putzer. (May 2018). *Perinatal: District of Columbia Department of Health perinatal health and infant mortality report.* https://dchealth.dc.gov/sites/default/files/dc/sites/doh/service_content/attachments/Perinatal Health Report 2018_FINAL.pdf.

visits.[22] Postpartum care has typically been limited to a 6-week postpartum visit for low-risk patients. However, increased understanding of maternal and infant risks and the varying needs of women and their families beyond 6 weeks postpartum has led to a shift towards individualized care. Many experts argue that postpartum care should be comprehensive and parent centered, offering as few or as many services and supports as a person desires.[23] The components of postpartum care include: emotional well-being and mood; infant care and feeding; sexuality, contraception, and birth spacing; sleep and fatigue; physical recovery from birth; chronic disease management; and health maintenance.[24] One common concern during the postpartum period is postpartum depression. While many parents experience postpartum blues, or "baby blues" that disappear within roughly 2 weeks, individuals with postpartum depression experience intense feelings of sadness, anxiety, or despair that are intrusive in their daily lives and may persist for up to 1 year.[25] Medical professionals, service providers such as nurse home-visitors, and family members can be helpful to mothers in adjusting to motherhood and managing concerns and opportunities that may arise.[26] Postpartum care remains a high-risk but often neglected aspect of a holistic and flexible scope of pregnancy care, for both mothers and newborns in the United States. This is attributable in part to having limited national initiatives to provide supportive and adequate health care, education programs, and reforming care policies that better address the current state of maternal morbidity and mortality in the country.[27]

Maternal Mortality and Morbidity

Maternal mortality is captured in the United States by measuring pregnancy-related deaths. A pregnancy-related death is the death of a person while pregnant or within 1 year of the end of that pregnancy, regardless of the outcome or duration of the pregnancy, that occurred as a direct or aggravated cause from the pregnancy.[28] For example, while a person who died from a cardiac condition that was aggravated during pregnancy would count as a pregnancy-related death, a pregnant person who died in a car crash would not. Because pregnancy-related death is a rare event in the United States, severe maternal morbidity (SMM) is often used to assess the quality of maternity care.

The CDC defines SMM as "unexpected outcomes of labor and delivery that result in significant short- or long-term consequences to a person's health."[29] SMM is nearly 100 times more

[22] American College of Obstetricians and Gynecologists. (2018). Optimizing postpartum care: ACOG Committee opinion 736. *Obstetrics and Gynecology* 131:e140-150.

[23] Ibid

[24] Ibid

[25] American College of Obstetricians and Gynecologists. (2013). Postpartum depression. Frequently Asked Questions about Labor, Delivery, and Postpartum Care. *American College of Obstetricians and Gynecologists: Women's Health Care Physicians.* https://www.acog.org/Patients/FAQs/Postpartum-Depression (accessed October 16, 2019)

[26] DeVoe, J. E., A. Geller, and Y. Negussie. (2019) Vibrant and healthy kids: Aligning science, practice and policy to advance health equity. Ch. 4. *The National Academies Press,* https://www.nap.edu/read/25466/chapter/4.

[27] Cheng, C.-Y., E. R. Fowles, and L. O. Walker. (2006). *Continuing education module: Postpartum maternal health care in the United States: A critical review.* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1595301/.

[28] Center for Disease Control and Prevention (2019). *Pregnancy-related deaths.* https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-relatedmortality.htm.

[29] Centers for Disease Control and Prevention. (27 November 2017). *Reproductive health: Severe maternal morbidity in the United States.* https://www.cdc.gov/reproductivehealth/maternalinfanthealth/severematernalmorbidity.html.

common than pregnancy-related death in the United States.[30] There are currently 21 SMM indicators that correspond with conditions listed in the International Classification of Diseases (ICD), including heart failure, eclampsia, sepsis, and pulmonary edema. The SMM incidence rate has increased both globally and nationally in the past decades (Figure 2).[31] A variety of factors contribute to an increase in SMM and pregnancy-related deaths. Many of these factors are either direct causes of pregnancy complications or predisposed conditions (e.g., obesity, thromboembolic disease, gestational diabetes, obstetrical hemorrhage, hypertension), while others are of profound nature such as structural inequalities based on socioeconomic and racial/ethnic status (e.g., being black or Hispanic, and being older than 40 years old). Other causes include complications attributable to medical procedures, such as prior history of cesarean delivery or anesthesia complications.[32]

Chronic conditions such as heart disease and obesity can increase the risk of having pregnancy complications, including SMM. Individuals who have a Body Mass Index (BMI) greater than 40 have 40 percent higher odds of experiencing SMM or mortality compared to those who have a BMI between 18.5 and 24.9.[33] High maternal prepregnancy weight and BMI, as well as gestational weight gain, are associated with pregnancy complications including pregnancy loss, prematurity, stillbirth, low birth weight, gestational diabetes, hypertension, preeclampsia, cesarean delivery, and postpartum weight retention.[34]

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[30] Ibid

[31] Centers for Disease Control and Prevention. (25 June 2019). *Reproductive health: Severe maternal morbidity indicators and corresponding ICD codes during delivery hospitalizations.* https://www.cdc.gov/reproductivehealth/maternalinfanthealth/smm/severe-morbidity-ICD.htm.

[32] Goffman, D., R. C. Madden, E. A. Harrison, I. R. Merkatz, and C. Chazotte. (16 August 2007). Predictors of maternal mortality and near-miss maternal morbidity. *Journal of Perinatology* 27(1):597-601. https://www.nature.com/articles/7211810.

[33] Ibid

[34] Santos, S., E. Voerman, P. Amiano, H. Barros, L. J. Beilin, A. Bergstrom, M. A. Charles, L. Chatzi, C. Chevrier, V. W. V. Jaddoe. (2019). Impact of maternal body mass index and gestational weight gain on pregnancy complications: An individual participant data meta-analysis of European, North American and Australian cohorts. *British Journal of Obstetrics and Gynecology* 126:8.

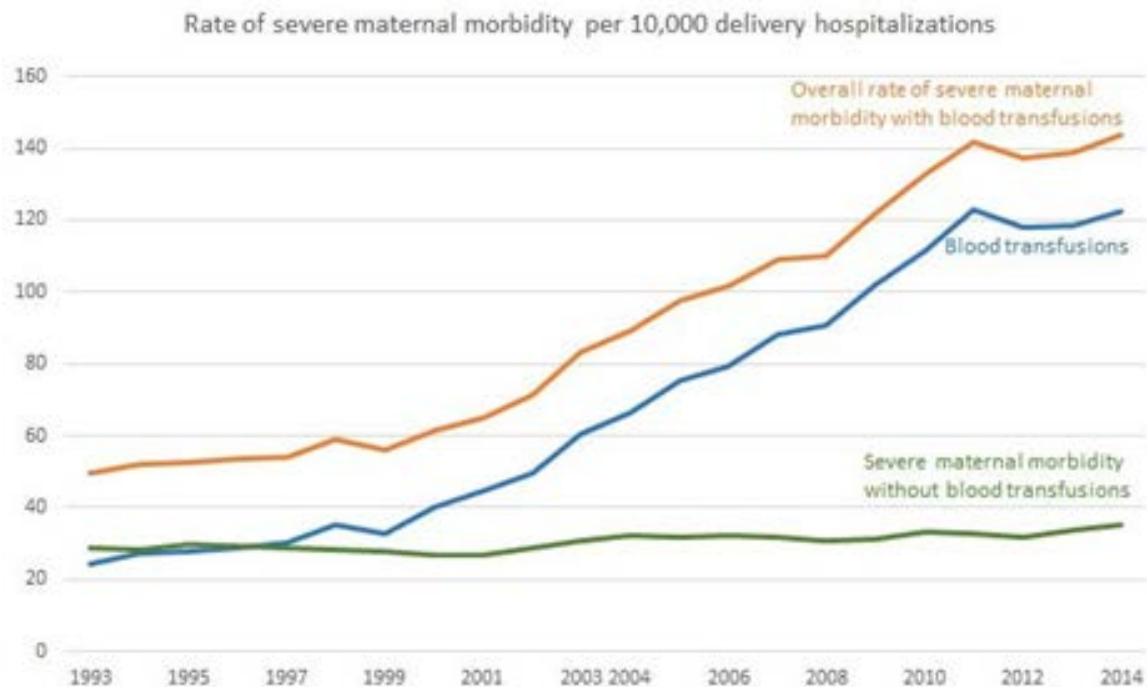Rate of severe maternal morbidity per 10,000 delivery hospitalizations

Figure 2. Trends in severe maternal morbidity (SMM) from 1993 to 2014. Source: HRSA Maternal Mortality Summit: Promising Global Practices to Improve Maternal Health Outcomes (HHS, 2019).[35]

National Statistics

There are approximately 700 pregnancy-related deaths in the United States each year, with disproportionately high rates occurring in low-income women and women of color.[36] Hispanic women have the lowest pregnancy-related mortality ratio (PRMR) in the United States at 11.5 deaths per 100,000 live births. Non-Hispanic white women and Asian/ Pacific Islander women have similar pregnancy-related mortality ratios at 12.7 and 13.5 deaths per 100,000 live births, respectively.[37] The PRMR is significantly higher for black and American Indian/Alaskan Native women compared to Hispanic, white, and Asian/Pacific Islander women. Black women have the highest PRMR at 40.8 deaths per 100,000 live births while American Indian and Alaskan Native women have a pregnancy-related mortality ratio of 29.7 deaths per 100,000 live births.[38] Racial and ethnic disparities in PRMR become more pronounced with increasing age, with black and American Indian/Alaskan Native women having PRMR four to five times higher than that of white women.[39] These disparities persist regardless of age and education level, and persist in states with the lowest national PRMRs.[40]

Pregnancy-related deaths can occur during pregnancy up until 1 year postpartum; 31 percent of these deaths occur during pregnancy, 36 percent occur at delivery or in the week following, and

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[35] https://www.cdc.gov/media/releases/2019/p0905-racial-ethnic-disparities-pregnancy-deaths.html (accessed October 16, 2019)

[36] Ibid 2, 3

[37] Ibid 4

[38] Ibid 4

[39] Ibid 2, 3, 4

[40] Ibid 2, 3, 4

33 percent occur between 1 week and 1 year postpartum (Figure 3).[41] An estimated three out of five pregnancy-related deaths in the United States are preventable.[42] The top causes of pregnancy-related deaths in the United States are cardiovascular diseases, infection, and hemorrhage. Although the leading cause of pregnancy-related death varies before, during, and following delivery, cardiovascular diseases are the leading cause of total pregnancy-related deaths, with heart disease and stroke contributing to over a third of pregnancy-related deaths.
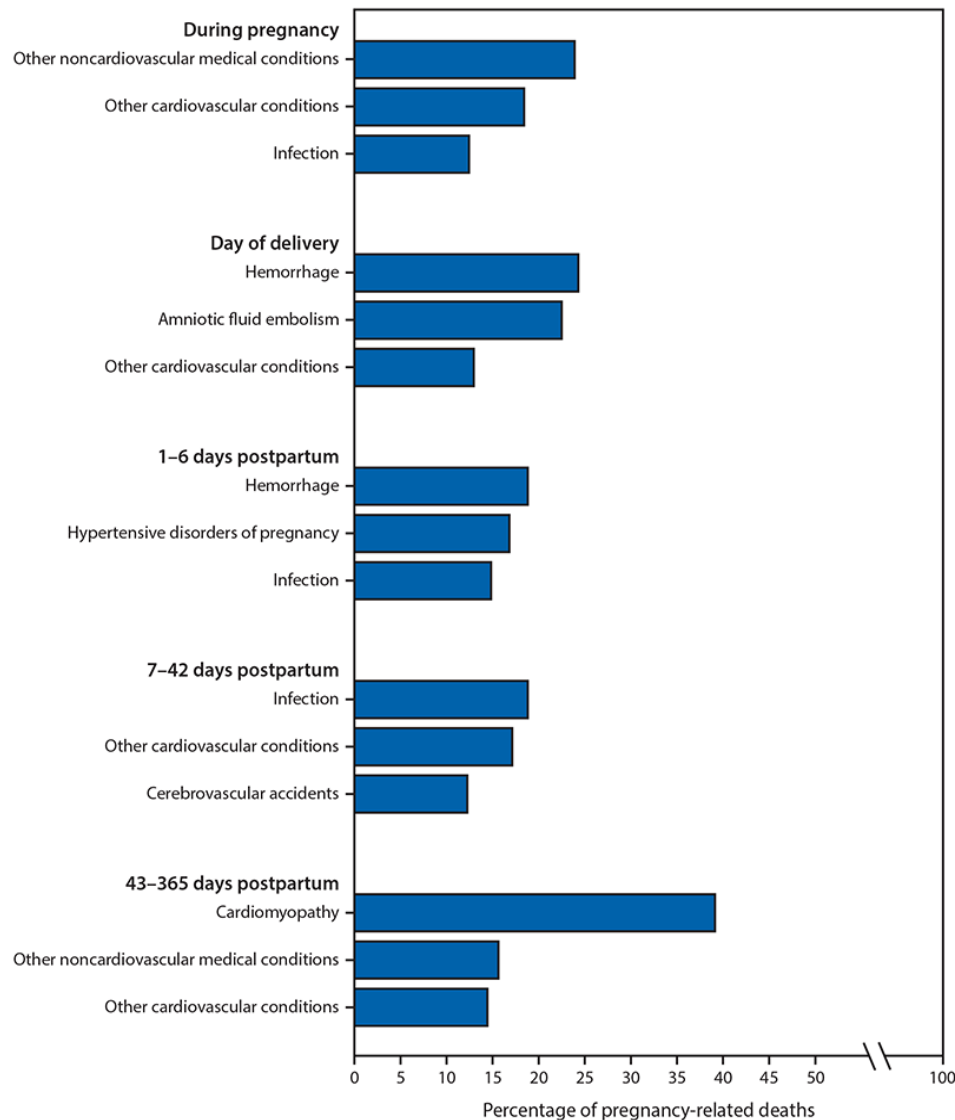
Figure 3: Percentage of pregnancy-related deaths at specific pregnancy intervals. Source: Pregnancy-Related Deaths Happen Before, During, and Up to a Year After Delivery (Centers for Disease Control and Prevention, 2019).

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[41] Centers for Disease Control and Prevention. (2019). *Pregnancy-related deaths happen before, during, and up to a year after delivery.* https://www.cdc.gov/media/releases/2019/p0507-pregnancy-related-deaths.html.
[42] Ibid 3

Lack of access to quality health care can contribute to poor maternal health outcomes. People in rural areas may be more likely to lack access to high-quality obstetric care.[43] Additionally, resource-deprived facilities tend to be staffed by providers with limited knowledge, training, and preparation, particularly in obstetric emergency situations, which further contributes to poor outcomes.[44] Limited knowledge among women and their families about care prior to conception, during pregnancy, and the postpartum period can increase risk factors for maternal morbidity.[45] Notably, mental health disorders, especially depression, occur in 10 percent of women who are pregnant and 13 percent of women who are postpartum. Women with a low income or who have experienced domestic violence have an increased risk for mental health disorders.[46] Women who are unaware of the signs and symptoms of depression may not recognize the need to seek care. Interventions at the individual, facility, community, and systems level are necessary to prevent pregnancy-related deaths.[47]

Over the past 60 years, the rate of pregnancy-related deaths among black women in the postpartum period has been three to four times higher than that of white women.[48] Moreover, American Indian and Alaskan Native women are twice as likely to die of pregnancy-related deaths during the postpartum period compared to white women.[49] These differences in mortality are largely attributed to factors such as decreased access to quality health care, discrimination in the health care system, and chronic stress caused by systemic discrimination. Additionally, many chronic diseases that increase risk for pregnancy complications including mortality are more prevalent in black women.[50] Systemic discrimination can lead to negative perinatal outcomes, which disproportionately affect the black and Hispanic community, and immigrants, as exemplified by a population study in New York City.[51] On average, 25 percent of U.S. women do not attend all of the recommended prenatal visits, with a higher proportion not attending among black women (32 percent) and American Indian or Alaska Native women (41 percent).[52]

Despite leading the world in health care spending dollars, the maternal mortality ratio in the United States is the highest of all high-resource countries.[53] While some of this can be contributed to improved data collection and measurement of pregnancy-related deaths,

[43] Health Resources and Services Administration. (15 February 2019). *HRSA maternal mortality summit: Promising global practices to improve maternal health outcomes.*
https://www.hrsa.gov/sites/default/files/hrsa/maternal-mortality/Maternal-Mortality-Technical-Report.pdf
[44] Ibid
[45] Ibid
[46] World Health Organization. (2019). *Mental health: Maternal mental health.*
https://www.who.int/mental_health/maternal-child/maternal_mental_health/en/.
[47] Centers for Disease Control and Prevention. (07 May 2019). *Pregnancy-related deaths: Saving women's lives before, during and after.* https://www.cdc.gov/vitalsigns/maternal-deaths/index.html
[48] Maternal Health Task Force. (2019). *Maternal health in the United States.*
https://www.mhtf.org/topics/maternal-health-in-the-united-states/.
[49] Ibid
[50] Ibid 3
[51] Angley, M., C. Clark, R. Howland, H. Searing, W. Wilcox, and S. H. Won. (2016). New York City, 2008-2012: Severe maternal morbidity. *New York City Department of Health and Mental Hygiene.*
https://www1.nyc.gov/assets/doh/downloads/pdf/data/maternal-morbidity-report-08-12.pdf.
[52] Ibid
[53] World Health Organization, United Nations International Children's Emergency Fund, United Nations Fund for Population Activities, World Bank Group, United Nations Population Division. (2015). *Trend in maternal mortality, 1990 to 2015: Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.* .
https://apps.who.int/iris/bitstream/handle/10665/194254/9789241565141_eng.pdf;jsessionid=76A9E625C9551FE322AD919602B669B8?sequence=1.

disparities in health care access and quality contribute as well. A study performed in 2017 concluded that pregnancy-related deaths in the United States initially slightly dropped from 2006 to 2010, but thereafter remained stagnant.[54]

Pregnancy-related deaths and other maternal mortality statistics have been historically hard to measure in the United States, though the introduction of pregnancy status on death certificates in many jurisdictions has been responsible for initiating a positive change.[55] Nonetheless, limited national standards exist for the collection of maternal mortality statistics, leading to insufficient data regarding the effect of race, ethnicity, income, and health insurance status on maternal health.[56] Inaccurate reporting of this information leads to the lack of recognition of disparities in health among minorities and minimal change to improve the health care of these individuals. To learn more about these data measurement and data sources, refer to the Policy section of this case (p. 46-47).

District of Columbia Demographics

From 2005 to 2014, the CDC reported that DC had the highest maternal mortality ratio in the nation with 38.8 pregnancy-related deaths per 100,000 live births (Table 2).[57] Areas outside DC reported far lower ratios, with 23.8 deaths per 100,000 live births in Maryland and 11.7 deaths per 100,000 live births in Virginia from 2005 to 2014. From 2016 to 2018 the pregnancy-related death rate in DC dropped from 40.0 to 36.1 pregnancy-related deaths per 100,000 births; however, that rate is still almost double the national average of 20.7 deaths per 100,000 births (Figure 4).[58] Additionally, the pregnancy-related death rate for women in DC is 1.5 times the national average for black women (Figure 5).[59] While DC has the highest prevalence of normal prepregnancy weight in the nation at 52.2 percent, 50.7 percent of all women were considered to be overweight or obese in 2017. Furthermore, low-income women and non-Hispanic black women in DC are significantly more likely to have overweight or obesity compared to women with higher incomes and non-Black women.[60]

Table 2: Comparison of maternal mortality rate stratified by ethnicity between the United States, DC, Maryland, Virginia, and other selected states. Adapted from: Health Care Disparity and State-Specific Pregnancy-Related Mortality in the U.S., 2005-2014 (Moaddab, 2016).

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[54] Creanga, A. A., C. Syverson, K. Seed, and W. M. Callaghan. 2017. Pregnancy-related mortality in the United States, 2011–2013. *Obstetrics & Gynecology* 130(2):366-373.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5744583/.

[55] Ibid 28

[56] Ibid 54

[57] Ibid 4

[58] United Health Foundation. (2018) *Maternal mortality. America's health rankings.*
https://www.americashealthrankings.org/explore/health-of-women-and-children/measure/maternal_mortality_a/state/DC.

[59] Ibid

[60] Ibid

STATE	TOTAL	HISPANIC	NON-HISPANIC WHITE	NON-HISPANIC BLACK	NATIVE AMERICAN	ASIAN
United States	17.2	11.3	14.1	40.2	25.1	10.6
District of Columbia	38.8	7.4	0	70.6	0	---
SURROUNDING REGION						
Maryland	23.8	9.4	16.5	41.8	0	14.9
Virginia	11.7	4.6	8.2	25.7	53.5	7.8
SECOND HIGHEST TOTAL MATERNAL MORTALITY RATE						
Arkansas	28.9	19.5	24.1	51.8	0	25.0
HIGHEST HISPANIC MATERNAL MORTALITY RATE						
Mississippi	24.4	33.7	16.0	34.2	0	0
HIGHEST NON-HISPANIC WHITE MATERNAL MORTALITY RATE						
Texas	23.9	15.6	26.2	56.5	26.3	12.3
HIGHEST NON-HISPANIC BLACK MATERNAL MORTALITY RATE						
New Mexico	23.0	25.5	14.9	83.0	23.7	0
HIGHEST NATIVE AMERICAN MATERNAL MORTALITY RATE						
North Dakota	18.0.	0	10.4	0	78.5	56.6
HIGHEST ASIAN MATERNAL MORTALITY RATE						
Vermont	11.7	4.6	8.2	25.7	53.5	78.2

The 2013 District of Columbia Community Health Needs Assessment primarily addressed maternal health from the perspective of its effect on infant mortality, noting complications of pregnancy was the second leading cause of infant mortality.[61] Pregnancy-related complications were associated with individuals who lacked high-quality prenatal care early in the pregnancy, during either the first or second trimester, which contributed to elevations in both infant mortality rate and maternal mortality rate. In 1991 the Community Health Administration of the District of Columbia Department of Health enabled residents of Wards 5, 6, 7, and 8 to receive home visits for obstetric care; however, in 2008 the Infant Mortality Citywide Action Plan was launched, which doubled the number of home visits and likely contributed to lower infant mortality rates. No specific attention was devoted to maternal health in the 2013 DC Needs Assessment.

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[61] District of Columbia Department of Health. (5 March 2013). District of Columbia community health needs assessment. *District of Columbia Department of Health* 1(1):1-80.

Trend: Maternal Mortality, District of Columbia, United States

Number of deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 births

■ District of Columbia

● United States

Source:
- CDC WONDER Online Database, Mortality files

Figure 4: Trends of maternal mortality rates in DC show a slight down trend but an overall higher rate compared to the national pregnancy-related death rates. Source: Maternal Mortality (United Health Foundation, 2018).[62]

Subpopulations: Maternal Mortality, District of Columbia, United States

RACE/ETHNICITY

Maternal Mortality - Black

DC: 70.9
U.S.: 47.2

Deaths per 100,000 live births

AGE

Deaths per 100,000 live births

Data suppression rules are as defined by the original source.

Race and ethnicity populations are as defined by the original source.

Source:
- CDC WONDER Online Database, Mortality files, 2011-2015

Figure 5: The average maternal mortality rate among black women in DC is 1.5 times greater than the national average. Source: Maternal Mortality (United Health Foundation, 2018).[63]

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[62] Ibid
[63] Ibid

Theoretical Background

Social Determinants of Health

When implementing public health interventions, it is important to be mindful of the target population and to align interventions with the social determinants of heal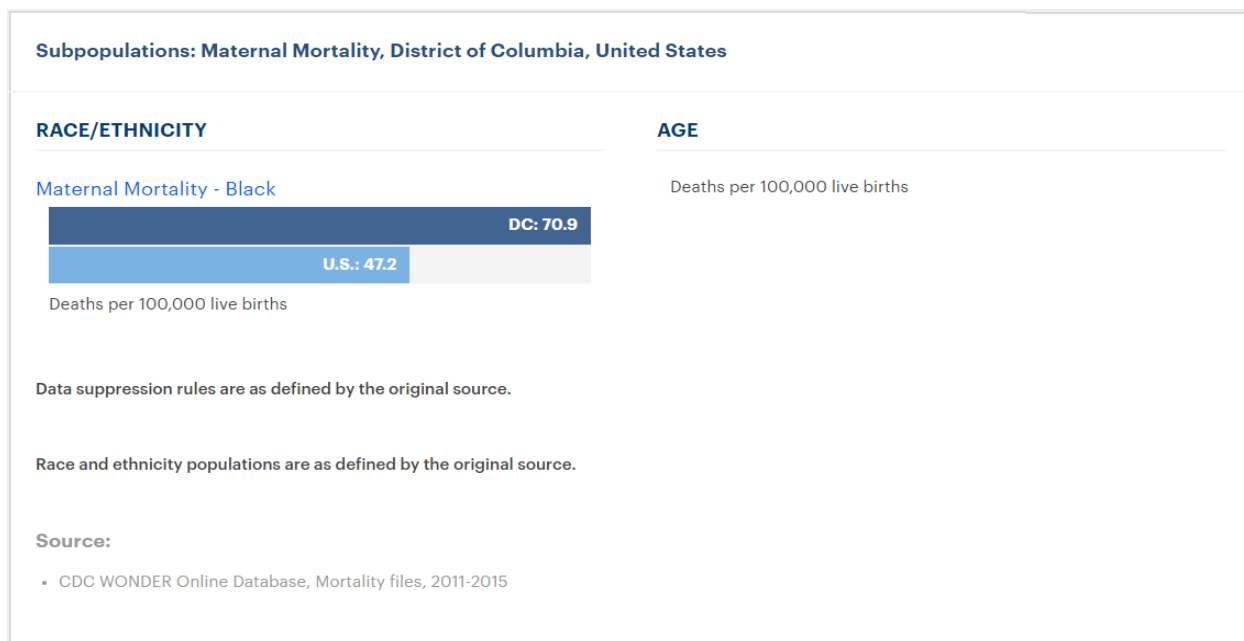th present in that population.[64] The CDC defines social determinants of health as " the circumstances in which people are born, grow up, live, work, and age" including "the systems in place to offer health care and services offered to the community."[65] The determinants of health may also be organized into structural determinants of health inequities (e.g., governance and policies), intermediary determinants of health (e.g., community conditions), and family and peer influences (see Figure 6).[66] By first identifying a community's social determinants of health, one is able to improve health and reduce long-standing health disparities. According to the National Academies of Sciences, Engineering, and Medicine (the National Academies), health disparities refer to "differences that exist among specific population groups in the United States in the attainment of full health potential that can be measured by differences in incidence, prevalence, mortality, burden of disease, and other adverse health conditions."[67] The combination of these two concepts are meant to lessen the social disadvantages in each community and increase health outcomes.
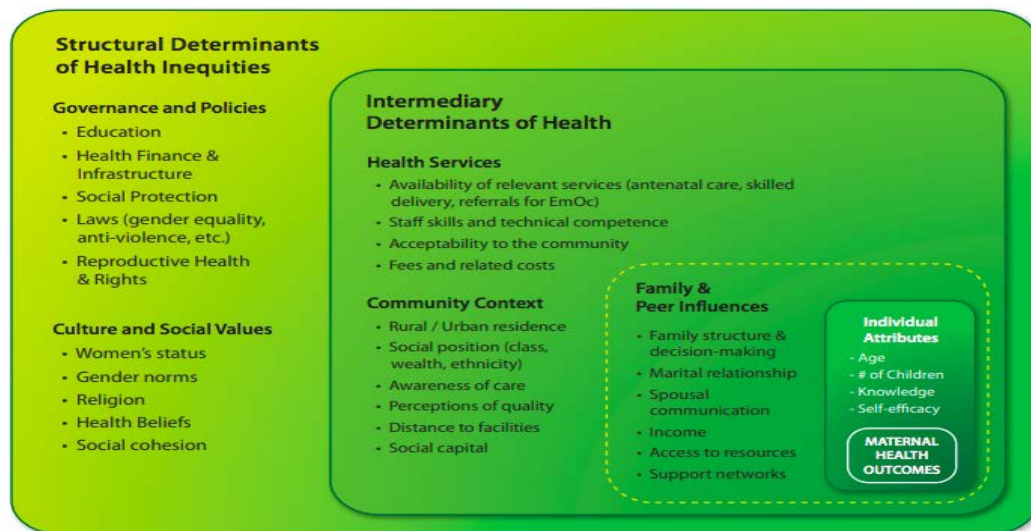

Figure 6: Depiction of social determinants of health inequalities at different social ecological levels. Source: Discussion Paper: A Social Determinants Approach to Maternal Health (Bureau for Development Policy, 2011).

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[64] U.S. Department of Health and Human Services. (2019). *Social determinants of health*.https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health.
[65] Centers for Disease Control and Prevention. (2019). *Social determinants of health NCHHSTP*. https://www.cdc.gov/nchhstp/socialdeterminants/index.html#targetText=Social determinants of health are,and services to a community.
[66] Bureau for Development Policy. (19 October 2011). *Discussion paper: A social determinants approach to maternal health. .* https://www.undp.org/content/dam/undp/library/Democratic%20Governance/Discussion%20Paper%20MaternalHealth.pdf.
[67] NASEM. (2017). Communities in action: Pathways to health equity. The National Academies Press. https://doi.org/10.17226/24624.

Social Ecological Model of Health

The social ecological model is a systems model representing the different levels of influence on health. At the core of the social ecological model is the individual, surrounded by the interpersonal, organizational, community, and policy levels. Effective implementation of public health activities at these levels of influence will enable interventions to have a greater affect through collaborative application.[68] The levels of influence are described below:

Individual level: The core of the social ecological model represents the individual as the target of intervention. The emphasis of influence at this level should focus on ways to increase the individual's knowledge and self-efficacy towards the potential risks and benefits of interventions. In addition to influencing individual attitudes and beliefs, efforts at this level should focus on facilitating access to affordable health care, including prenatal, perinatal, and postnatal care; contraceptive access; and cancer and STI screenings.

Interpersonal level: At the interpersonal level of influence, interventions should aim to facilitate behavior change by focusing on shifting cultural and social norms. This could include encouraging family members and friends to be a source of support to the individual, as well as timely reminders about prevention, screenings, and discussions on family planning and social support.

Organizational level: Organizational-level influence should incorporate various institutions, such as health care systems, community clinics, local health departments, schools, and faith-based organizations, to support health interventions. These organizations could offer support by providing assessment of screening efforts, expanding access to screening, and supporting policies that promote preventive care including safe reproductive health clinics and easy access to contraceptives, as well as depression screening and management and prevention of commodities.

Community level: Community-level interventions involve those that leverage community organizations as a means to encourage and facilitate behavior change through energizing the community and its stakeholders to address public health issues within their community. Interventions at this level normally involve changing or bringing awareness to social or physical public health issues that can be improved by energizing community stakeholders to enact change. Some examples include establishing home visits within a community, empowering mothers through community groups, and even leveraging technology between community health organizations and mothers to reduce potential complications.

Policy level: Policy-level influence involves actions by federal, state, and local governments to support and enact policies to advance health. Efforts at this level are intended to promote healthy behavior and help increase cognizant awareness of what those policies bring to help stakeholders thrive. While affecting this level, it is important to differentiate between "Big Policy" government-based legislation and "Little Policy" nongovernmental legislation, so the issue can be effectively pinpointed and addressed.[69] Examples of Big Policy influence include funding of reproductive health clinics, tax-free feminine hygiene products, access to abortion clinics, and advocacy for maternity and paternity leave, while Little Policy examples include improving a company's organizational stance on maternal health.

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[68] Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion* 10(4): 282-298. http://www.escholarship.org/uc/item/2bv79313.
[69] House, E. (1991). Big policy, little policy. *Educational Researcher* 20(5):21-26. http://www.jstor.org.proxygw.wrlc.org/stable/1176398.

Maslow's Hierarchy of Needs

Maslow's hierarchy of needs provides a framework in which to conceptualize human needs. The framework could be useful to consider when developing public health solutions and implementation strategies because it informs discussing and understanding the spectrum of human needs, and by extension, the needs of people of reproductive age before, during, and after pregnancy.

In 1943, Abraham Maslow identified five categories of needs: physiological, safety, love belonging, esteem, and self-actualization (Figure 7).[70,71] Maslow's needs are organized in a pyramidal structure, demonstrating the natural tendency to fulfill the bottom-most categories prior to addressing higher-level needs. However, it is recognized that people often deviate from this structure, as life experiences cause fluctuation in the current needs, and people sometimes suppress needs of lower tiers to prioritize accomplishing higher-level goals first.
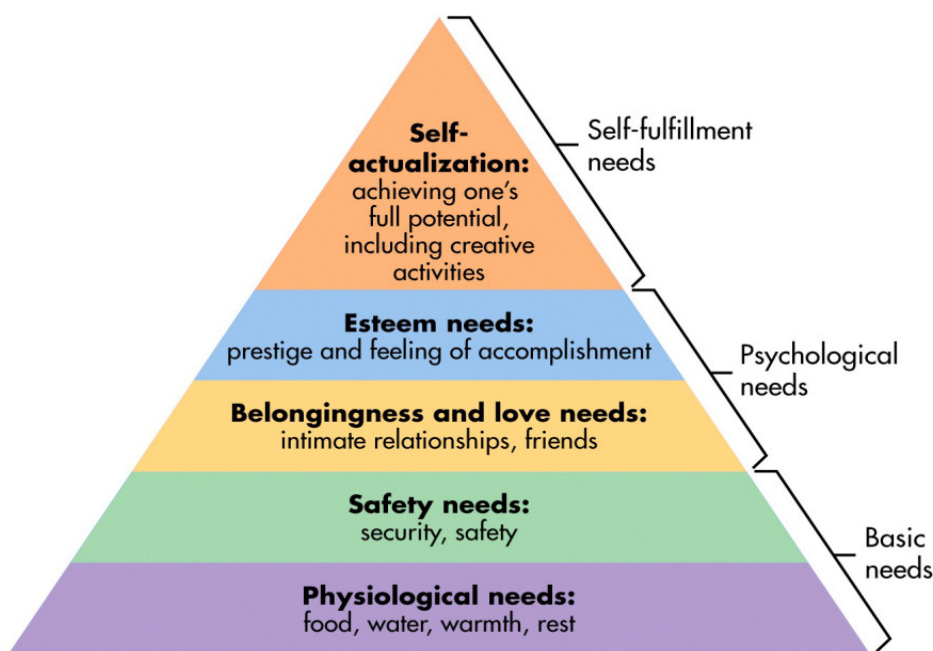
Figure 7: A pyramidal depiction of Abraham Maslow's original hierarchy of needs, demonstrating the greater propensity to satisfy needs in an immediate fashion as the diagram descends. Source: Maslow's Hierarchy of Needs (McLeod, 2018)[72]

Physiological needs are rooted in achieving biological homeostasis to maintain survival, such as consumption of nutrients and water, using shelter and clothing, regulating body temperature, engaging in sexual reproduction, and achieving adequate sleep.[73] After fulfilling one's basic needs, the focus pivots towards addressing safety concerns, which include seeking protection from natural elements, avoiding societal sanctions, and maintaining emotional stability.[74] Success in maintaining safety further contributes to one's survival.

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[70] McLeod, S. (2018). Maslow's hierarchy of needs. https://www.simplypsychology.org/maslow.html.
[71] Huitt, W. (2007). Maslow's hierarchy of needs. *Educational Psychology Interactive.* http://www.edpsycinteractive.org/topics/conation/maslow.html.
[72] Ibid
[73] Ibid
[74] Ibid

Once individual needs are met, motivation can be directed towards developing positive interpersonal interactions and relationships in order to gain social support.[75] Belonging can provide a sense of purpose and heighten one's well-being. Sense of esteem is based upon the perspective of oneself as well as others' perceptions of the individual.[76] The emotional well-being of individuals can greatly alter one's mental health, which can profoundly affect physical health.

After biological and emotional needs are satisfied, cognitive desires can be sought in order to expand growth of knowledge and exploration.[77] After gaining insight, one may appreciate and strive to fulfill aesthetic needs, which encompasses the desire for symmetry, organization, and beauty.[78] These needs are not always essential for survival, but often augment the quality of one's life.

The final two needs are not necessary for survival, but help contribute to fulfilling one's sense of purpose. The first step is recognizing the need for self-actualization.[79] Secondly, after achieving self-actualization, some may strive to reach beyond the needs of their ego to guide others towards obtaining their self-fulfillment and ultimately reaching their potential.[80]

The Workforce for Maternal Health

DC residents receive pregnancy, birth, and postpartum care from several types of providers, both clinical and nonclinical. In 2016, 89.4 percent of DC women received maternal health care from physicians and 10.3 percent received care from certified nurse midwives (CNMs).[81] The history, varying skill sets, and status of midwives have important implications for the integration of midwifery into maternal health care systems. Integration of midwifery care models into traditional maternal care systems is important, as it improves access to culturally appropriate maternal health care.[82]

History of Midwives

Midwifery has an ancient history around the world.[83] Before the advent of modern medicine, midwives attended almost all home births, and skills were passed down through generations without any formal training.[84] The evolution of obstetrics care has affected both the scope and purpose of midwifery in the United States (Figure 8).

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[75] Ibid

[76] Ibid

[77] Ibid

[78] Ibid

[79] Ibid

[80] Ibid

[81] March of Dimes. (2018). *Nowhere to go: Maternal care deserts across the U.S.* https://www.marchofdimes.org/materials/Nowhere_to_Go_Final.pdf.

[82] Strauss, N. (January 2018). Maximizing midwifery to achieve high-value maternity care in New York. *Choices in Childbirth and Every Mother Counts.* https://everymothercounts.org/wp-content/uploads/2018/10/MaxiMiNY_Final_5_3_18.pdf.

[83] Whaley, H. Colonial midwifery. *Wonders and marvels: A community for curious minds who love History, its odd stories and good reads.* http://www.wondersandmarvels.com/2011/06/colonial-midwifery.html.

[84] Rooks, J. P. (22 May 2014). The history of midwifery. *Our bodies our selves: Information inspires action.* https://www.ourbodiesourselves.org/book-excerpts/health-article/history-of-midwifery/.

1910-1920	• US obstetricians were poorly trained, recommendation for hospitalization for deliveries and abolition of midwifery practices; preference of charity hospitals (with doctors-in-training) over midwifery for the poor
1914	• "Twilight sleep" referring to utilization of morphine (pain relief) and scopolamine (amnesiac) during upper-class births, however later negative effects were discovered and publicized
1915	• Dr. Joseph DeLee described the physiologic stress placed on women and fetuses during pregnancy, referring to it as a "pathologic process," and devaluing the competencies of midwives which lead to a decrease in midwifery in the US, while implementing new interventions to counteract the destructive nature of deliveries
1925	• Frontier Nursing Service (Kentucky) founded by Mary Breckinridge, a public health nurse for the Red Cross in France in WWI, who trained with the British, introduced nurse-midwifery
1930	• Less than 15% of practicing midwives, mostly black or poor-white granny midwives in the south, increased incidence of mother and infant deaths (41% infant mortality rate increase)
1950	• Nurse-midwives started practicing in hospitals instead of only attending home births
1960	• Less than 70 nurse-midwives were practicing, focused on family-centered care, provided childbirth education, encouraged mother-baby rooming, promoted breastfeeding, mostly work in hospitals nowadays
1960-1970	• Direct-entry midwives were created, empowered women to claim their bodies and births, home births by informally trained midwives, no prior nursing background, mainly provide home birth care today
Today	• In the US 98.6% of births occur in hospitals with almost 92% of deliveries assisted by physicians • UK, Sweden, Japan and other industrialized countries: midwives deliver more babies than obstetricians

Figure 8: Timeline of the evolution of obstetricians and their effect on midwifery. Adapted from: The History of Midwifery[85] (Rooks, 2014).

Although midwifery began in home-based settings, most midwives today work in health care facilities such as hospitals or birthing centers. Midwives have different scopes of practice based on their license, training, and qualifications. CNMs are registered nurses certified in midwifery. CNMs can work in hospitals and clinic-based settings. Direct-entry midwives, such as certified professional midwives (CPMs) and certified midwives (CM) are trained primarily in settings located outside of the hospital. CMs are similar to CNMs in their training and scope of practice, but instead of a nursing degree, other science and health coursework and skills training is required.[86,87] CPMs may be trained by accredited programs with varied standards, but they may

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[85] Ibid

[86] Ibid

[87] American College of Nurse-Midwives. (n.d.) *Comparison of certified nurse-midwives, certified midwives, certified professional midwives clarifying the distinctions among professional midwifery credentials in the U.S.* https://www.midwife.org/acnm/files/ccLibraryFiles/FILENAME/000000006807/FINAL-ComparisonChart-Oct2017.pdf (accessed October 2, 2019).

also simply learn as apprentices under an experience midwife, without any type of formal training.[87,88] CPMs are outlawed in 22 states and barred from receiving licensure, certifications, registration, or permits required to practice.[89]

Integration of midwifery care models into the health care system can prevent poor maternal and infant health outcomes such as preterm birth, low-birth weight, and cesarean delivery.[90] Policies that limit or outlaw midwifery limit access to care, particularly for those in poor and rural communities who may have limited access to hospitals and birth centers.[91]

History of Doulas

Doulas are not health care providers and therefore do not actually carry out the task of delivering babies.[92] Instead, the role of doulas is to advocate for the patient through providing physical, emotional, and social support. Such support has been proven to be beneficial since nurses and physicians often cannot provide sufficient time and attention to fully comfort patients owing to the demands of high volumes of patients.[93,94] Some doulas provide care during labor while others provide care throughout the postpartum period. Labor doulas attend the birth of the child and provide support throughout the delivery, while postpartum doulas help mothers access and use existing resources and services following delivery.[95]

Studies show that doula care can decrease poor maternal and newborn outcomes.[96] No certification is required to become a doula, although many participate in programs such as DONA International and Childbirth and Postpartum Professional Association (CAPPA) for formal training and certification.[97]

The role of doulas was established to provide support to mothers and expecting mothers beyond that which is provided to them by health care providers.[98] Although over 50 percent of women who gave birth in 2014 were women of color, racial and ethnic diversity is scarce among

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[88] Lusero, I. (30 November 2014). Making the midwife impossible: How the structure of maternity care harms the practice of home birth midwifery. *Women's Rights Law Reporter* 35(3):406-434. https://static1.squarespace.com/static/57126eff60b5e92c3a226a53/t/57bef331197aeadebcdb1c41/14721 31890592/Lusero+FINAL.pdf.
[89] Ibid
[90] DeVoe, J. E., A. Geller, and Y. Negussie. (2019) Vibrant and healthy kids: Aligning science, practice and policy to advance health equity. Ch. 5. *The National Academies Press.* https://www.nap.edu/read/25466/chapter/5.
[91] Ibid
[92] Dekker, R. (04 May 2019). *Evidence-based birth: Evidence on doulas.* https://evidencebasedbirth.com/the-evidence-for-doulas/.
[93] Main, M. (June 2017). Beyond the breast: Culturally competent doulas as a breastfeeding intervention. *University of Washington School of Public Health: Northwest Bulletin of Family and Child Health.* https://depts.washington.edu/nwbfch/archives/beyond-breast-culturally-competent-doulas-breastfeeding-intervention.
[94] Grubber, K. J., S. H. Cupito, and C. F. Dobson. (2013). Impact of doulas on healthy birth outcomes. *Journal of Perinatal Education: Advancing Normal Birth* 22(1):49-58. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3647727/.
[95] Ibid
[96] Kozhimannil, K. B., R. R. Hardeman, L. B. Attanasio, C. Blauer-Peterson, and M. O'Brien. (April 2013). Doula care, birth outcomes, and costs among Medicaid beneficiaries. *American Journal of Public Health* 103(4):e113-e121. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3617571/.
[97] Ibid
[98] Ibid

health care providers including both midwives and obstetricians.[99] A study in 2003 showed that most doulas are well-educated, upper-middle class white mothers.[100] Women of color often report improved care when paired with doulas of the same racial or ethnic background.[101] Culturally competent doulas may be particularly effective advocates for these patients, serving as a mediator between the patient and the provider to promote better understanding of the patient's values and desires, as well as comprehension of expected provider roles and procedures.

Services provided by doulas are not typically covered by insurance, so individuals who might benefit the most may lack access to their services.[102] The Community-Based Doula Program has been enacted nationally to counteract disparities in access by providing doulas to communities where there are increased health care and social needs.[103] Since this program has been initiated, there have been better pregnancy outcomes in this population.

Midwives and Doulas in DC

The District of Columbia Primary Care Association (DCPCA) has recently recommended the use of midwives and doulas to improve access and quality of maternal health care. While patients are often unaware of the existence of midwives and doulas, they are generally receptive to receiving their care when offered. Disseminating information about midwives and doulas as well as establishing partnerships between the Maternal Mortality Review Committees (MMRC) and the Women's Health Improvement Collaborative could expand access and knowledge to care. Additionally, the DCPCA identified the need to build trust between the community and the providers, including midwives and doulas. Specifically, the DCPCA recommended increasing representation of minorities among midwives and doulas to help address cultural and language barriers faced by many women.[104]

A 1989 study analyzing the availability of CNMs in DC found that hospitals were becoming more receptive to integrating CNMs into their practice, but barriers to access remained a problem.[105] The practices of midwives are highly regulated and tightly supervised, and midwives often require constant physician oversight.[106] In most of the hospitals CNMs were unable to obtain hospital privileges (i.e., the ability to admit patients), which prevented true collaboration. For example, midwives from Community of Hope only have hospital privileges at the Medstar Washington Hospital Center.[107] Furthermore, the scope of practice of CNMs is restricted by their

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[99] Hardeman, R. R., and K. B. Kozhimannil. (14 November 2016). Motivations for entering the doula profession: Perspectives from women of color. *Journal of Midwifery and Women's Health* 61(6):773-780. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5143171/.

[100] Lantz, P. M., L. K. Low, S. Varkey, and R. L. Watson. (2005). Doulas as childbirth paraprofessionals: Results from national survey. *Women's Health Issues* 15(3):109-116. https://www.ncbi.nlm.nih.gov/pubmed/15894196.

[101] Ibid

[102] Ibid

[103] Ibid

[104] Ibid

[105] Langton P. A., and D. A. Kammerer. (1989). Childbearing and women's choice of nurse-midwives in Washington, D.C. hospitals. *Women's Health* 15(2):49-65. https://www.ncbi.nlm.nih.gov/m/pubmed/2781810/.

[106] District of Columbia Municipal Regulations. (n.d.). *District of Columbia municipal regulations for maternity centers.* District of Columbia Municipal Regulations Title 22:Chapter 6. https://dchealth.dc.gov/sites/default/files/dc/sites/doh/publication/attachments/Regulations-Maternity-Ctrs.pdf.

[107] Ibid

level of education.[108] Mary's Center has used telehealth for patients who are high-risk obstetrics patients, and in 2018 hired a CNM trained in telehealth medicine in hopes of improving access to care and decreasing poor outcomes in at-risk populations.[109]

Effect of Toxic Stress Across the Life Course

Early life events play an important role in shaping an individual's health trajectory. These life experiences can be both protective and harmful, and can accumulate across the life course and affect future generations. The life course approach looks across these experiences to better understand health outcomes by taking into account the social, economic, and cultural context of the individual.[110] Acknowledgement of how one's physical and social environments interact and affect the trajectory of the life course is vital in understanding the effect of chronic adversity on maternal mortality.[111,112] Studies have shown that various types of adversity can result in biological, specifically genetic, changes that can alter risk for various health conditions.[113] The science of such changes is referred to as "epigenetics." Epigenetic changes are heritable modifications to gene expression that do not physically result in a change to the genetic code.[114] DNA methylation is one example of such a change.[115] These changes are known to affect pregnancy outcomes and fetal/infant health, but such mechanisms may also affect maternal health outcomes.[116]

Epigenetic modifications can occur because of a variety of triggers, from nutritional deficits[117] and environmental toxins,[118] to chronic stress and intergenerational trauma.[119] Early life exposures can affect maternal health indirectly by increasing the likelihood of chronic conditions in adulthood such as cardiovascular disease, diabetes, and mental health conditions, which can increase the risk for pregnancy-related death.[120]

[108] Ibid

[109] Ibid

[110] NASEM. (2019). The promise of adolescence: Realizing opportunity for all youth. National Academies Press: Washington, DC.

[111] Halfon, N., K. Larson, M. Lu, E. Tullis, and S. Russ. (2014). Life course health development: past, present and future. *Maternal and Child Health Journal 18*(2):344-365.

[112] Ibid

[113] Ibid

[114] Januar, V., G. Desoye, B. Novakovic, S. Cvitic, and R. Saffery. (2015). Epigenetic regulation of human placental function and pregnancy outcome: Considerations for causal inference. *American Journal of Obstetrics and Gynecology* 213(4):S182-S196.

[115] Ibid

[116] Cao-Lei, L., D. P. Laplante, and S. King. (2016). Prenatal maternal stress and epigenetics: Review of the human research. *Current Molecular Biology Reports* 2(1):16-25.

[117] Geraghty, A. A., K. L. Lindsay, G. Alberdi, F. M. McAuliffe, and E. R. Gibney. (2016). Nutrition during pregnancy impacts offspring's epigenetic status: Evidence from human and animal studies. *Nutrition and Metabolic Insights* 8(Suppl 1):41-47. http://doi:10.4137/NMI.S29527.

[118] Perera, F., and J. Herbstman. (2011). Prenatal environmental exposures, epigenetics, and disease. *Reproductive Toxicology* 31(3):363-373. http://doi:10.1016/j.reprotox.2010.12.055.

[119] Bowers, M. E., and R. Yehuda. (2016). Intergenerational transmission of stress in humans. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology* 41(1):232-244. http://doi:10.1038/npp.2015.247.

[120] Ibid

Chronic and cumulative stress exposure and its direct effect on maternal health has been specifically implicated as an epigenetic cause for maternal health disparities.[121,122] Such stress exposures can result in allostatic load, which is when an overproduction of chemicals and hormones normally released during times of acute stress is experienced chronically and adversely.[123] Allostatic load can result in epigenetic changes such as DNA methylation, which can "turn off" certain genes, thus altering an individual's risk for certain conditions associated with that gene.[124] High allostatic load is associated specifically with increased odds of developing preeclampsia, preterm birth, and low birth weight among the highly exposed.[125,126] Populations who are repeatedly exposed to stress are thus uniquely at risk for adverse maternal outcomes, which is why allostatic load has been posited as a driver of health disparities across socioeconomic strata.[127]

One hypothesis that seeks to explain such disparities is the weathering hypothesis, which suggests that the cumulative exposure to socioeconomic disadvantage and environmental stressors results in increased disparities as high-exposed populations age and experience more stress.[128] This is supported by studies showing that black women in their twenties and thirties are at their lowest risk for adverse pregnancy outcomes when they are younger, unlike their white counterparts who are at their lowest risk at older ages.[129] A recent systematic review found evidence in support of weathering among at least one "socially or economically disadvantaged group" for a variety of health outcomes, including maternal health.[130]

Health-Related Social Needs

In addition to the clinical health care individuals receive before, during, and after pregnancy, maternal health is greatly influenced by health-related social needs, which include environmental and living conditions, socioeconomic status, employment status, educational level, and lifestyle choices, especially with regards to diet and physical activity. Identifying potential barriers to optimal conditions in these areas can help elucidate deficiencies and ultimately generate targeted solutions.

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[121] Szanton, S. L., J. M. Gill, and J. K. Allen. (2005). Allostatic load: A mechanism of socioeconomic health disparities? *Biological Research for Nursing* 7(1):7-15. http://doi:10.1177/1099800405278216.
[122] Ibid
[123] McEwen, B. S. (2005). Stressed or stressed out: What is the difference? *Journal of Psychiatry and Neuroscience* 30(5):315-318.
[124] Jin, B., Y. Li, and K. D. Robertson. (2011). DNA methylation: Superior or subordinate in the epigenetic hierarchy? *Genes and Cancer* 2(6):607-617. http://doi:10.1177/1947601910393957.
[125] Hux, V. J., and J. M. Roberts. (2015). A potential role for allostatic load in preeclampsia. *Maternal and Child Health Journal* 19(3):591-597. http://doi:10.1007/s10995-014-1543-7.
[126] Vitek, W., E. S. Barrett, O. Mbowe, S. W. Thurston, N. Santoro, and M. P. Diamond. (2017). Pre-conception allostatic load is associated with pregnancy outcomes, but not fertility, among women with unexplained infertility. *Fertility and Sterility* 108(3):e102-e103.
[127] Ibid
[128] Geronimus, A. T. (1992). The weathering hypothesis and the health of African-American women and infants: Evidence and speculations. *Ethnicity & Disease* 2(3):207-221.
[129] Ibid
[130] Forde, A. T., D. M. Crookes, S. F. Suglia, and R. T. Demmer. (2019). The weathering hypothesis as an explanation for racial disparities in health: A systematic review. *Annals of Epidemiology*, 33(1-18.e3).

Housing and Neighborhoods

Healthy People 2020 defines housing instability as a combination of various factors leading to the loss of long-term secure housing.[131] Some of the challenges include unaffordable rent, living in overcrowded conditions, and spending a large portion of income on housing.[132] These challenges can make it difficult to access health care and can negatively affect physical health.

A study conducted by the DC Fiscal Policy Institute found that rental prices in DC are growing faster than the incomes of many residents.[133] Housing is widely considered affordable if the cost of ownership or rent is less than 30 percent of household income prior to taxes.[134] Within DC, there are now half as many low-income housing units as there were in 2002, with low-income families spending almost half their monthly income on rent.[135] In 2019, the National Community Reinvestment Coalition conducted a study that found that gentrification and displacement of long-term residents was heavily present in the nation's largest cities.[136] In DC, approximately 20,000 black residents were displaced between 2000 and 2013.[137] Over the past 3 decades, DC's black population has dropped nearly 20 percent because of continuous relocation to neighboring counties or other more affordable areas.[138]

Quality, safety, and stability are other important factors for housing. *Healthy People 2020* defines housing quality as both the physical and social environment where a home is located.[139] Poor-quality housing is associated with various negative health outcomes, including chronic diseases and preventable injuries. In addition, housing deterioration in neighborhoods can negatively affect the mental health of residents, leading to chronic stress.[140] Safety risks associated with unstable and low-quality housing include issues with toxic mold, rodents and vermin, lack of proper ventilation, overcrowding, and crime.[141]

A 2016 report published by Georgetown University outlined the close relationship between housing, health, and quality of life, noting how destabilized housing can lead to homelessness

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[131] Office of Disease Prevention and Health Promotion. (2019). *Housing instability.* https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-health/interventions-resources/housing-instability.

[132] Ibid

[133] Rivers, W. (12 March 2015). Going, going, gone: DC's vanishing affordable housing. *DC Fiscal Policy Institute: An Affiliate of the Center on Budget and Policy Priorities.* https://www.dcfpi.org/wp-content/uploads/2015/03/Going-Going-Gone-Rent-Burden-Final-3-6-15format-v2-3-10-15.pdf.

[134] DeVoe, J. E., A. Geller, and Y. Negussie. (2019) Vibrant and healthy kids: Aligning science, practice and policy to advance health equity. Ch. 3. *The National Academies Press.* https://www.nap.edu/read/25466/chapter/3.

[135] Ibid

[136] Richardson, J., B. Mitchell, and J. Franco. (19 March 2019). *Shifting neighborhoods: Gentrification and cultural displacement in American cities.* https://ncrc.org/gentrification.

[137] Ibid

[138] Jackson, M., B. Floyd, C. J. King, T. Brown, S. Kurgatt, E. Marino, O. Nwodim, E. Schimmel, J. Smith, J. Tatge, and J. A. Davis. (July 2016). *The health of the African American community in the District of Columbia: disparities and recommendations.* https://www.georgetown.edu/sites/www/files/The%20Health%20of%20the%20African%20American%20Community%20in%20the%20District%20of%20Columbia.pdf.

[139] Office of Disease Prevention and Health Promotion. (2019). *Quality of housing.* https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-health/interventions-resources/quality-of-housing.

[140] Ibid

[141] Ibid

and social disconnection.[142] Similarly, a study conducted by the University of Massachusetts states that pregnant women face a significant increase in health risks while facing housing instability.[143] The study also found that women who face housing instability and relied on shelters had higher rates of mental health issues and substance use disorders.[144] In addition, women who were homeless faced significantly greater physical health risks in the periods during and surrounding pregnancy.[145] Although shelter-based interventions to improve prenatal care can be helpful, these interventions may come at a time when it is too late to reduce risk to a level that is comparable to that of women living in more stable housing.[146] Furthermore, inconsistent use of health care services, prior to and during pregnancy, is likely a contributing factor for more frequent pregnancy and birth complications in shelter-residing women.[147] In addition, women in shelters with inconsistent access to health care services also had a greater probability of one or more emergency department visits as well as significantly more months without clinical care.[148]

Poverty

Poverty can broadly be defined as the lack of financial and material resources to meet basic needs and is associated with several factors that affect health status, such as food insecurity, exposure to crime and violence, unsafe neighborhoods, and housing insecurity.[149,150] The federal poverty level is a measure of income used to determine eligibility for programs and benefits, and takes into account household size.[151] The federal poverty level is the same for 48 states and the District of Columbia, but higher in Alaska and Hawaii. For example, in 2019 the federal poverty level in 48 states and DC was $21,330 for a family of three and $34,950 for a family of six.[152] In 2016, 22 percent of black families in DC were at or below the federal poverty level. That same year, 16 percent of all other racial and ethnic groups combined were at or below the federal poverty level.[153]

In 2016, 13.4 percent of black residents in DC were unemployed, whereas 1.6 and 3.6 percent of white and Hispanic residents were unemployed, respectively.[154] Furthermore, the unemployment rate of black individuals was higher than the national average in 2016 (7.9 vs. 4.5 percent).[155] The DC Fiscal Policy Institute reported that the 2007 median income for all

[142] Ibid

[143] Clark, R. E., L. Weinreb, J. M. Flahive, and R. W. Seifert. (2019). Homelessness contributes to pregnancy complications. *Health Affairs* 38(1):139-146. http://doi:10.1377/hlthaff.2018.05156.

[144] Ibid

[145] Ibid

[146] Ibid

[147] Ibid

[148] Ibid

[149]Ibid

[150] Ibid

[151] U.S Department of Health and Human Services. (2019). *U.S federal poverty guidelines used to determine financial eligibility for certain federal programs.* https://aspe.hhs.gov/poverty-guidelines.

[152] Ibid

[153] Ibid

[154] Lassiter, L. (01 March 2017). *Still looking for work: Unemployment in DC highlights racial inequity.*https://www.dcfpi.org/all/still-looking-work-unemployment-dc-highlights-racial-inequity/.

[155] Jackson, M., M. Jensen, A. Beer, J. Bonilla, R. Marcellin, M. Miraglia, N. Edson, J. Liang, R. Meyer, B. Tingle, M. Barber, E. Gardner, J. Mayer, A. Rivlin, M. Ross, E. Lazere, and J. Jackson. (2017). *An analysis: African American employment, population and housing trends in Washington, D.C.* https://www.cityfirstfoundation.org/wp-content/uploads/2015/11/DC-AAEPHT-Report-091217.pdf.

black households within DC was about $43,000.[156] Ten years later, the 2017 median income of all black households decreased slightly to about $42,000. In comparison, the median household income for white families increased from about $116,000 to $134,000 within the same time period. Moreover, DC's overall median household income in 2017 was $82,000—almost double that of black households in the same year.[157]

In addition to chronic stress, poverty is associated with multiple social determinants of health, including food insecurity, inadequate transportation, unemployment, unstable housing, and increased rates of other health conditions.[158] Even with Medicaid, poverty can severely limit access to health care. The Substance Abuse and Mental Health Services Administration (SAMHSA) found that adults with household incomes below the federal poverty level disproportionately face mental health issues.[159] Subsequently, women who experience poverty during pregnancy are at higher risk of experiencing mental health issues.[160,161] As a result, the higher rates of mental health and substance use disorders contribute to pregnancy and birth complications.[162] Furthermore, as discussed previously above, toxic stress from chronic adversity (such as poverty or financial instability) during preconception and pregnancy can lead to negative obstetric health outcomes.[163]

Workplace and Occupational Issues

The Family and Medical Leave Act (FMLA) entitles eligible employees under covered employers to take unpaid, job-protected leave. Eligible employees may take up to 12 weeks of unpaid leave for the birth of a child.[164] However, many families are not able to afford unpaid leave, and, as a result, most individuals work until their delivery date and return to work soon after, sometimes within days or weeks of giving birth. Only 13 percent of workers in the United States reported having access to paid leave in 2015, and only 4 percent of women in the lowest income decile reported having access to paid leave.[165] Non-Hispanic black women are significantly less likely to use unpaid leave than women of other races and ethnicities. Additionally, low- or middle-income women are significantly less likely to take unpaid leave than

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[156] Lazare, E. (2018). *DC's growing prosperity is not reaching black residents, census data show.* https://www.dcfpi.org/all/dcs-growing-prosperity-is-not-reaching-black-residents-census-data-show/.
[157] Ibid
[158] Ibid
[159] Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, U.S. Department of Health and Human Services, and Research Triangle Institute International. (December 2013). *Results from the 2012 national survey on drug use and health: Mental health findings.* NSDUH series H-47. 13(4805). https://www.samhsa.gov/data/sites/default/files/2k12MH_Findings/2k12MH_Findings/NSDUHmhfr2012.htm.
[160] Franks, W. L., K. E. Crozier, and B. L. Penhale. (2017). Women's mental health during pregnancy: A participatory qualitative study. *Women and Birth*, *30*(4), e179-e187.
[161] DeVoe, J. E., A. Geller, and Y. Negussie. (2019) Vibrant and healthy kids: Aligning science, practice and policy to advance health equity. Ch. 3. *The National Academies Press.* https://www.nap.edu/read/25466/chapter/3http://nationalacademies.org/hmd/Reports/2019/vibrant-and-healthy-kids.
[162] Ibid
[163] Ibid 124, 125
[164] U.S. Department of Labor. (2012). *Fact sheet 28: The Family and Medical Leave Act.* https://www.dol.gov/whd/regs/compliance/whdfs28.pdf.
[165] Andres, E., S. Baird, J. B. Bingenheimer, and A. R. Markus. (2016). Maternity leave access and health: A systematic narrative review and conceptual framework development. *Maternal Child Health Journal* 20(1):1178-1192.

high-income women.[166] Duration of leave has been shown to be positively associated with improved maternal mental health.[167] Additionally, recent studies show that women who took partial or full leave following delivery were less likely to be rehospitalized following discharge compared to women who took no leave.[168] Duration of leave also correlates with higher rates and longer durations of breastfeeding. Many individuals face barriers to breastfeeding at work, including finding time, space, and support to breastfeed; this is especially true for parents who work low-paying jobs.[169] Breastfeeding can also improve mother–infant interaction during the postpartum period.[170] Duration of leave is positively associated with improved parent–infant interaction and attachment during the postpartum period, which improves maternal and newborn health.[171]

Access to Health Care and Health Insurance

Medicaid is the largest payer of maternity health care services, with nearly half of all births in the United States financed with Medicaid.[172] In DC, 38.8 percent of births were financed with Medicaid from 2013 to 2016.[173] States are federally mandated to provide coverage for pregnant women whose incomes are up to 133 percent of the federal poverty level, but most provide coverage beyond the federal minimum.[174] DC provides coverage for women whose incomes are up to 319 percent of the federal poverty level. States are only federally required to offer inpatient and outpatient (prenatal) care, but most offer a broad range of perinatal and preventative services as well. States that opted to expand Medicaid are required to provide women with all preventive services recommended by the U.S. Preventive Services Task Force.[175] While women in states that have expanded Medicaid are generally able to stay enrolled well into the postpartum period, women in nonexpansion states may lack coverage beyond 60 days postpartum.[176] Only 3 percent of nonelderly women in DC were uninsured in 2017; many of these women were either eligible for Medicaid but not enrolled, or fell into the Medicaid coverage gap.[177] Data from 2016 revealed that only 36 percent of women enrolled in Medicaid and the Children's Health Insurance Program (CHIP) in DC received a majority of the expected prenatal care visits, and only 49 percent had a postpartum care visit between 21 and 56 days following delivery.[178]

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[166] Ibid

[167] Ibid

[168] Ibid

[169] Ibid

[170] Ibid

[171] Ibid

[172] Medicaid's Role for Women. (2019). *The Kaiser Family Foundation*. https://www.kff.org/womens-health-policy/fact-sheet/medicaids-role-for-women/.

[173] District of Columbia Department of Health. (2018). *Perinatal health and infant mortality report*. https://dchealth.dc.gov/sites/default/files/dc/sites/doh/service_content/attachments/Perinatal%20Health%20Report%202018_FINAL.pdf.

[174] Kaiser Commission on Medicaid and the Uninsured. (2015). *Where are states today? Medicaid and CHIP eligibility levels for adults, children, and pregnant women.* http://files.kff.org/attachment/fact-sheet-where-are-states-today-medicaid-and-chip-2.

[175] Ibid

[176] Ibid 164

[177] Kaiser Family Foundation. (2018). *Women's health insurance coverage,* https://www.kff.org/womens-health-policy/fact-sheet/womens-health-insurance-coverage-fact-sheet/.

[178] Russell, R., C. Rodehau, and P. Quinn. (2018). *Human-centered solutions to improve reproductive and maternal health outcomes in Washington, D.C.* District of Columbia Primary Care Association.

As of November 2018, 39 facilities provide prenatal care services in DC; this includes facilities with OB-GYNs, nurse practitioners, family physicians, and certified nurse midwives.[179] Forty-one percent of facilities providing prenatal care services are federally qualified health centers (FQHCs). Sixty-four percent of facilities accept Medicaid or Alliance, and a majority of these facilities are FQHCs.[180] While Wards 7 and 8 have the highest rates of deliveries per year, closure of maternity wards east of the Anacostia River has created a maternal health care desert in these neighborhoods. For example, the United Medical Center's labor and delivery unit in DC was closed because of safety concerns in 2017.[181] This medical center is located in Congress Heights, a predominantly low-income black community, and it is one of the few public hospitals in DC.[182] Since the closure of the labor and delivery unit, many neighborhood residents have had to seek care elsewhere, often in other wards. Several hospitals and birth centers have created new initiatives to address the maternal health care desert and racial disparities in DC. An example is the Community of Hope Family Health and Birth Center, which has recently implemented their CenteringPregnancy program. This program aims to improve pregnancy outcomes for low-income women through education and group prenatal care.[183]

Findings from the 2017 DC Health Systems Plan show that barriers to accessing care, such as securing child care and high costs of transportation, are responsible for low prenatal care participation rates, rather than an absolute lack of providers.[184] While prenatal care services and providers are available, they are not necessarily accessible.[185]

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[179] District of Columbia Department of Health. (2017). *District of Columbia health systems plan.* https://dchealth.dc.gov/sites/default/files/dc/sites/doh/publication/attachments/DC%20Health%20Systems%20Plan%202017_0.pdf.

[180] Ibid

[181] News 4 Washington. (09 August 2017). *Southeast DC hospital ordered to stop delivering babies due to "deficiencies": The hospital says health officials cited "deficiencies in screening, clinical assessment and delivery protocols.* https://www.nbcwashington.com/news/local/DC-Orders-Hospital-to-Suspend-Baby-Deliveries-Prenatal-Care-439322383.html.

[182] United Medical Center. *About.* https://www.unitedmedicaldc.com/.

[183] Community of Hope. *About.* https://www.communityofhopedc.org/healthcare/family-health-and-birth-center.

[184] Ibid

[185] Pérez, M. Z. (2019). Culture and conversation maternity and birthing: How this DC birth center is building the "answer for black women." *Rewire News.* https://rewire.news/article/2018/07/31/how-this-dc-birth-center-is-building-the-answer-for-black-women/.
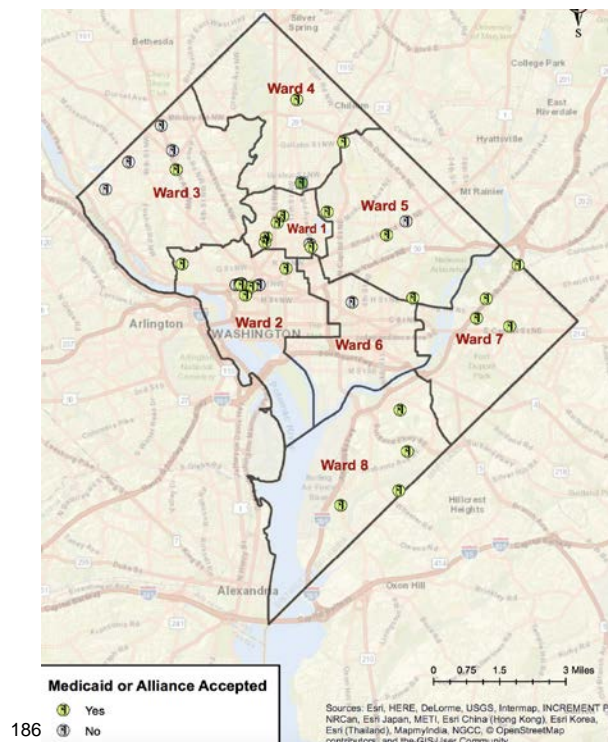
Figure 9: Health care facilities providing prenatal care in DC as of November 2018.

Nutrition

The United States has several programs in place to support the nutrition of women, infants, and children.[187] The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides federal grants to states to support supplemental foods, nutrition education, breastfeeding support, and health care referrals. Low-income pregnant, postpartum, and breastfeeding women, and infants and children up to age 5, are eligible to enroll in WIC. Participants' household income must be at or below 185 percent of the federal poverty level. Those who meet the above specifications who are enrolled in Medicaid, Temporary Assistance for Needy Families, or the Supplemental Nutrition Assistance Program (SNAP) automatically qualify for WIC benefits. Because WIC is not an entitlement program, women who lack contact with the health care and social services systems may be less likely to receive services they are eligible for, which could lead to lower levels of enrollment. In 2016, 26,439 DC women and children were eligible for WIC and 14,285 were enrolled, for a rate of coverage of about 54 percent.[188] The national rate of coverage for WIC is 54.5 percent.[189] Current issues with WIC include a continuously declining enrollment rate, which results in less funding for the program.

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[186] District of Columbia Department of Health. (2018) *Health care facilities providing prenatal care in the District of Columbia.*
https://dchealth.dc.gov/sites/default/files/dc/sites/doh/page_content/attachments/Prenatal%20Facility.v2.pdf.
[187] Carlson, S., and Z. Neuberger. (2017). WIC works: Addressing the nutrition and health needs of low-income families for forty years. *Center on Budget and Policy Priorities*.
[188] Trippe, C., C. Tadler, P. Johnson, L. Giannarelli, and D. Betson. (2019). National and state level estimates of WIC eligibility and WIC program reach in 2016. *U.S Department of Agriculture*.
[189] Ibid

SNAP, formerly known as the food stamp program, provides monthly benefits for participants to purchase food items at authorized retailers.[190] These benefits can be used to purchase a variety of foods but cannot be used to purchase alcohol, tobacco, hot foods, or foods intended to be cooked in a store.[191] Families qualify for SNAP based on household income and residence, and there are no specific eligibility criteria for pregnant women. However, unlike WIC, participants of SNAP must be U.S. citizens. Of eligible DC residents, 97.9 percent participated in SNAP in 2015, and 62 percent of eligible workers participated.[192] Similar to WIC, enrollment for SNAP has declined for the past 4 years. In 2017, the average monthly SNAP benefit was $224 for all households in DC and $422 for households with children.[193] In DC, 57 percent of households that receive SNAP have children. However, most low-income households receiving SNAP benefits struggle to afford nutritious meals. Benefits allotted by SNAP may grossly underestimate costs of transportation, access to grocery stores with nutritious foods, and costs associated with food preparation.

Education

Women with lower educational attainment have an increased risk of SMM and mortality. SMM is highest among women without a high school education, but the rate of SMM differs by racial/ethnic group.[194] Lower educational attainment is a factor associated with poverty that may be disproportionately experienced by low-income women and women of color. However, disparities between racial and ethnic groups in maternal health outcomes persist regardless of educational attainment.[195] The PRMR is five times higher for black women with a college degree compared to white women with a college degree.[196] Even more striking is that the PRMR for black women with a college education or more is higher than that for white women, regardless of education level (Figure 10).[197] Similarly, disparities between American Indian/Alaskan Native women and white women persist at all education levels, with disparities more pronounced with increasing educational attainment.

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[190] Center on Budget and Policy Priorities. (25 June 2019). *Policy basics: The supplemental nutrition assistance program (SNAP)*. https://www.cbpp.org/research/food-assistance/policy-basics-the-supplemental-nutrition-assistance-program-snap
[191] Ibid
[192] U.S. Department of Agriculture. (2018). Profile of SNAP households: District of Columbia delegate district. *United States Department of Agriculture*.
[193] Ibid
[194] Ibid
[195] Creanga, A., B. Bateman, E. Kuklina, and W. Callaghan. (2014). Racial and ethnic disparities in severe maternal morbidity: A multistate analysis, 2008-2010. *American Journal of Obstetrics and Gynecology* 210(435):e1-e8.
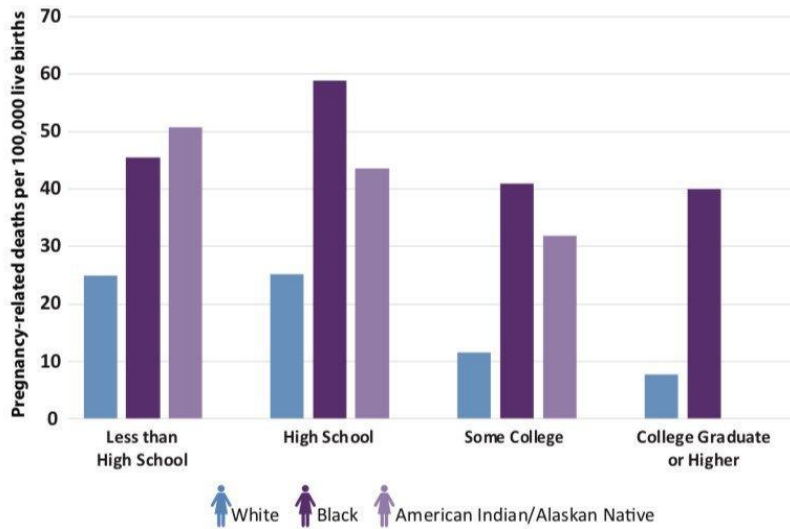[196] Ibid
[197] Ibid

Figure 10: Racial/ethnic disparities in pregnancy-related deaths by educational attainment. Source: Center for Disease Control (2019).

Safety from Violence

As discussed previously, safety and security make up the second tier of needs, after physiological, through the framework of Maslow's Hierarchy of Needs. For many parents, throughout all stages of pregnancy, safety from violence is a significant concern.

Surveillance efforts by various national and international organizations have highlighted violence during pregnancy and the postpartum period as an issue of concern, usually with a focus on physical abuse and intimate partner violence.[198] Some documented risk factors for violence during these periods include younger parental age, prior experience of violent victimization, single marital status, and unintended pregnancies.[199] [200]

Experiencing violence has documented effects on maternal health and pregnancy outcomes. Stress from violence during the prenatal period has been linked to elevated levels of mental health conditions such as depression, anxiety, post-traumatic stress disorder (PTSD), self-harm,

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[198] Martin, S. L., J. Arcara, and M. D. Pollock. (2012). Violence during pregnancy and the postpartum period. *National Resource Center on Domestic Violence*. https://vawnet.org/material/violence-during-pregnancy-and-postpartum-period.

[199] Finnbogadóttir, H., A. K. Dykes, and C. Wann-Hansson. (2016). Prevalence and incidence of domestic violence during pregnancy and associated risk factors: A longitudinal cohort study in the south of Sweden. *BMC Pregnancy and Childbirth* 16(1):228. http://doi:10.1186/s12884-016-1017-6.

[200] Bailey, B. A. (2010). Partner violence during pregnancy: Prevalence, effects, screening, and management. *International Journal of Women's Health* 2(1):183-197.

and more.[201,202,203] Additionally, such experiences have also been found to increase risk of threatened preterm labor and preeclampsia risk.[204,205]

These risks are present even when the experience of intimate partner violence occurred prior to pregnancy.[206] Similarly, childhood trauma and other adverse childhood experiences can increase risk for PTSD and depression during the postpartum period as well as affect pregnancy complications directly.[207,208] Sexual assault survivors may also face increased risk for adverse obstetric outcomes.[209] In one study, pregnant women were twice as likely to experience any form of violent trauma, which was then associated with a three-fold increase in mortality.[210]

Homicide was the second leading cause of injury-related deaths during pregnancy and the first year postpartum in the United States between 1991 and 1999 and continues to have a high prevalence.[211,212] Unfortunately, homicides among pregnant women are often missed in surveillance meant to capture pregnancy-related death rates.[213] In DC, 43 percent of pregnant women who died by homicide were not captured in the pregnancy-related deaths reported.[214]

Community and Nonprofit Work

As pregnancy-related death rates and disparities increase in DC and across the nation, the mission of many new and existing nonprofit and community organizations has become increasingly important. Nationally, there are a variety of organizations advocating for more focus on maternal health and wellness, such as Every Mother Counts, MomsRising, and the Black Mamas Matter Alliance.

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[201] Ibid

[202] Dahlen, H. G., A. M. Munoz, V. Schmied, and C. Thornton. (2018). The relationship between intimate partner violence reported at the first antenatal booking visit and obstetric and perinatal outcomes in an ethnically diverse group of Australian pregnant women: A population-based study over 10 years. *British Medical Journal Open* 8(4):e019566.

[203] Ibid

[204] Ibid

[205] Shaw, J. G., S. M. Asch, J. G. Katon, K. A. Shaw, R. Kimerling, S. M. Frayne, and C. S. Phibbs. (2017). Post-traumatic stress disorder and antepartum complications: A novel risk factor for gestational diabetes and preeclampsia. *Paediatric and Perinatal Epidemiology* 31(3):185-194.

[206] Ibid

[207] Sexton, M. B., L. Hamilton, E. W. McGinnis, K. L. Rosenblum, and M. Muzik. (2015). The roles of resilience and childhood trauma history: Main and moderating effects on postpartum maternal mental health and functioning. *Journal of Affective Disorders* 174(1):562-568.

[208]Kendall-Tackett, K. A. (2007). Violence against women and the perinatal period: The impact of lifetime violence and abuse on pregnancy, postpartum, and breastfeeding. *Trauma, Violence, and Abuse* 8(3):344-353.

[209] Gisladottir, A., M. A. Luque-Fernandez, B. L. Harlow, B. Gudmundsdottir, E. Jonsdottir, R. I. Bjarnadottir, and U.A. Valdimarsdottir. (2016). Obstetric outcomes of mothers previously exposed to sexual violence. *Public Library of Science One Journal*11(3):e0150726.

[210] Deshpande, N. A., L. M. Kucirka, R. N. Smith, and C. M. Oxford. (2017). Pregnant trauma victims experience nearly two-fold higher mortality compared to their nonpregnant counterparts. *American Journal of Obstetrics and Gynecology* 217(5):590-e1.

[211] Ibid

[212] Koch, A. R., D. Rosenberg, and S. E. Geller. (2016). Higher risk of homicide among pregnant and postpartum females aged 10–29 years in Illinois, 2002–2011. *Obstetrics and Gynecology* 128(3):440-446.

[213] Kilpatrick, S. J. (2018). Trauma in pregnancy: An underappreciated cause of maternal death. *Obstetric Anesthesia Digest* 38(3):127-128.

[214] Ibid

While Every Mother Counts works on improving access to maternity care globally, the United States is targeted for grants and programming through Every Mother Counts.[215] MomsRising is an activist network that uses grassroots organizing tactics to bring parents to the forefront of advocacy for a variety of issues, including maternal mortality and morbidity.[216]

The Black Mamas Matter Alliance (BMMA) is a cross-sectoral alliance led by black women that puts black parents in the center of the fight for better maternal outcomes through policy change, research, advanced care, and culture shifts.[217] BMMA works with many partner organizations, from other nonprofit organizations and local initiatives to doula groups and birthing centers. The National Birth Equity Collaborative is an example of one such partner; it similarly focuses on racial disparities in maternal health and aims to optimize black maternal and infant health outcomes through training, policy advocacy, research, and community-centered collaboration.[218]

In DC, many advocates and practitioners are at work, both in the form of local DC chapters of national organizations, such as MomsRising, and through distinct local organizations and health centers such as Mamatoto Village, Community of Hope, and Mary's Center.

Mamatoto Village is a nonprofit organization that works to reduce maternal mortality among women of color by providing accessible and empowering perinatal support services.[219] The services provided include peer support groups, parenting classes, birth workers, home visiting programs, and lactation support.

Community of Hope supports maternal health and wellness in DC by supporting homeless, low-income, and underserved families through health care and housing initiatives.[220] Midwives are available through Community of Hope and are able to support births at both Medstar Washington Hospital Center and Community of Hope's freestanding birth center, the Family Health and Birth Center.

Mary's Center is a community health center that provides medical, behavioral, and educational services for DC residents. Many programs across these services aim to improve maternal health in the area, including the Maternal Mental Health program, prenatal care and midwifery services, and a CenteringPregnancy program.[221]

Trust and Cultural Competency

Structural inequities, racism, and discrimination are key drivers of health disparities in the United States.[222] Inequities in health outcomes both result from and lead to further generalizations and stereotyping of groups of individuals, perpetuating inaccurate perceptions and discrimination in health care. It is human nature to generalize and infer, as people have a tendency to group and categorize in order to simplify complex concepts that are difficult to comprehend into tangible ideas; however, it is these same mental heuristics that foster fallacies of thought and lead to stereotypes, followed by conscious and unconscious thoughts and behaviors that reinforce the

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[215] Every Mother Counts. *About*. https://everymothercounts.org/grants/united-states/.

[216] MomsRising. *About*. https://www.momsrising.org/campaigns/maternal-justice.

[217] BMMA (Black Mamas Matter Alliance. (2019). About. https://blackmamasmatter.org/about/.

[218] National Birth Equity Collaborative. *About*. https://birthequity.org/about/mission-and-vision/.

[219] Mamatoto Village. *About*. https://www.mamatotovillage.org/about.html.

[220] Ibid

[221] Marys Center. *About*. https://www.maryscenter.org/about-us.

[222] Ibid

stereotypes.[223,224,225] Everyone, including health care providers, may carry implicit biases—unconscious attributions of particular qualities to a member of a certain group—that can be problematic when left unaddressed.

The implicit biases of health care providers complicate the trust between patients and their providers. Unlike explicit biases, which are conscious attitudes and beliefs, implicit biases are often unconscious and may present more subtly.[226] A study by Blair and colleagues (2013) found that two-thirds of health care providers maintained an implicit bias towards African American and Latino patients.[227] These prejudices, although often subconscious, may result in inadequate or inappropriate treatment of individuals. Furthermore, patients who perceive this differential treatment, both socially and medically, often exhibit distrust of the health care system, further impairing communication and rapport between patients and their physicians.[228]

The Social Distance Hypothesis in Health Care describes the phenomenon whereby physicians who relate to their patients on the levels of class, culture, and/or social status, tend to provide more timely and higher quality care and attention.[229] Furthermore, studies have demonstrated that black populations are more likely to trust physicians of the same race and gender, which emphasizes the importance of representation in health care and the need for racial, ethnic, and gender diversity among providers.[230]

Mistrust of providers and the health care system can lead to decreased quality of care, which is attributed to a myriad of factors including inadequate knowledge provided for informed decision making, decreased patient cooperation with subsequent stereotypic labeling by providers, and patients withholding information critical to their care.[231] For example, it has been found that patients who are quick to decline invasive procedures, such as cesarean sections and use of tools during assisted delivery, such as forceps or vacuum extractors, owing to concerns about unnecessary use, are deemed to be "uncooperative," "noncompliant" or "difficult" patients.[232] Such labels can often lead to dismissal of patients' concerns.

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[223] Fantino, E., S. Stolarz-Fantino, and A. Navarro. (2003). Logical fallacies: A behavioral approach to reasoning. *Behavior Analyst Today* 4(1):109-117.
https://opentextbc.ca/socialpsychology/chapter/reducing-discrimination/.
[224] Stangor, C., R. Jhangiani., and H. Tarry. (2011). *Principles of social psychology*.
https://opentextbc.ca/socialpsychology/.
[225] IOM. (20103). Unequal treatment: Confronting racial and ethnic disparities in health care. *The National Academies Press.* http://nap.edu/10260.
[226] Hall, W. J., M. V. Chapman, K. M. Lee, Y. M. Merino, T. W. Thomas, B. K. Payne, E. Eng, S. H. Day, and T. Coyne-Beasley. (15 October 2015). Implicit racial or ethnic bias among health care professionals and its influence on health care outcomes: A systematic review. *American Journal of Public Health* 105(12):e60-e76. https://www.ncbi.nlm.nih.gov/pubmed/26469668.
[227] Blair, I. V., E. P. Havranek, D. W. Price, R. Hanratty, D. L. Fairclough, T. Farley, H. K., Hirsh, and J. F. Steiner. (January 2013). Assessment of biases against Latinos and African Americans among primary care providers and community members. *American Journal of Public Health* 103(1):92-98. https://www.ncbi.nlm.nih.gov/pubmed/23153155.
[228] Ibid
[229] Schnittker, J. (September 2004). Social distance in the clinical encounter: Interactional and sociodemographic foundations for mistrust in physicians. *Social Psychology Quarterly* 67(3):217-235. https://www.jstor.org/stable/3649109, no. 3 (2016).
[230] Ibid
[231] Attanasio, L. B. and R. R. Hardeman. (July 2019). Declined care and discrimination during the childbirth hospitalization. *Society of Science and Medicine* 232:270-277.
[232] Ibid

The term *systemic racism* acknowledges the inherent discrimination against people of different races and ethnicities as a result of historical imbalances of power. In the case of black Americans, although slavery and legally sanctioned segregation have ended, the ensuing effects are still in existence today, with whiteness viewed as superior to blackness. This is evident throughout many aspects of culture and policy, including community conditions and allocation of resources, and inherent trust and mistrust.[233] Black populations have historically shouldered the burden of mistreatment, and, as a result, many mistrust the system that has repeatedly failed them and worked against their interests.[234]

American culture has been built on and further perpetuates gender roles based on a patriarchal society that oppresses women and undervalues them across multiple domains, from health insurance coverage to labor force participation and wages.[235] This discrimination persists in many ways, leading to intentional and unintentional changes in behaviors, attitudes, and cognitions based on gender.

Furthermore, the importance of intersectionality—the overlap of multiple identities that have been the subject of discrimination—must be acknowledged, as the experiences of white women vastly differ from those of black women and other women of color, who have been discriminated against for both their race/ethnicity as well as their gender.[236] With regards to black women, the overlap of identities has resulted in experiences that substantially differ from both those of black men and white women. For many, there are even more identities that are at play here, such as socioeconomic background, sexual orientation, and disability status.

Policy

National Policy—Measuring and Documenting Maternal Mortality Nationwide

When measuring maternal mortality, definitions and criteria are integral to capturing the extent of this health burden. As discussed above, the national definition of a pregnancy-related death is the death of a person while pregnant or within 1 year of pregnancy from any cause related to or aggravated by the pregnancy or its management. Pregnancy-associated deaths, as opposed to pregnancy-related deaths, are the deaths that occur during pregnancy or within 1 year, regardless of cause.[237] After review, pregnancy-associated deaths may be declared a "pregnancy-associated, but not related death" or a death that occurs during this time period and is not caused or aggravated by pregnancy.[238]

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[233] Ibid

[234] Ibid

[235] Ibid

[236] Ibid

[237] Berg, C. J. (2012). Identification and review to action: Maternal mortality review in the United States. *Seminars in Perinatology* 36(1):7-13, in Review to action working together to prevent maternal mortality: process of a review. *Maternal Mortality Review Information Application: Building U.S. Capacity to Review and Prevent Maternal Deaths.* https://reviewtoaction.org/implement/process-review.

[238] Ibid

Vital records are a primary source of data that surveillance and research efforts pull from that include births, deaths, and fetal death certificates for 57 jurisdictions in the United States.[239] Identification of pregnancy-related deaths through such records has been historically difficult.[240] To address this, the United States added checkboxes to death certificates to document pregnancy status in a number of states, which has been effective in identifying pregnancy-associated deaths that result from maternal causes but less effective for nonmaternal causes, such as homicide, injury, and substance use.[241] To complement this data and provide more sufficient information regarding pregnancy-associated and pregnancy-related deaths, the CDC recommends the use of Maternal Mortality Review Committees (MMRCs).[242]

MMRCs typically use data from the National Center for Health Statistics, which uses death certificate information to assign ICD-10 codes that are used to identify maternal deaths and produce a maternal mortality rate, and the Pregnancy Mortality Surveillance System, which uses death certificates that show a relationship to pregnancy identified by either a checkbox on the death certificate or by a linked birth or fetal death certificate registered in the year preceding death (Table 3).[243,244]

The purpose of MMRCs are to thoroughly investigate pregnancy-associated and pregnancy-related deaths so the committees can improve their reporting of data to the CDC and gain a deeper understanding of the maternal mortality issue in their states. Some existing MMRCs even go as far as to have additional protocols for identifying pregnancy-related deaths, such as direct hospital reporting, media reports, or obituary searches. Although there are differences in how MMRCs conduct their reviews, all committees strive to answer the following six questions about each death they review:[245]

1. Was the death pregnancy related?
2. What was the cause of death?
3. Was the death preventable?
4. What were the critical contributing factors to the death?
5. What are the recommendations and actions that address those contributing factors?
6. What is the anticipated impact of those actions if implemented?

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[239] Mayer, R., A. Dingwall, J. Simon-Thomas, A. Sheikhnureldin, and K. Lewis. (04 February 2019). The United States maternal mortality rate will continue to increase without access to data. *Health Affairs: Project Hope.* https://www.healthaffairs.org/do/10.1377/hblog20190130.92512/full/.

[240] Horon, I. L., and D. Cheng. (2011). Effectiveness of pregnancy check boxes on death certificates in identifying pregnancy-associated mortality. *Public Health Reports* 126(2):195-200. http://doi:10.1177/003335491112600210.

[241] Ibid

[242] Ibid

[243] Centers for Disease Control and Prevention. (04 June 2019). *Reproductive health: Pregnancy mortality surveillance system.* https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-mortality-surveillance-system.htm.

[244] Brantley, M. D., W. Callaghan, A. Cornell, S. Cox, N. Davis, S. Foster, D. Goodman, S. Haight, K. Hatfield-Timajchy, J. Ko, M. Kramer, E. Kuklina, K. Liu, K. Mishkin, A. St. Pierre, A. Strahan, A. Thomas, and J. Zaharatos. (January 2018). Report from nine Maternal Mortality Review Committees. *The Maternal Mortality Review Information Application: Building U.S. Capacity to Review and Prevent Maternal Deaths.* https://www.cdcfoundation.org/sites/default/files/files/ReportfromNineMMRCs.pdf.

[245] Network for Public Health Law. (July 2018). Maternal and child health issue brief: Maternal Mortality Committees. *Network for Public Health Law: Ideas, Experience, Practical Answers* 1-7. https://www.networkforphl.org/_asset/bytdhv/MMRC-Issue-Brief-PFDEL_DY.pdf.

When the MMRC reports its findings, the information is stratified by race/ethnicity, age, and timing of death in relation to pregnancy. The highest quality of data for identifying pregnancy-associated deaths is available through data linkage efforts.[246] These efforts attempt to connect various data sources by linking death certificates of birth and fetal death certificates with death certificates of reproductive-aged people for more efficient case identification.[247]

Initiatives to create comprehensive, high-quality databases have been successful in a few states, such as Massachusetts and California. In Massachusetts, the Pregnancy to Early Life Longitudinal Data System connects vital records and Pregnancy Mortality Surveillance System data with various other data sources.[248] The newly formed California Maternal Quality Care Collaborative was able to reduce maternal mortality rates by 55 percent from 2006 to 2013, attributable in large part to the creation of a comprehensive maternal–infant dataset and the use of evidence- and data-based decisions for policy changes.[249]

Table 3. Comparison of death certificates used nationally addressing sources of maternal mortality. Source: Report from Nine Maternal Mortality Review Committees (Brantley, 2018).

Table 1. National Sources of Maternal Mortality Information*

DATA SOURCE	CDC – National Center for Health Statistics DEATH CERTIFICATES	CDC – Pregnancy Mortality Surveillance System (PMSS)† DEATH CERTIFICATES LINKED TO FETAL DEATH AND BIRTH CERTIFICATES
Time Frame	During pregnancy – 42 days postpartum	During pregnancy – 365 days postpartum
Source of classification	International Classification of Diseases, 10th revision (ICD-10) codes	Medical epidemiologists assign PMSS codes
Terms	Maternal death	• Pregnancy-associated death, • (Associated and) Pregnancy-related death, • Associated but not pregnancy-related death
Measure	Maternal mortality rate: Ι # of maternal deaths Ι per 100,000 live births	Pregnancy-related mortality ratio: Ι # of pregnancy-related deaths Ι per 100,000 live births
Purpose	Show national trends and provide a basis for international comparison	Analyze clinical factors associated with deaths, publish information that may lead to prevention strategies
Strengths	• Best source of historical data (back to 1900) • Reliable basis for international comparison • Based on readily available data (death certificates)	Most clinically relevant national measure of the burden of maternal deaths
Challenges	• Constrained by ICD-10 codes • Lacks sufficient detail to inform prevention strategies	• Constrained by information available on death and birth certificates • Lacks detailed information on contributors to deaths

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[246] Ibid

[247] Ibid

[248] Commonwealth of Massachusetts. (2019). *Major projects of the office of data translation: Learn about our projects.* https://www.mass.gov/service-details/major-projects-of-the-office-of-data-translation.

[249] Ibid

District of Columbia's Maternal Mortality Efforts

As mentioned above, the recent implementation of checkboxes on death certificates to indicate pregnancy status has been instrumental in measuring pregnancy-associated and pregnancy-related deaths. In DC, death certificates began recording pregnancy status in 2005. Prior to 2005, analysis of pregnancy-related deaths in DC was challenging.[250]

In June 2017, the passage of a bill prompted the creation of the District's MMRC. DC Law 22-111 created a MMRC for the District of Columbia; its responsibility is to identify factors and/or situations that could have contributed to pregnancy-related deaths in DC.[251] The main goal of the committee is to identify, based on their discoveries and discussion, the best approach to address maternal mortality in DC (Table 4).[252] The committee is composed of representatives from the Office of the Chief Medical Examiner, the Department of Health, the Department of Behavioral Health, the Department of Health Care Finance, and the Department of Human Services, as well as health care providers, including obstetricians, gynecologists, midwives, doulas, nurses, and social workers.

Table 4: Duties of the DC Maternal Mortality Review Committee based upon DC Law 22.111. Adapted from: DC Law 22.111: Maternal Mortality Review Committee Establishment Act of 2018 (District of Columbia Council, 2018).

DC Law 22-111. Maternal Mortality Review Committee Establishment Act of 2018 Overview
Definitions
Maternal mortality means any pregnancy-related death or pregnancy-associated death.
Personally identifiable information means information that identifies any person or could be used to identify any person,
Duties
The committee shall evaluate maternal mortalities and associated factors that occur to DC residents.
The Committee's duties shall include:
Identify and characterize the scope and nature of maternal mortality.
Describe and record any data or patterns that are observed surrounding maternal mortalities.

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[250] MacDorman, M. F., E. Declercq, H. Cabral, and C. Morton. (September 2016). Is the United States maternal mortality rate increasing? Disentangling trends from the measurement issues: U.S. maternal mortality trends. *Obstetrics and Gynecology* 128(3):447-455. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5001799/.

[251] District of Columbia Council. D.C. Law 22-111: (2018). Maternal Mortality Review Committee Establishment Act of 2018. *District of Columbia Law Library*. https://code.dccouncil.us/dc/council/laws/22-111.html.

[252] Randall, K. (13 March 2019). D.C. finally establishes a committee to address maternal deaths: But the committee's lived-experience role remains unfilled. *Washington City Paper*. https://www.washingtoncitypaper.com/news/city-desk/article/21059548/dc-finally-establishes-a-committee-to-address-its-maternal-mortality-rate.

Examine past events and circumstances surrounding maternal mortalities.
Develop and revise operating rules and procedures for the review of maternal mortality.
Recommend systemic improvements to promote improved and integrated public and private systems serving pregnant women in the District.
Create a strategic framework for improving maternal health outcomes for racial and ethnic minorities in the District, including reducing disparities in maternal mortality rates for racial and ethnic minorities.

DC participates in the Healthy People initiative, a 10-year federal initiative that coordinates with numerous stakeholders to create a national benchmark and monitoring program that encourages collaboration across communities and measures the effect of prevention activities.[253] For 2020, DC has monitored these benchmarks and set goals for each category that are summarized in Table 5.

Table 5: DC health goals in 2020 for mothers, infants, and children. Adapted from: DC Law 22.111: Maternal Mortality Review Committee Establishment Act of 2018 (District of Columbia Council, 2018).

DC Maternal, Infant, and Child Health Goal			
Objectives and Targets			
Increase births with timely entry into prenatal care		Increase well-woman visits	
Baseline (2011)	66.80%	Baseline (2011)	79.30%
Most recent benchmark (2014)	68.30%	Most recent benchmark (2014)	76.90%
DC 2020 target	78.40%	DC 2020 Target	87.20%

DC Social Determinants of Health Goal			
Objectives and Targets			
Decrease racial segregation		Decrease racial isolation	
Baseline (2010)	35.40%	Baseline (2010)	11.20%
Most recent benchmark (2014)	29.20%	Most recent benchmark (2014)	8.40%
DC 2020 Target	24.50%	DC 2020 Target	3.70%
Notes: Indicator moving in the wrong direction. Racial disparity is getting worse.			

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[253] Office of Disease Prevention and Health Promotion. (2019). *About healthy people.* https://www.healthypeople.gov/2020/About-Healthy-People.

Efforts in Technology and Unintended Consequences

While endeavors to build maternal and child health datasets are vital to improving research efforts and developing innovative solutions to health disparities, inherent issues within data systems need to be addressed along the way. Additionally, the innovation in technological forms of maternal health care delivery, such as telehealth, are quickly coming to the forefront.

Data Exchange and Interoperability

Creating an effective database requires formatted, standardized datasets that enable interoperability. Interoperability is the ability of different information systems to exchange and use data with the goal of optimizing health.[254] Health data is collected from various sources such as patient surveys or administrative information collected from federal, state, local, and private health care facilities. Although data collected from these sources is abundant, quality and accuracy issues have made integration and interpretation difficult.[255] In addition, since information collected from these sources can be clustered, disaggregating the data into subcategories, such as race and ethnicity, is vital during analysis.[256] Unfortunately, disaggregation of data can also be difficult depending on the data collected and how it is stored.[257]

Patient medical and treatment data is digitally stored and accessed through electronic medical records (EMRs), electronic health records (EHRs), and personal health records (PHRs; see Table 6).[258]

Health data is protected information under the Health Insurance Portability and Accountability Act of 1996 (HIPAA), which established privacy standards addressing the use and disclosure of individuals' health information.[259] The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 provided the Department of Health and Human Services (HHS) with the authority to establish programs to improve health care quality and safety through the promotion of health information technology.[260]

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[254] HIMSS. (2019). *What is interoperability?* https://www.himss.org/library/interoperability-standards/what-is-interoperability.

[255] O'Hara, A. (2019). *Session 2: Data sources for indicators.* http://www.nationalacademies.org/hmd/Activities/PublicHealth/LeadingHealthIndicatorsForHealthyPeople2030/2019-MAY-28/Videos/S2/10.aspx.

[256] PolicyLink. (2018). *Making the case for data disaggregation to advance a culture of health* [background]. https://www.policylink.org/our-work/community/health-equity/data-disaggregation.

[257] Ibid

[258] Health Information Technology. (02 May 2019). *What are the differences between electronic medical records, electronic health records, and personal health records?* https://www.healthit.gov/faq/what-are-differences-between-electronic-medical-records-electronic-health-records-and-personal.

[259] HHS Office for Civil Rights. (26 July 2013). *Health information privacy: Summary of the HIPAA privacy rule.* .https://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html.

[260] HHS Office for Civil Rights. (16 June 2017). *Health information privacy: HITECH act enforcement interim final rule.* https://www.hhs.gov/hipaa/for-professionals/special-topics/hitech-act-enforcement-interim-final-rule/index.html.

Table 6: Types of electronic patient records. Adapted from: Health Information Technology (2019).

Types of Electronic Patient Records[261]	
Electronic medical records (EMRs)	Digital versions of clinic paper charts containing information that is used to diagnose and treat conditions at that facility
Electronic health records (EHRs)	Contain comprehensive treatment information from all the providers involved in the care of the patient and can expand across different specialties and facilities. EHRs follow the patient throughout life and continuously build upon previous clinical information.
Personal health records (PHRs)	Similar to EHRs in terms of content, but are simplified and designed to be set up, accessed, and managed by patients

Emerging Technologies

Artificial intelligence (AI) is the term used to describe the "ability of a machine to represent the human mind and perform any intellectual task that a human can perform".[262,263] AI applications have been used in health care for their ability to handle and optimize complex datasets and improve output from repeatedly performing algorithms.[264] A current example of AI application in health care is IBM's Watson Health, which has the ability to recommend the treatment trial most likely to cure an individual's cancer by considering patients' genome, history, imaging, and pathology.[265]

There are several efforts underway to incorporate technology into maternal health care. A 2018 report by the District of Columbia Primary Care Association (DCPCA) recommended improving text and telehealth services by working with established technology companies. Such ideas were highlighted as a way to leverage technology and increase primary care visits for women in DC.[266] Text4baby is another free initiative launched by HHS that aims to help pregnant women and new mothers increase their knowledge about caring for their health and the health of their babies.[267] Text4baby supports mothers by providing accurate information on health resources through text messaging.[268]

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[261] Ibid
[262] Wahl, B., A. Cossy-Gantner, S. Germann, and N. R. Schwalbe.(2018). Artificial intelligence (AI) and global health: How can AI contribute to health in resource-poor settings? *British Medical Journal: Global Health 3*(4). http://doi:10.1136/bmjgh-2018-000798.
[263] Bini, S. (2018). Artificial intelligence, machine learning, deep learning, and cognitive computing: What do these terms mean and how will they impact health care? *Journal of Arthroplasty 33*(8):2358-2361. http://doi: 10.1016/j.arth.2018.02.067.
[264] Ibid
[265] Ibid
[266] Ibid
[267] Administration for Children and Families. (n.d.). *Text4Baby*. https://www.acf.hhs.gov/text4baby.
[268] Ibid

Implications and Unintended Consequences

Because of the several ethical, moral, and legal issues associated with incorporating AI into health care, it is important to consider the risks and benefits of AI for health care providers and patients.[269] The rapid growth of AI brings several factors into consideration, primarily issues involving patient safety, trust, liability, and proficiency of applications.[270] In addition to the aforementioned considerations, another major aspect to consider is the bias associated with AI applications. Since AI systems are designed and programmed by humans, these systems are vulnerable to exhibiting biases and prejudices. Reports have found an "application that uses arrest records, postal codes, and socioeconomic data to assess the risk of recidivism in U.S. courts was biased against black citizens."[271] These biases in AI could pose an even greater risk when the systems are applied to maternal health and health care generally, especially given the evidence that black women experience adverse health outcomes at a higher rate than other racial groups.

Conclusion

Pregnancy-related death is an event in the United States that is experienced disproportionately by low-income and black women.[272] An estimated three out of five pregnancy-related deaths are preventable in the United States through interventions at the systems, local, and/or individual levels.[273] A myriad of complex factors, including access to care, socioeconomic status, and health history contribute to disparities in maternal morbidity and mortality. Understanding what resources are available in the systems that provide and influence maternal health care services and identifying the systemic biases and barriers that affect the quality and accessibility of those services will be imperative for constructing a successful intervention.

Appendix A: List of Acronyms and Initials

AI   artificial intelligence
BMI   body mass index
BMMA   Black Mamas Matter Alliance
C-section   caesarean section
CAPPA   Childbirth and Postpartum Professional Association
CDC   Centers for Disease Control and Prevention
CNM   certified nurse midwife
CPM   certified professional midwife
CRNP   certified registered nurse practitioners
DC   District of Columbia
DCPCA   District of Columbia Primary Care Association
EHR   electronic health records
EMR   electronic medical records
FMLA   Family and Medical Leave Act

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[269] Luxton, D. (2014). Recommendations for the ethical use and design of artificial intelligent care providers. *Artificial Intelligence In Medicine 62*(1):1-10. http://doi: 10.1016/j.artmed.2014.06.004
[270] Ibid
[271] Ibid
[272] Ibid 4
[273] Ibid 4

FQHC	Federally Qualified Health Center
HELLP	hemolysis, elevated liver enzymes, and low platelet count syndrome
HHS	Department of Health and Human Services
HIPAA	Health Insurance Portability and Accountability Act of 1996
HITECH	Health Information Technology for Economic and Clinical Health Act of 2009
HL7	Health Level 7
ICD	International Classification of Diseases
MHTF	Maternal Health Task Force
MISS	Midwifery Integration Scoring System
ML	machine learning
MMR	maternal mortality ratio
MMRC	Maternal Mortality Review Committee
NASEM	National Academies of Sciences, Engineering and Medicine
NIH	National Institute of Health
OB/GYN	obstetrics and gynecology
OB/GYN	obstetrician and gynecologist
PHR	personal health records
PRMR	pregnancy-related mortality ratio
PTSD	post-traumatic stress disorder
SAMHSA	Substance Abuse and Mental Health Services Administration
SEM	social ecological model
SNAP	Supplemental Nutrition Assistance Program
SSM	severe maternal morbidity
STI	sexually transmitted infection
U.S.	United States of America
WHO	World Health Organization
WIC	The Special Supplemental Program for Women, Infants, and Children

Appendix B: Resource List

National Organizations

- Black Mamas Matter Alliance
- Centers for Disease Control and Prevention
- DONA International and Childbirth and Postpartum Professional Association
- Every Mother Counts
- March of Dimes
- MomsRising
- Medicaid
- National Academies of Sciences, Engineering and Medicine
- National Birth Equity Collaborative
- National Community Reinvestment Coalition
- National Institutes of Health
- Planned Parenthood
- Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
- Substance Abuse and Mental Health Services Administration
- Supplemental Nutrition Assistance Program
- Temporary Assistance for Needy Families

- United Nations International Children's Emergency Fund
- United Nations Fund for Population Activities
- United States Department of Health and Human Services (HHS)
- United States Department of Labor
- World Health Organization

Local Organizations (DC, Maryland, Virginia)

- Centers for Medicare and Medicaid Services Maternal and Infant Health Initiative
- Centering Pregnancy Program
- Community of Hope
- District of Columbia Council
- District of Columbia Department of Health
- District of Columbia Fiscal Policy Institute
- District of Columbia Maternal Mortality Review Committee (DC MMRC)
- District of Columbia Primary Care Association
- Family Health and Birth Center
- Health Information Exchanges
- Health Level 7
- Mamatoto Village
- Mary's Center
- Medstar Washington Hospital Center
- United Medical Center (UMC)

Appendix C: Judging Rubric

DC Regional Case Challenge 2019—Judging Rubric

These criteria will be considered collectively through a facilitated judging discussion to determine the overall grand prize winner and category prizes. The criteria contributing to the three category prizes listed are indicated below.

Category Prizes: *Practicality Prize; #Interprofessional Prize; Wildcard Prize;

	Poor	Accept-able	Very Good	Out-standing	Comments
Analysis of Problem/Challenge					
• Astute synthesis of problem • Identification of key issues	☐	☐	☐	☐	
Appropriateness/Justification of Solution					
• Justification of chosen priorities • Justification of chosen intervention(s) • Evidence to support likely effectiveness • Resourcefulness in gathering information	☐	☐	☐	☐	
Acceptability/Uptake of Solution*					
• Acceptability to relevant DC area stakeholders • Cultural acceptability • Social/behavioral considerations	☐	☐	☐	☐	
Implementation Considerations*					
• Implementation plan • Timeline and budget	☐	☐	☐	☐	

• Feasibility (budget and other resources, time frame, cultural/political constraints, logistical/infrastructure constraints) • Monitoring and evaluation plan					
Potential for Sustainability*					
• Addresses/considers root causes & structural factors that lead to disparities in health outcomes (institutional racism, social/economic/physical conditions, etc.) • Long-term maintenance and growth (feasibility, funding)	☐	☐	☐	☐	
Interdisciplinary/Multisectoral#					
• Use of collaborations/interactions among disciplines and/or sectors	☐	☐	☐	☐	
Teamwork#					
• Engagement of whole team in preparation and/or presentation • Clear team understanding and use of each other's roles and expertise	☐	☐	☐	☐	
Presentation Delivery					
• Clarity of content and logic of flow • Time management • Audience engagement • Visual aesthetic • Professionalism, poise, and polish	☐	☐	☐	☐	
Questions and Answers					
• Clarity and thoughtfulness of responses • Ability to draw from evidence	☐	☐	☐	☐	

Appendix D: Case Writing Team Biographies

Rediet Woldeselassie (Team Co-Lead) is a second-year master's student at George Mason University studying Health Informatics with a concentration in Health Data Analytics. He graduated from George Mason University with a bachelor's in health administration and policy in 2018. Rediet is a 10-year veteran of the United States Marine Corps, where he served as a logistics management and supply chain analyst. Previously, Rediet was a research assistant at George Mason University's College of Education and Human Development where he worked on analyzing the impact of education on minority and underrepresented university students. Rediet was on the team representing George Mason University at the 2016 DC Public Health Case Challenge. In 2017 and 2018, he was part of the case writing teams, and is now the co-lead for the 2019 case challenge.

Liliana Zigo (Team Co-Lead) graduated from American University with a B.S in Public Health and a B.A. in Psychology. She was a member of American University's Honors program and in the College of Arts and Sciences Leadership and Ethical Development program. Previously, Liliana was a Killam Fellow sponsored by Fulbright Canada and attended the University of Toronto. Presently, Liliana works at the Office of Innovation and Entrepreneurship at The George Washington University, as a program associate. She started her Master's of Public Health in Epidemiology at the Milken Institute School of Public Health this fall. Liliana was on the team representing American University at the 2016 DC Public Health Case Challenge. In 2018, she was part of the case writing team and returns as a co-lead for the 2019 case challenge.

Mc Millan Ching (Case Writer) graduated from the University of Hawaii at Manoa with a B.S. in Molecular Biosciences and Bioengineering. He was a fellow of the National Institute of General Medical Sciences and did his research fellowship in Cancer Biology and Oncology at the University of Maryland School of Medicine. Together with his team from the University of Maryland Baltimore, he won the DC Public Health Case Challenge in 2018. Mc Millan is currently pursuing his doctoral training (Ph.D.) in Cellular and Molecular Medicine at the Johns Hopkins School of Medicine.

Rain Freeman (Case Writer) received her Master of Public Health degree in Epidemiology and Biostatistics from the Boston University School of Public Health, where she served as a Maternal and Child Health Research Fellow under reproductive environmental epidemiologist Ann Aschengrau, ScD. Currently, Rain works on research initiatives related to rural maternal, child, and adolescent health epidemiology at the University of Montana. Formerly, Rain worked as a Research Coordinator at the Emergency Medicine Network (EMNet) within Massachusetts General Hospital. At EMNet, she helped coordinate studies on health services in U.S. emergency care, with a focus on telemedicine and pediatric readiness. Rain received her B.S. in Public Health and Justice from American University in 2017. In 2016, Rain competed with the American University team in the DC Public Health Case Challenge. While in DC, Rain was privileged to work and volunteer among fellow disability rights, suicide prevention, and mental health advocates in various capacities.

Vidya Lala (Case Writer) graduated from Lebanon Valley College in Annville, Pennsylvania, with a B.S. in Biology, Pre-Medicine, with a Chemistry Minor and is currently a third-year medical student at the F. Edward Hérbert School of Medicine at the Uniformed Services University in Bethesda, Maryland. She was born in South Africa and moved to the United States when she was 4 years old. Upon entering medical school Vidya was commissioned as a second lieutenant in the United States Army. She is currently exploring the various fields of medicine and is still figuring out what she wants to be when she grows up! Last year Vidya participated in the DC Case Challenge and was honored that her team from USU was awarded the Harrison C. Spencer Interprofessional Prize for their theory-based community approach. She is excited to gain a new perspective by working behind the scenes on developing the case this year and wants to wish your team all the best in the competition this year!

Terry Pang (Case Writer) recently received his Master's of Public Health in Health Policy and Management from George Washington University Milken School of Public Health. His undergraduate degree is a Bachelor of Science in Public Health from the College of Charleston. Previously, Terry was a Public Health Leader Fellow which was sponsored by the Centers for Disease Control Office of Minority Health and Health Equity. Terry is also an alumnus of George Washington University's ISCOPES program, where he was able to create powerful learning experiences in partnership with the DC Metro community.

Morgan Taylor (Case Writer) received her MSPH in Population, Family, and Reproductive Health from the Johns Hopkins Bloomberg School of Public Health where she was a recipient of the federal Maternal and Child Health Training Grant. She holds certificates from Johns Hopkins in epidemiology and maternal and child health. Currently, Morgan works as a research data analyst on the early childhood services research team at Johns Hopkins. In this role, she collaborates with the project PI and program coordinators on several local and national research studies aimed at intensifying the use of breakthrough impact research methods to address home visiting priorities and impact among at-risk families. She received a B.S in Public Health from American University in 2017, and was a member of American's 2016 DC Public Health Case Challenge team.

Appendix E: Presentation Day Agenda

Agenda

October 18, 2019
National Academy of Sciences Building
2101 Constitution Avenue, NW, Washington, DC

8:00–8:30 a.m.	**Arrival and Registration** *(Room 125; breakfast available)*
8:30 a.m.	**Deadline to Turn in Presentation** *(Room 125)*

Please take your flash drive to the Case Challenge staff member at the computer. This is when you will draw a number for presentation order.

Judges Check In *(Room 125)*

8:45 a.m.   **Welcoming Remarks** *(Room 125)*
Victor J. Dzau, M.D., President, National Academy of Medicine

8:55 a.m.   **Logistics** *(Room 125)*

9:00 a.m.–12:40 p.m.   **Presentations** *(Room 125)*
At this time, all but the first team should leave and go to the West Court. After your team has presented, you may remain in the room to watch the remaining presentations. At some point during the day, an organizer will gather each team to take a photo at the Einstein statue in front of the NAS building.

9:00–9:30	Team 1
9:30–10:00	Team 2
10:00–10:30	Team 3
10:30–10:45	Break
10:45–11:15	Team 4
11:15–11:45	Team 5
11:45–12:00	Break
12:00–12:30	Team 6
12:30–1:00	Team 7

1:00–2:30 p.m.   **Lunch** *(West Court)*

Judges' Deliberations *(judges grab lunch from West Court and take to Board Room)*

2:30–3:00 p.m.   **Presentation and Discussion** *(Room 125)*
Marcia K. McNutt, Ph.D., President, National Academy of Sciences

3:00–3:15 p.m.   **Group Photo with Students, Advisors, and Judges** *(Outside)*

3:15–3:30pm   **Presentation**
Kimberly Seals Allers, Founder, The Irth App

3:30–4:00 p.m.   **Awards Ceremony and Reception** *(West Court)*