

Infant and Maternal Mortality in the City of Richmond

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Prepared for the City of Richmond



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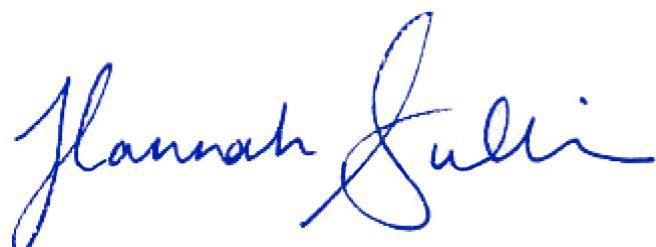
This is for the thousands of women in the United States annually who experience complicated or life-threatening pregnancies resulting in loss and hardship.

DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other entity.

HONOR PLEDGE

On my honor as a student, I have neither given nor received unauthorized aid on this assignment.



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Glossary of Terms

Cesarean delivery – a surgical procedure used to deliver a baby through incisions in the abdomen and uterus (ACOG, 2014).

Doulas – trained individuals that provide continuous social and emotional support from the prenatal phase through weeks following birth (DONA International, 2019).

Gestational age – the age of the pregnancy from the last normal menstrual period (APA, 2016).

Infant mortality – the death of an infant before his or her first birthday (CDC, 2019b).

Interconceptional period – the time between pregnancies, including but not limited to the post-partum period (DeFranco et al., 2015).

Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index – a measure that characterizes if the amount and timing of prenatal care (PNC) visits are consistent with American College of Obstetricians and Gynecologist (ACOG) recommendations for PNC utilization, though does not assess quality of care delivered (UDH, n.d.).

Low birthweight birth – a baby born less than 5 pounds, 8 ounces (March of Dimes, 2019d).

Maternal mortality – defined in the U.S. as death while or within 42 days of giving birth (CDC, 2019c).

Perinatal Care – health services before, during and after pregnancy (ACOG, 2017).

Postpartum – the first six weeks following birth (APA, 2016).

Preconception – the period of time before a woman becomes pregnant (ACOG, 2017).

Preeclampsia – pregnancy-specific hypertensive disease (high blood pressure) (CDC, 2019b).

Pregnancy-related death – results from the following: complications of the pregnancy itself; the chain of events initiated by the pregnancy that led to death; or aggravation of an unrelated condition by the physiological effects of the pregnancy that subsequently causes death (CDC, 2019c).

Prenatal care – pregnancy-related health care during pregnancy.

Preterm birth – a baby born before 37 completed weeks of pregnancy (CDC, 2019d).

Short interpregnancy intervals – births that occur less than six months between delivery and conception (DeFranco et al., 2015).

Acronyms

ACF	Administration for Children and Families
ACOG	American College of Obstetricians and Gynecologists
AIM	Alliance for Innovation on Maternal Health
BHB	B'More For Healthy Babies
CHIP	Children's Health Insurance Program
CP	CenteringPregnancy
FAMIS	The Family Access to Medical Insurance Security Plan
FPL	Federal Poverty Line
HFA	Healthy Families America
HRSA	Health Resources and Services Administration
LARCs	Long-acting Reversible Contraceptives
MIECHV	Maternal, Infant, and Early Childhood Home Visiting Program
MMRCs	Maternal Mortality Review Committees
NFP	Nurse Family Partnership
OKQ	One Key Question
RCHD	Richmond City Health District
TANF	Temporary Assistance for Needy Families
VDH	Virginia Department of Health
VDSS	Virginia Department of Social Services
VNPC	Virginia Neonatal Perinatal Collaborative

Executive Summary

Infant mortality in the City of Richmond occurs at nearly twice the state and national rates. Additionally, rates of infant and maternal mortality have been substantially higher for black Richmond residents compared to white Richmond residents over the last ten years. Based on analysis by the Virginia Maternal Mortality Review, the most important causes of infant deaths in Richmond are believed to be factors preceding birth.

Racial disparities in birth outcomes in Richmond reflect those nationally, with black infants and black women in the United States at least twice as likely to die within a year of birth compared to their white counterparts (CDC, 2018a; Mathews & Driscoll, 2017). Differences in extreme preterm births (PTB) between black and white infants are estimated to explain nearly 80 percent of the disparity in infant mortality (Bryant et al., 2010). Nearly half of all U.S. pregnancy-related maternal deaths are the result of hemorrhage, cardiovascular and coronary conditions or infection (CDC, 2018b). Though women of all races experience these complications, black women are more likely to die than women of other races with the same health risks (Tucker et al., 2007). The reasons for these health disparities are not well understood, though research shows that factors like poverty, discrimination and persistent stress lead to social, economic and physical challenges that negatively impact birth outcomes (Lu & Halfon, 2003; Woolf & Braveman, 2011).

This analysis proposes five alternatives that address infant and maternal mortality in the City of Richmond:

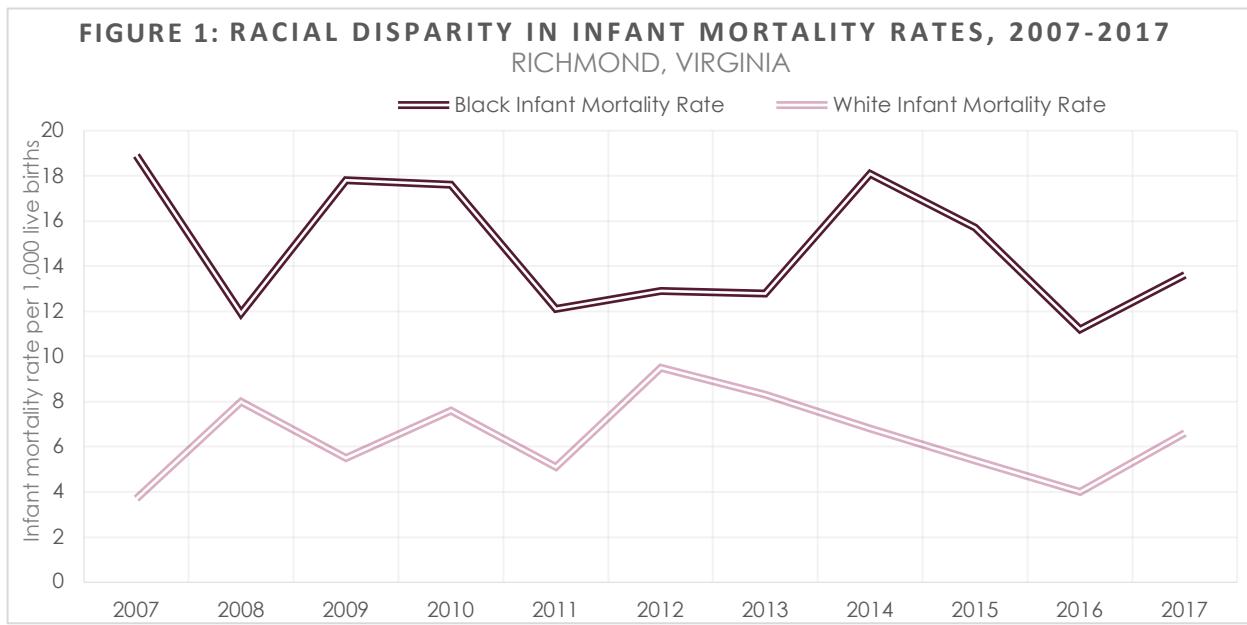
1. Implement One Key Question Training
2. Increase Access to Doulas
3. Expand CenteringPregnancy
4. Create Healthy Start in Housing
5. Establish the Richmond Healthy Births Collaborative

Each alternative is evaluated with respect to: a) cost; b) possibility for external funding; c) effectiveness in reducing infant and maternal mortality; d) cost-effectiveness; e) equity; and f) ease of implementation. In order to establish a holistic effort to reduce infant and maternal mortality, two short term alternatives will be recommended as well as a longer-term, more integrative option. In the short term, piloting One Key Question and providing grants to increase doula access are recommended as options with the best outcomes for the Richmond City Health District (RCHD) across the criteria domains. In the long term, creating a Richmond Healthy Births Collaborative is recommended as providing the most significant and coordinated impact on birth outcomes for the city. **Implementing these initiatives over five years would lead to an estimated 26 percent reduction in infant mortality and an 11 percent reduction in maternal mortality in the City of Richmond.**

Context of the Problem

PROBLEM STATEMENT

The infant mortality¹ rate in the City of Richmond (10.8 per 1,000 live births) is nearly twice the state and national rates. Additionally, rates of infant and maternal mortality² have been substantially higher for black Richmond residents compared to white Richmond residents over the last ten years (Figure 1).



Data Source: Virginia Department of Health. Data from the 2007 – 2017 Infant Deaths Data Tables.

THE SCOPE INFANT MORTALITY IN RICHMOND

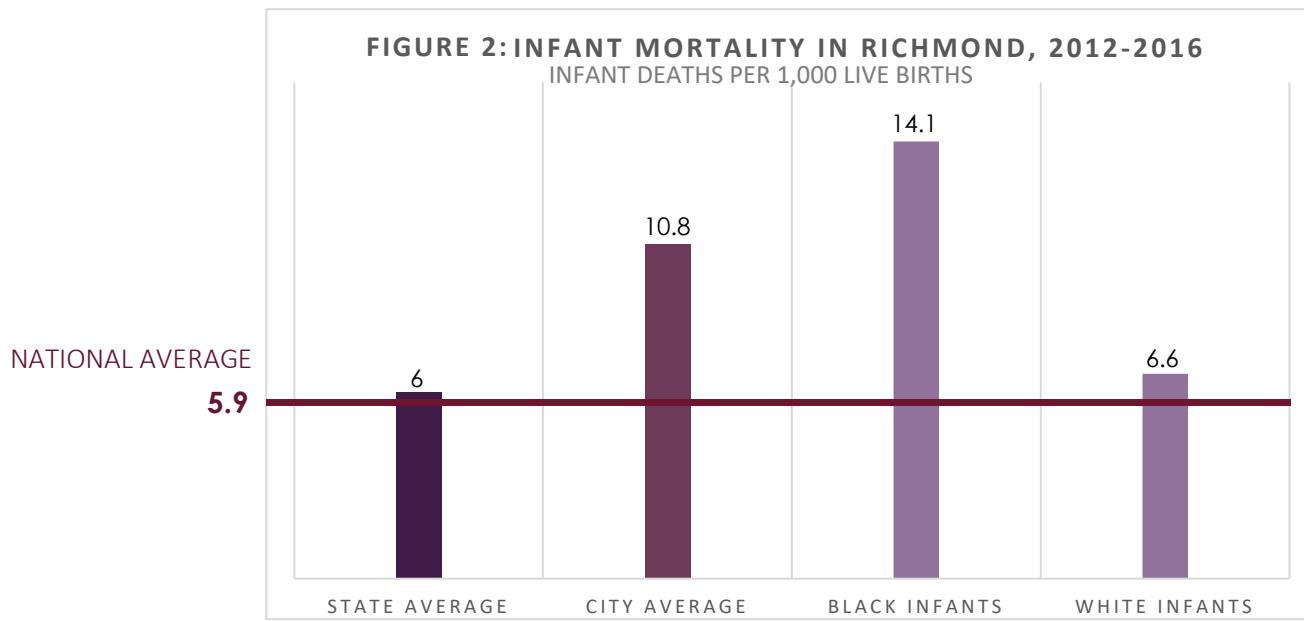
Infant mortality in the City of Richmond is particularly high, with around 30 infant deaths occurring annually. Between 2012 and 2016, Richmond had a higher aggregate infant mortality rate (10.8 per 1,000 live births) than the state of Virginia (6) and nationally (5.9) (Figure 2). The city's infant mortality rate is higher than that of Costa Rica, Sri Lanka, Bosnia, and Thailand and is equivalent to that of Libya (CIA, 2017). Black infants in Richmond die at a rate of 14.1 deaths per 1,000 live births, which is double the rate of white infants at 6.6 per 1,000 births. Though infant mortality in Richmond has fluctuated over the last 10 years, this gap has remained persistent.

Similar racial disparities in mortality rates exist on the state and national level, each around twice as high for black infants compared to white infants, yet at much lower overall magnitudes. Between 2012 and 2016, black infant mortality in the state of Virginia was 11.7 per 1,000 live

¹The death of an infant before his or her first birthday.

²Death while or within the first 42 days of giving birth.

births compared with 4.9 for white infants. Nationally, black infant mortality was 10.8 per 1,000 compared to 5 for white infants in the United States (RCHD, 2018).



Data Source: RCHD, 2018.

Factors preceding birth are thought to be the most important causes of infant deaths in Richmond. Nearly half of all deaths occurred under one day of age and around 20 percent occurred within the first four weeks of life. The most common cause of death within the first four weeks of life was prematurity or preterm birth (PTB) (58 percent of deaths). Following the first four weeks, 38 percent of deaths occurred due to unsafe sleeping conditions like co-sleeping or unsafe bedding. The number of deaths were too small to determine disparities in causes of death by race (RCHD, 2018).

MATERNAL MORTALITY IN RICHMOND

Between 1999 and 2013, 36 women in the City of Richmond died within a year of pregnancy, while a total 628 maternal deaths occurred in the State of Virginia during this period. Nine (one third) of maternal deaths in Richmond were pregnancy-related. Due to the small number of total pregnancy-related deaths, determining patterns in causes of death are difficult. That being said, the maternal mortality review panel found that most pregnancy-related deaths occurred in black women (80 percent) and in women ages 20 to 29. Women in all cases were found to have met the expected number of prenatal care visits determined as adequate by the Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index³. The causes of death for these women

³A measure that characterizes if the amount and timing of prenatal care (PNC) visits are consistent with American College of Obstetricians and Gynecologists (ACOG) recommendations for PNC utilization, though does not assess quality of care delivered.

included pregnancy-induced hypertension and eclampsia, and cardiomyopathy, though the causes mostly varied among the few pregnancy-related deaths (Rouse, 2018).

Between 1999 and 2013, 80 percent of pregnancy-related maternal deaths in Richmond were black women.

NATIONAL TRENDS IN INFANT AND MATERNAL MORTALITY

Infant mortality has declined in the last decade. By 2017, the infant mortality rate in the U.S. was 5.8 per 1,000 live births, which was down 15 percent from 2005 (6.9 per 1,000) (CDC, 2019b; Mathews & Driscoll, 2017). Black women saw the largest decline in infant mortality rates over this period, decreasing by 20 percent from 13.6 to 10.9. Yet, these rates are persistently twice as high compared to white women (from 5.8 to 4.9) and Hispanic women (from 5.6 to 5.0) (Mathews & Driscoll, 2017).

Though global maternal mortality rates have decreased by around 30 percent from 1990 to 2015, U.S. maternal mortality rates have been increasing. Women in the U.S. die of pregnancy-related complications at higher rates than any other developed country. In 2015, the U.S. maternal mortality rate was 26.4 per 100,000, compared to 9.2 in the United Kingdom, 7.3 in Canada, and 5.5 in Australia (GBD, 2017). This rate is much higher for black women in the U.S., who are approximately three times more likely to die during or within 42 days after child birth (40 deaths per 100,000 live births) than white women (12.4) and women of other races (17.8) (CDC, 2018a).

It should be noted that the classification of maternal mortality varies. The World Health Organization defines maternal mortality as “the death of a woman while pregnant or within 42 days of termination of pregnancy, regardless of cause” (WHO, 2018). Few countries outside of the U.S. consider mortality rates beyond 42 days after giving birth, which have shown to account for a significant amount of deaths in both low and high-income settings (GBD, 2017).

Additionally, in 2003, the United States added a category to the U.S. Standard Certificate of Death indicating a female decedents’ pregnancy status in the year before death. As it can be difficult to determine if deaths are pregnancy-related, especially in later months after birth, this has increased identification capabilities of the U.S. (Horon & Cheng, 2011). The U.S. is one of the few countries to use this identification system, which may account for part of the increases in U.S. mortality rates starting in 2003 (GBD, 2017).

Trends in U.S. maternal mortality rates have been difficult to discern due to the fact that the U.S. Standard Certificate of Death is not universally used and many states were slow to adopt a pregnancy status question on death certificates⁴. A 2016 study that adjusted for data before the standard pregnancy question was adopted in each state found that maternal mortality rates (deaths within a year of giving birth irrespective of cause) still increased by 26.6 percent from 2000 to 2014 (MacDorman et al., 2016). The Centers for Disease Control and Prevention reported trends in reported pregnancy-related deaths increasing steadily from 14.5 per 100,000 in 2000 to 18.1 in 2014, though analyses did not consider adjustments for differences in the adoption of a pregnancy question on death certificates (Division of Reproductive Health, 2018).

Causes and Risk Factors

CAUSES OF INFANT AND MATERNAL MORTALITY

Preterm birth and low birthweight are the most prominent causes of infant mortality, with preterm birth the leading cause of infant deaths in the United States (Kramer et al., 2010). Nearly half of all U.S. pregnancy-related deaths are the result of hemorrhage, cardiovascular and coronary conditions or infection, though the leading causes of death vary by race. One review estimated that over 60 percent of pregnancy-related deaths between 2008 and 2017 were preventable (Building U.S. Capacity, 2018).

Social determinants of health, the environments and circumstances in which people live and grew up in, are key to understanding negative birth outcomes (CDC, 2018b). This is often referred to as the life-course perspective, which has become a popular framework in understanding health inequity. This theory maintains that a woman's health before pregnancy can have a much larger impact on outcomes and disparities, than the nine months of gestation. In a cyclical flow, factors like poverty, discrimination and persistent stress lead to social, economic and physical challenges that negatively affect health (Lu & Halfon, 2003; Woolf & Braverman, 2011).

There is a depth of strong evidence linking the relationship between low socioeconomic status (education, income and class) and poor birth outcomes like low birthweight and preterm birth (Braverman et al., 2015; Mendez, Hogan & Culhane, 2014; Margerison-Zilko, et al., 2015; Salow et al., 2018). Additionally, being unmarried has been linked to higher rates of preterm birth and partner violence is associated with fewer prenatal care visits (Dole et al., 2004; Mendez, Hogan & Culhane, 2014; Musa et al., 2019). Studies have also linked exposure to stress and depression to

⁴Virginia adopted the standard pregnancy question in 2013.

adverse birth outcomes (Kramer et al., 2009; Witt et al. 2014). Health-specific risks include tobacco exposure and use of illicit drugs, vaginal infections, previous preterm birth, short pregnancy intervals, low or high maternal body mass index, and hypertension and diabetes (Rundell & Panchal, 2017; Mendez, Hogan & Culhane, 2014; Donoghue et al., 2013; Spong, 2007; Ehrenthal et al., 2011). Additionally, Caesarian deliveries are associated with higher risks of maternal deaths (ACOG, 2014).

Table 1: Major Infant and Maternal Mortality Risk Factors

Structural and community factors	<ul style="list-style-type: none"> • Neighborhood socioeconomic deprivation (concentrated poverty, educational outcomes, unemployment, housing) • Living in a racially segregated or redlined area • Air and water pollution
Socioeconomic and interpersonal status	<ul style="list-style-type: none"> • Poverty, unemployment, improper housing • High school non-completion • Partner violence • Single, unmarried
Behavioral risks	<ul style="list-style-type: none"> • Tobacco, opioid or illicit drug use • Short interpregnancy intervals • Attending fewer than 10 prenatal visits • Unsafe infant sleep practices
Health-related factors	<ul style="list-style-type: none"> • Chronic health diseases like Type 2 diabetes and hypertension • Low or high maternal body mass index • Younger age or older age • Stress • Vaginal infections and sepsis • Caesarean delivery and early elective caesarean delivery • Previous PTB

RACIAL DISPARITIES IN BIRTH OUTCOMES

PRETERM BIRTH AND SOCIOECONOMIC STATUS

Differences in extreme preterm births (PTB) between black and white infants are estimated to explain nearly 80 percent of the disparity in infant mortality. Despite the identified risk factors, reasons for the racial disparity in extreme PTB are not well understood (Bryant et al., 2010).

Socioeconomic factors including neighborhood deprivation, maternal education and income explain some prevalence of risk, but do not account for the majority of the observed differences by race (Grobman et al., 2018; Manuck, 2017). A study of 10,000 women in California found

significant levels of disparity in preterm birth rates among white and black women of both lower and higher socioeconomic status (Braverman et al., 2015). Multiple studies have found that disparities in preterm and low birthweight are *greatest* between black women of high socioeconomic status compared to white women of high socioeconomic status, and differences persist between black women of high socioeconomic status and white women of low socioeconomic status (Coley, & Nichols, 2011; Kothari et al., 2016; Smith et al., 2018). Black women with master's and doctorate degrees have higher infant mortality rates than white women who have not finished high school. Though the underlying reasons for these disparities at high socioeconomic levels are still being identified, researchers point to perceived discrimination, racial isolation, and race-related stress throughout a woman's lifespan as major contributors (Smith et al., 2018).

Black women with master's and doctorate degrees have a higher risk of infant mortality than white women who have not finished high school.

HEALTH FACTORS AND RACIAL DISPARITY

Studies investigating the prevalence of adverse biological responses in black women have reported mixed findings (Donoghue et al., 2013; Manuck, 2017; Tucker et al., 2007). Black women are more likely to experience hypertensive disorders of pregnancy than other groups and are more at risk of entering pregnancy with preexisting diabetes and obesity (Branum, Kirmeyer, & Gregory, 2016; Bryant et al., 2010). Obesity is linked to many pregnancy risks like infant mortality, preterm birth, gestational diabetes and cesarean delivery (Stubert et al., 2018). Stress is also a significant contributor to adverse birth outcomes. Studies have shown that black women are most likely of any racial group report chronic stress while pregnant (Dominguez et al., 2008; Grobman et al., 2016; Kramer et al., 2009; Witt et al. 2014). Yet, studies have revealed that foreign-born black women have lower infant mortality, preterm births and low birthweight compared to United States-born black women, even after U.S.-born women received earlier prenatal care and more education (Acevedo-Garcia, Soobader, & Berkman, 2005; Baker & Hellerstedt, 2006; Elo, Vang, & Culhane, 2014). Additionally, though black women tend to have shorter pregnancy intervals, one study concluded that a factor like shorter interpregnancy intervals only explains four percent of the black-white disparity (Hogue et al., 2011).

Further, fatality rates among black women and black infants are much higher than white women with comparable health status. A study conducted on a national sample of women revealed that black women did not have a higher prevalence of maternal risk factors like preeclampsia and eclampsia, postpartum hemorrhage, or placental abruption, though black women did have a higher fatality rate, between double and triple, that of white women (Tucker et al., 2007). A comprehensive review of over 100 studies found that black women with chronic conditions like asthma, gum disease, and human immunodeficiency virus (HIV) have worse pregnancy outcomes than white women with the same diseases. Further, black women have a higher risk associated with cesarean deliveries than white women, even after adjusting for socioeconomic status, maternal age, chronic disease and preeclampsia (Bryant et al., 2010). Though women who do not participate in prenatal care are most likely to be nonwhite, it is unclear if nonparticipation in prenatal care explains the majority of racial disparities (Bryant et al., 2010; Sparks, 2009). Black and white disparities in preterm birth rates have also been found in populations where women had the same access to care, such as the military (Manuck, 2017).

RACISM AND BIRTH OUTCOMES

As biological and socioeconomic factors remain inconclusive in fully explaining the racial gap in disparate birth outcomes, various studies have explored the role of racism on preterm birth risk. Studies have revealed that living in segregated residential areas; structural racism across community, politics, and judicial systems; racial discrimination in prenatal care and employment; and perceived racism increase the risk of adverse birth outcomes (Alhusen et al., 2016; Chambers et al., 2018; Dominguez, 2011; Mendez, Hogan & Culhane, 2014; Slaughter-Acey et al., 2018). One study found that a slight increase in racism in a woman's area (as determined by Google searches associated with racism) was associated with a five percent increase in both low birthweight and preterm birth among black women (Chae et al., 2018).

The Role of Government Policy

FEDERAL GOVERNMENT POLICY

On December 22, 2018, Congress passed the Preventing Maternal Deaths Act of 2018, which created a grant program for states aimed at establishing or improving maternal mortality review committees (MMRCs) and enhancing reporting and data collection around maternal mortality. These committees bring together local experts in infant, maternal and public health to review maternal death cases and identify specific, local action steps to prevent future deaths (Preventing Maternal Deaths, 2018). Additionally, a Black Maternal Health Caucus was formed on March 9, 2019 in the U.S. House of Representatives, with the goal of working with the Black

Mamas Matter Alliance to create policies for improving black maternal health rooted in evidence-based and culturally relevant practices (Frazin, 2019).

GRANTS

The Title V Maternal and Child Health Services Block Grant Program administered by Health Resources and Services Administration (HRSA) creates federal and state partnerships to support quality and access to health care for mothers and children. The grant program is one of the largest federal block grant programs, serving over 48 million children, supporting a wide range of activities related to improving maternal and child health. States match federal funds based on a formula that calculates the number of low-income children in the state (HRSA, 2019a). In FY 2017, the State of Virginia received \$12.1 million in federal funding through the block grant, spending \$23.8 million total in health service activities (HRSA, 2018c).

PROGRAMS

In partnership with the Administration for Children and Families (ACF), HRSA also funds the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) Program which provides funds to states to develop and implement evidence-based home visiting programs for low-income families (HRSA, 2018a). In FY 2018, the Virginia Department of Health received \$7.9 million in MIECHV funds (HRSA, 2018b). Additionally, HRSA funds the Healthy Start Initiative which is a community-based approach to reducing infant mortality for at risk women (HRSA, 2018b). Healthy Start is administered by local agencies with varied services depending on the state, often providing care coordination, parenting education, smoking cessation assistance, psychosocial counseling, home visits, and support groups (APA, 2019). Richmond's Healthy Start Initiative provides home visiting services through case management and coordination, receiving around \$850,000 in federal funds (HRSA, 2017).

INSURANCE

Federal policies regarding insurance coverage contribute to efforts in improving maternal and child health. The federally funded insurance programs, Medicaid, CHIP and healthcare provided through the Affordable Care Act enhance policies improving infant and maternal health.

Medicaid provides insurance to low-income individuals, with income eligibility varying state-to-state. A study using data from all 50 states and Washington, DC between 2010 and 2015 found that states that expanded Medicaid saw reductions of infant mortality of more than 50 percent compared to non-Medicaid expansion states. Additionally, the difference in rates were greatest in African American infants, largely driving the differences between expansion and non-expansion states (Bhatt & Beck-Sagué, 2018).

The Children's Health Insurance Program (CHIP) provides health insurance to low-income children as determined by income as a proportion of the federal poverty line (FPL). This program provides insurance to children who are ineligible for Medicaid but whose families cannot afford

insurance from a private provider. Additionally, states have the option to include coverage for pregnant women through this program to cover prenatal checkups and other services (NCSL, 2017). Virginia's CHIP, the Family Access to Medical Insurance Security Plan (FAMIS), provides coverage to pregnant mothers up to 200 percent of the FPL (Medicaid.gov, 2018). Additionally, insurance through the Affordable Care Act provides access to a wide range of contraceptive option and well-woman visit coverage (HealthCare.gov, n.d.).

VIRGINIA STATE POLICY

In the 2019 Virginia General Assembly session, the House and Senate passed HB 2546, which established the Maternal Death Review Team, requiring the Virginia Department of Health to review pregnancy-related deaths in Virginia. The bill requires this team to develop operating procedures for maternal death reviews, improves data collection and record keeping, and recommends educational awareness and prevention programs and training. Although the Virginia Department of Health has operated some form of a maternal mortality review team starting as early as 2002, this bill extends the team's requirement of reporting to the General Assembly and the Governor and bolsters data collection, record keeping, and recommendation efforts (HB 2546, 2019; Bacak et al., 2006).

INITIATIVES

LARCs

In October, 2018, the Virginia Department of Health (VDH) launched an initiative to increase education and access to long-acting reversible contraceptives (LARCs). Through funds from the Temporary Assistance for Needy Families (TANF) block grant, VDH awarded up to \$6 million to qualified health care providers to provide LARCs to patients through May 2020. Additionally, funds will be used to increase awareness and engagement with the state's Medicaid Plan First program, providing family planning services to women at 200 percent of the FPL (VDH, 2018a).

HOSPITAL SAFETY PROCEDURES

In 2017, Virginia joined the Alliance for Innovation on Maternal Health (AIM)⁵ which collaborates with states and hospital systems across the U.S. to improve maternal safety throughout and following delivery (VDH, 2018b). AIM helps implement evidence-based maternal safety bundles in hospitals relating to important high-risk factors affecting maternal health like obstetrical hemorrhage, severe hypertension, and reduction in low risk primary cesarean births (for more information, see appendix A) (ACOG, 2019b). Virginia is currently implementing the Maternal Hemorrhage patient safety bundle and piloting the Obstetric Care for Women with Opioid Use Disorder safety bundle. Additionally, the newly formed Virginia Neonatal Perinatal Collaborative

⁵Funded by the federal Maternal and Child Health Bureau.

(VNPC)'s Improving Perinatal Outcomes Advisory Committee is working to develop quality improvement projects to improve key problems in obstetric care and outcomes (VDH, 2018b).

SAFE SLEEP

The Virginia Department of Social Services (VDSS) uses part of the state's federal Title V funds to support Safe Sleep 365, a statewide partnership to improve safe sleep practices and reduce Sudden Unexpected Infant Death (SUID) in Virginia (HRSA, 2018c). Partners include the Virginia Department of Health, the Virginia Department of Medical Assistance Services, the Virginia General Assembly and the Virginia Supreme Court (Safe Sleep 365, 2019). Funds are used to train and educate home-visitors, health care professionals, and health educators in safe sleep education and effective means of disseminating this information to new parents (HRSA, 2018c). Additionally, the campaign includes a partnership between the Children's Hospital of Richmond at VCU and Baby Box University (Safe Sleep 365, 2019). Baby Box University is a program that encourages parents to take a 15 to 20-minute-long online course about sleep safety and healthy pregnancy. In return, users are given safety and care products including a Baby Box, which is a small, padded box that acts as a safe sleeping environment for infants (Baby Box, 2019).

VIRGINIA MEDICAID EXPANSION

As of 2019, Virginia expanded Medicaid to include individuals between the ages of 19 to 64 with income at or below 138 percent of the federal poverty line. This action expanded coverage to an additional 400,000 people, which would increase current enrollment (1.2 million) by one third (Norris, 2018). Additionally, the expansion retains Virginia's Plan First program that offers Medicaid-covered family planning services for individuals earning up to 200 percent of the FPL (Cover Virginia, n.d.).

Evidence-Based Interventions

EVIDENCE OF SOLUTIONS

Strong Evidence	Moderate Evidence	Mixed Evidence	Weak Evidence	Little Evidence
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This scale evaluates the strength of evidence in reducing the following risk factors: preterm birth, low birthweight, preeclampsia and cesarean delivery, as well as reductions in infant and maternal mortality.

PERINATAL CARE

Perinatal care is defined as health services before, during and after pregnancy. Because infant and maternal health depend largely on interrelated and environmental factors, care throughout

pregnancy is important for maternal and infant health and wellbeing. Perinatal care improves a range of pregnancy outcomes, including reducing infant and maternal mortality risk factors (ACOG, 2017). Yet, many women experience barriers to perinatal care including lack of medical coverage, unrecognized or unintended pregnancy, financial restraints, lack of transportation, long wait times and a shortage of providers (Shah, Revere, & Toy, 2018; Mackert et al., 2017).

INCREASING ACCESS TO LARCS

Unintended pregnancies and pregnancies that start less than 18 months after birth are both less likely to receive on-time prenatal care and at a higher risk birth of outcomes like low birthweight, preterm birth, infant and maternal mortality (DeFranco et al., 2015; Shah et al., 2011). Long acting reversible contraceptives (LARCs) are a birth control method that after one-time implementation, provide long-term and reliable prevention of pregnancy (Curtis & Peipert, 2017). Studies have revealed that LARCs have effectively reduced unintended pregnancies in the United States and within state and city initiatives in Colorado and St. Louis (Finer & Zola, 2016; Harper et al., 2015; Secura et al., 2014). Rigorous studies in California and Colorado revealed that seeing a publicly funded LARC provider once or living in proximity to clinics with LARC access reduce high risk births and PTB rates (Goldthwaite et al., 2015; Rodriguez et al., 2015; Ricketts, Klingler, & Schwalberg, 2014).

INCREASING DOULA ACCESS

Increasing access to doulas has emerged recently as an innovative policy to reduce black-white birth disparities. Doulas are trained individuals that provide continuous social and emotional support from the prenatal phase through weeks following birth (DONA International, 2019). The use of doulas to impact birth outcomes has been rigorously studied, often cited as an evidence-based method of reducing Caesarian deliveries. The ACOG has cited expanding access to doula services as “one of the most effective tools to improve labor and delivery outcomes” (ACOG, 2019a). Studies on the effect of doulas have revealed positive outcomes especially among women who are low-income, socially disadvantaged, unmarried, experience language and cultural barriers and give birth in hospitals without a companion (Vonderheid et al., 2011).

Studies focusing on low-income women have revealed that using doulas decrease Caesarian deliveries, increase contact with health care professionals, and increase healthy infant-care behavior like safe sleeping practices and breastfeeding (Gruber, Cupito, & Dobson, 2013; Mottl-Santiago et al., 2008). Yet these studies, as well as meta-analyses, do not find positive effects of doula programs on preterm birth (Bohren et al., 2017; Hans, Edwards & Zhang, 2018; Kozhimannil et al., 2014). Conversely, three recent studies specifically involving samples of minority women qualifying for Medicaid, revealed reduced risk of preterm birth, low birthweight, complications during birth, and Caesarean deliveries (Gruber, Cupito, & Dobson, 2013; Kozhimannil et al., 2016; Kozhimannil et al., 2013). The Gruber, Cupito, and Dobson study

that matched 226 white and African American women, assigning roughly half to a doula, found that women matched with doulas were *four times* less likely to have a low birthweight baby and two times less likely to experience a birth complication affecting themselves or the baby (2013). A study that matched nearly 2,000 Medicaid-qualifying women with doula care to women with similar characteristics who did not receive doula care found that women with doula care had 22 percent lower odds of preterm birth. While studies acknowledge reductions in risky Caesarean deliveries and birth complications for mothers, there is a gap in explicit evidence of doula services reducing maternal mortality.

HOME VISITING PROGRAMS

Home visiting programs are a widely endorsed method of addressing disparities in birth outcomes by bringing preventative and early intervention services to families in need. Several systematic reviews of home visiting programs have found mixed results of impact on birth outcomes (Filene et al., 2013; Michele Issel et al., 2011). Two rigorously studied programs, the Nurse-Family Partnership (NFP) and Healthy Families America (HFA), have revealed positive and lasting maternal and child across a range of health, economic and educational outcomes. Initial randomized controlled trials of NFP revealed that the program decreases prenatal cigarette smoking, reduces risk of hypertensive disorders and lessens short interpregnancy births (Kitzman et al., 2010; Olds et al. 1986, 1988, 2002). A comprehensive study of 27,000 women participating in NFP between 2007 and 2010 matched a control group of women based on demographic factors found that NFP had no effect on low birthweight, but reduced incidence of preterm birth (Thorland, & Currie, 2017). One follow-up study of randomized controlled trials of NP found reductions in mortality by any cause among mothers and preventable mortality in highly disadvantaged children (Olds et al., 2014). Studies of the HFA program revealed reduced risk of low birthweight for black and unmarried women by 50 percent and infants were 2.5 times more likely to survive infancy (Lee et al., 2009; Donovan et al., 2007).

GROUP PRENATAL CARE

Coupling group prenatal care with standard individualized care has demonstrated positive outcomes for women in terms of increased prenatal knowledge, improved mental health, and satisfaction with care (Benediktsson et al., 2013; Cunningham et al., 2016; Ickovics et al., 2007). Yet, there is mixed evidence about group prenatal care decreasing risks like preterm birth, low birthweight and Caesarean sections (Carter et al., 2016; Cunningham et al., 2019; Ickovics et al., 2016, 2007). A systematic review of 14 studies, including four randomized trials⁶, found no

⁶ Randomized trials are considered the gold standard of research. Individuals are assigned randomly to treatment and control groups and their outcomes are compared after the treatment is administered. This allows researchers to determine the effectiveness of the treatment for those who received it, compared to similar individuals who did not receive treatment.

significant differences in preterm birth rates among women who received group prenatal care compared to those who received standard care (Carter et al., 2016). Yet, a study of nearly 10,000 women revealed that those receiving group prenatal care programs, CenteringPregnancy (CP) and Expect With Me, had significantly lower risk of preterm birth and low birthweight babies compared to those receiving individual care (Cunningham et al., 2019).

Several rigorous studies have found no significant difference in PTB rates for women participating in CP compared to those not participating (Fausett et al., 2014; Kennedy et al., 2011; Ickovics et al., 2016; Tanner-Smith, Steinka-Fry, & Lipsey, 2014). Yet, Fausett and colleagues found in a quasi-random study⁷ of around 1,000 women that CP reduced only early PTB rates (<32 weeks). A randomized control trial, containing a sample of around 1,000 women attending two hospital prenatal clinics, 80 percent of whom were African American, found that women participating in CP were 33 percent less likely to have PTB (Ickovics et al., 2007). A randomized control trial of the CP program in 14 health centers in New York City from 2008 to 2012 revealed favorable birth outcomes in terms of birthweight and gestational age (Ickovics et al., 2016). Another study using rigorous quasi-experimental methods, with a sample of over 6,000 women in Tennessee, found that women participating in CP had longer weeks of gestation and lower risk of very low birthweight (Tanner-Smith, Steinka-Fry, & Lipsey, 2014). Though evidence of reduction in PTB rates is mixed, studies of CP reveal strongly positive results in terms of reducing early PTB and very low birthweight, reductions in PTB for African American women and greater gestational age. Few studies have evaluated the benefits CP on maternal mortality.

BABY BOXES

Baby box interventions send families home from the hospital with a bundle of resources in a cardboard box that doubles as a sleeping environment for newborns. The intention of the intervention is to disrupt the risky practice of having a newborn sleep in the mother's bed. Often, this intervention is used as a way to distribute face-to-face safe sleep instruction from medical practitioners. Yet, there lacks rigorous evidence of the effectiveness of baby box interventions in reducing infant mortality. In July, 2017, the American Academy of Pediatrics (AAP), released a statement cautioning the use of cardboard baby boxes, citing no information on their effectiveness in reducing infant mortality and that baby boxes are not required to meet safety rules like cribs and bassinets (AAP, 2017). Multiple national and international experts from pediatric, public health, epidemiology, social work, and infant health fields, including experts at the University of Virginia, have also recently released statements cautioning the use of carboard baby boxes. Researchers again state their lack of evidence, as well as safety hazards like the

⁷Quasi-random studies use statistical processes to emulate random assignment, often matching individuals who received treatment to those with similar characteristics who did not receive treatment.

flammability and durability of a cardboard box, and multiple risks associated with the box being placed on the floor (Blair et al., 2018).

PROMISING INTERVENTIONS

These interventions have been implemented on smaller scales or are newer and have yet to be researched as thoroughly as policies in the previous section.

ONE KEY QUESTION

One Key Question (OKQ) is a practice developed to direct women to proper prenatal and pre-pregnancy care. The intervention involves doctors posing the question, “Would you like to become pregnant in the next year?”, during all clinic visits with women. Responses to this question are tied to a specific follow-up protocol that direct women to contraception or preconception care (see Appendix B for the OKQ diagnostic diagram) (Allen et al., 2017). Though there have been few rigorous analyses of this program, an initial case study of One Key Question (OKQ) in an Oregon health clinic found that it increases contraception use by 14 percent and initiated a change in preferred method of use by nine percent (Power to Decide, 2019). Another pilot in a family medicine clinic in Oregon found that women screened using OKQ were more than three as likely to receive a prenatal vitamin prescription and twice as likely to receive any reproductive health prescription compared to those not screened (Yonke, 2011). In combination with other prenatal interventions, multiple cities that have made gains in reducing infant and maternal mortality have implemented this practice (BHB, 2019; BPHC, 2014).

HEALTHY START IN HOUSING

The City of Boston has also implemented various home visiting programs that work to intervene in and protect the environments surrounding pregnant women. One of the programs, Healthy Start in Housing, provides pregnant women at risk of homelessness with priority access to the city’s public housing units and intensive case management programs. A recent evaluation of the program found that participants in the program had statistically significant increases in mental health during and in the year following participation in the program (Scally, Waxman, & Gourevitch, 2017). A comparative study of women experiencing homelessness and women in public housing have revealed that women with access to public housing were more likely to have a low birthweight baby, a baby born preterm, and less likely to breastfeed within five days of birth (Reilly et al., 2018). For a full case study on the city of Boston’s infant mortality reduction initiative, see Appendix C.

Case Studies: Collaborative Models

CASE STUDY 1: B'MORE FOR HEALTHY BABIES

In partnership with the Family League of Baltimore and CareFirst, the Baltimore Health Department created an evidence-based strategy to reduce infant mortality in the city¹ (AECF, 2018). The strategy identified the leading causes of infant mortality in the city: preterm birth, low birthweight, and unsafe sleep. Baltimore then highlighted 11 evidence-based, high impact services that must be accessible and high quality to address these risks including: 1) Primary health care in a medical home; 2) Obstetric care; 3) Home visiting; 4) Drug and alcohol treatment; 5) Intervention for domestic violence; 6) Mental health care; 7) Smoking cessation; 8) Family planning; 9) Nutrition support; 10) Breastfeeding promotion; 11) Safe sleep education (City of Baltimore et al., 2009). The city-wide partnership accomplished a 35 percent reduction in infant mortality between 2009 and 2016 (13.5 to 9.7 per 1,000 births) and the Black – White disparity decreased by almost 64 percent during this period (from a disparity of 15 per 1,000 births to 5.4 per 1,000 births in 2016) (BHB, n.d.).

CITY WIDE MEDIA CAMPAIGNS

BHB stimulated demand for health services with massive city-wide media and public education campaigns on topics like safe sleep for infants, teen pregnancy prevention, risks of smoking for newborns and contraceptive options (City of Baltimore et al., 2009; AECF, 2018).

A NETWORK OF COORDINATED STAKEHOLDERS

For each of the 11 service impact areas, a lead agency is assigned to assesses current services available and develops a plan to increase capacity and close the gap with Health Department oversight (City of Baltimore et al., 2009). Examples include:

- Partnerships with HealthCare Access Maryland, a quasi-public nonprofit agency, and the Family League of Baltimore, gave BHB more flexibility to raise private-sector funding.
- A centralized system was created to connect eligible women to prenatal care and support services through HealthCare Access Maryland.
- Health clinics and hospitals collaborated to made contraception more accessible.
- The BHB Community Doula Program launched a partnership with Johns Hopkins to increase city resident doula certifications (AECF, 2018).

HIGH QUALITY HOME VISITING SERVICES

BHB streamlined home visiting to include only strongly evidenced-based models (NFP and HFA); established a central triage and referral system for mothers; and created a monitoring

and reporting system to evaluate outcomes (The Pew, 2015).

EXTENSIVE SUPPORT OF HIGHEST RISK COMMUNITIES

In two Baltimore communities, BHB supports ongoing outreach by connecting women to services, offering exercise classes, hosting community health-focused events, and supporting new mom's clubs (AECF, 2018).

CASE STUDY 2: THE WORCESTER HEALTHY BABY COLLABORATIVE (WHBC)

WHBC was created in 1996 to reduce preterm birth and infant death in Worcester, Massachusetts. The collaborative is comprised of local stakeholders that contribute time and resources to engage the community and agencies to invest in maternal and infant health (WHBC, 2019b). More than 30 entities make up WHBC including Worcester Department of Health, Massachusetts Department of Health, Worcester Department of Social Services, the March of Dimes, the City Mayor's Office, the University of Massachusetts hospital system and medical school, community organizations and local health providers. WHBC holds regular Infant Mortality Summits to engage the community, bringing forth topics like:

- Prenatal and hospital care best practices
- Public health campaigns
- Minority doula care
- Institutional racism and lack of trust in health care systems
- Culturally and linguistically appropriate interventions for the large African immigrant population
- Advocacy for expanding case management programs

These summits have led to policy changes and increased collaboration around city initiatives including public education campaigns, anti-racism trainings, the creation of culturally appropriate programming in home visiting, and extended home visiting services throughout the city (WHBC, 2018). *Worcester's infant mortality rate decreased by around 41 percent between 1993 and 2015, narrowing the gap from the state average by around 58 percent (WHBC, 2019a).* The city has also seen major reductions in the black infant mortality rate, which is now lower than the city's Hispanic mortality rate, but with so few deaths, estimation of this decline is not statistically significant (WHBC, 2019b; CDC, 2019a). Funding from the Healthy Start Initiative and the March of Dimes have supported various collaborative programs implemented through the collaborative (WHBC, 2018).

Criteria

CRITERIA

Five alternatives are presented to reduce infant and maternal mortality in Richmond. The alternatives are based in research literature and evidence-based examples from other localities. Each of the alternatives will be evaluated based on the following six criteria. Each of the criteria will be weighted equally as they each evaluate important considerations by RCHD: cost, effectiveness and equity. Alternatives with the best evaluated outcomes across all criteria will be considered for recommendation.

COST: This criterion will evaluate the direct cost of each alternative to RCHD. Cost will be measured in dollars spent by the Health District. The lowest cost alternative would be the ideal outcome for this criterion.

POSSIBILITY FOR EXTERNAL FUNDING: This criterion will evaluate the possibility that each alternative could be financed by sources other than RCHD. This will be measured using the Likert-Type Scale of likelihood which is measured using the categories: “very unlikely; unlikely; neutral; likely and extremely likely”, based on examples of funding sources from other cities. A result of “very likely” is the best outcome for this specific alternative, where the initiative may be fully funded with little to no barriers. An outcome of “extremely unlikely” would indicate that major barriers exist to external funding and falling within the range of “unlikely” to “likely” identifies some level of barriers to funding and whether only partial funding exists.

EFFECTIVENESS: This criterion will evaluate each alternative’s potential impact in reducing infant and maternal mortality. Analysis will rely on research of evidence-based policies to determine the estimated impact each alternative will have on reducing preterm birth, low birthweight births, infant and maternal mortality. This measure will provide the annual reduction in infant and maternal deaths both in raw numbers and as a percentage change from the city average. The best outcome under this criterion would be the largest positive percentage, which indicates the greatest total decrease.

COST EFFECTIVENESS: This criterion will evaluate the economic efficiency of each alternative, determining which alternatives achieve the greatest outcomes for the required costs. This will be measured by dividing the annual estimated reductions in mortality by the annual estimated cost of each alternative. The final product will be measured in annual cost (\$) per annual infant death avoided and annual cost per annual maternal death avoided. In evaluating along this criterion, the lowest dollar amounts would be ideal, as estimates correspond to the cost associated with deaths avoided as a result of each alternative.

EQUITY: This criterion will evaluate whether each alternative prioritizes outcomes for the city’s most vulnerable populations (low-income, minority women). Measurement of this criterion will be qualitative, measured using the categories: “very low; low; neutral; moderate and high”,

based on the population each alternative serves. A score of “high” would be the best outcome, indicating that the alternative serves Richmond’s highest risk population, low-income, minority women. A score of “very low” would indicate that the alternative does not serve low-income, minority women, and scores between “low” and “moderate” indicate the varying degrees with which the alternative serves either low-income or minority women, or both.

EASE OF IMPLEMENTATION: This criterion will evaluate the administrative burden to implementing each alternative. Factors will include the level of involvement required by RCHD in implementation; the complexity of the new policy and whether it will take multiple years to phase in; and if the alternative requires buy-in from stakeholders outside of the Health District. Measurement of this alternative will evaluate the combination of factors in implementation to determine where each alternative falls on a Likert-Type scale of difficulty: “very difficult; difficult; neutral; easy and very easy”. A score of “very easy” would be the best outcome for this alternative, indicating that there would be very few barriers to RCHD implementing the alternative. A score of “very difficult” would indicate that the alternative requires high levels of involvement from RCHD, complexity with multiple year phase in, and requires a high level of buy-in from stakeholders. Scores between “difficult” and “easy” identify varying levels of difficulty corresponding to the list of considerations stated in the previous sentence.

Alternatives

This section provides a description and evaluation of five policy alternatives to reduce infant and maternal mortality in the City of Richmond. The options address various sectors of the problem including reproductive health, community support, social determinants of health and multi-sector initiatives. The alternatives could be implemented on their own or in conjunction with each other. The five options will be evaluated based on the previously stated criteria.

1. Implement One Key Question Training
2. Increase Access to Doulas
3. Expand CenteringPregnancy
4. Create Healthy Start in Housing
5. Establish the Richmond Healthy Births Collaborative

ALTERNATIVE 1: IMPLEMENT ONE KEY QUESTION TRAINING

This alternative recommends piloting One Key Question (OKQ) training to service providers engaging with pregnant-aged women in Richmond. OKQ trains providers to pose the question, “Would you like to become pregnant in the next year?”, during all clinic visits with women. Responses to this question are tied to a specific follow-up protocol that direct women to contraception or preconception care (see Appendix B for the OKQ diagnostic diagram) (Allen et al., 2017). OKQ has shown promising results in increasing highly effective birth control use among women in various settings (Power to Decide, 2019; Yonke, 2011).

An estimated 50 percent of pregnancies were unintentional in Richmond in 2017 (VDH, 2017c). As unintended pregnancies and short interconceptional pregnancies are highly risky to women and infants, contributing to delayed prenatal care and higher likelihoods of low birthweight births, preterm births and complications during pregnancy, this alternative is likely to be advantageous to the city (DeFranco et al., 2015; Shah et al., 2011). Additionally, OKQ would complement the Virginia Department of Health’s initiative to expand access to LARCs for low-income women by increasing contact with women who do not intend to become pregnant, yet are passive in using birth control. With LARC promotion initiatives already in place in RCHD’s community health clinics, this alternative recommends providing training to WIC⁸ clinic staff and home visiting case managers from Richmond Healthy Start and Richmond Healthy Families.

COST

Training for three programs is estimated to cost **\$45,000**. This is based on a grant of \$90,000 for six federally qualified health centers from the Abell Foundation in Baltimore (Grillo, 2015).

EXTERNAL FUNDING POSSIBILITY

This alternative is **very likely** to qualify external funding as the distributor of the One Key Question training, Power to Decide, offers free training through an application process to cities or organizations who demonstrate high need.

EFFECTIVENESS

OKQ training is estimated to reduce infant mortality by 2.2 percent annually (**0.7 deaths avoided**) and maternal mortality by 0.5 percent annually (**0.002 deaths avoided**) (see Appendix D).

⁸The Special Supplemental Nutrition Program for Women, Infant, and Children (WIC) is a federal food assistance program for low-income pregnant women, breastfeeding women, and women with children under the age of five.

COST EFFECTIVENESS

Cost effectiveness is estimated to be **\$62,937 per every infant death avoided** and **\$22,500,000 per every maternal death avoided** (see Appendix D).

EQUITY

Equity is estimated to be **moderate** as One Key Question is recommended to be implemented in settings that serve low-income women, though not specifically target minority groups.

EASE OF IMPLEMENTATION

Ease of implementation is estimated to be **difficult** as the initiative requires buy-in from stakeholders outside of the Health District (RDSS's home visiting program) and requires efforts by RCHD to implement trainings for WIC providers. Additionally, the policy is complex as it requires screening/questioning of individuals and referrals to other clinics to provide the contraception.

ALTERNATIVE 2: INCREASE ACCESS TO DOULAS

This alternative, modeled after a pilot program implemented in Milwaukee, Wisconsin (see Appendix E), recommends that the city provide funding to cover doula⁹ support fees for 50 Medicaid-qualifying women in Richmond. This funding would be directed to one or several of the doula collectives serving minority and low-income women in Richmond, including Urban Baby Beginnings, the Richmond Doula Project, and Birth in Color RVA. Providing low-income minority women with access to doula-supported births has shown to improve a range of outcomes including preterm birth, low birthweight births and reductions in cesarean delivery (Gruber, Cupito, & Dobson, 2013; Kozhimannil et al., 2016; Kozhimannil et al., 2013). Cities including Baltimore, Chicago, New York City, and Tampa have recently implemented initiatives to increase investment in doula services for low-income and minority women (Ollove, 2017).

COST

The total cost of this initiative is estimated to be **\$40,000** annually to support 50 new mothers based on average doula fees in Richmond. This cost is flexible depending on how many births are supported (see Appendix E).

⁹ Doulas are trained individuals that provide continuous social and emotional support from the prenatal phase through weeks following birth (DONA International, 2019).

EXTERNAL FUNDING POSSIBILITY

The external funding possibility of this alternative is estimated to be **likely** as various city doula programs have received grant or state funding for implementation, though the probability of a fully funded program is low. Examples include the Groundswell Fund's Birth Justice Fund which supports community-based efforts to eliminate disparities in birth outcomes for low-income, minority women (Groundswell Fund, n.d.). The Merck Mother initiative also funds doula programs for minority women in New York City (Mehra et al., 2019). Additionally, the city could request matched funding from the state or search for grants (example: Milwaukee) (Hess, 2019).

EFFECTIVENESS

The effectiveness of this alternative was analyzed to be a 0.03 percentage reduction annual in total infant mortality (**0.008 deaths avoided**) and an annual 0.26 percentage reduction in maternal mortality (**0.001 deaths avoided**) (see Appendix E).

COST EFFECTIVENESS

The cost of **avoiding one infant death** is estimated to be **\$5,000,000** and **\$40,000,000 per maternal death avoided** (see Appendix E).

EQUITY

This alternative is assessed to have **high** equity because the option specifically targets low-income and minority women.

EASE OF IMPLEMENTATION

Ease of implementation is assessed to be **very easy** because it involves low RCHD involvement and complexity, no phase-in period, and little buy-in from stakeholders because doula collectives are already carrying out this work and the initiative would pay outside providers market-rate wages.

ALTERNATIVE 3: EXPAND CENTERINGPREGNANCY

This alternative recommends providing an additional CenteringPregnancy (CP) site¹⁰ to a prenatal services provider in a location that serves low-income, minority women.

CenteringPregnancy is a form of group prenatal care that brings together groups of eight to 10 women for around two hours over 10 visits¹¹ during pregnancy. CenteringPregnancy has shown

¹⁰VCU Health currently hosts a CP program.

¹¹Following the schedule recommended by the Kotelchuck Index.

to improve outcomes like preterm birth and low birthweight birth for low-income, minority women, which are high risk factors for infant mortality (Ickovics et al., 2007; 2016; Tanner-Smith, Steinka-Fry, & Lipsey, 2014). Recommended sites include Capital Area Health Network (CAHN) in the North Side, East End Pregnancy Center, CrossOver Health Care Ministry or one of RCHD's community health centers if the size and internal resources are suitable.

COST

The cost of implementing CenteringPregnancy is estimated as \$20,000 over the first two years and \$500 in subsequent years (Rowley et al., 2016). Annual program cost over five years is estimated to be **\$4,300** (see Appendix F).

EXTERNAL FUNDING POSSIBILITY

The external funding possibility of this alternative is estimated to be **very likely** as CP is offering implementation support and facilitation training to 130 eligible sites - primarily in FQHCs and community health centers - eliminating the financial barrier to those in resource-limited communities (second wave proposals May 31, 2019; third wave proposals July 31, 2019) (Centering Healthcare Institute, 2019). Additionally, these programs are generally provided by hospitals or other health care providers which finance them on their own and receive revenues from Medicaid or insurance payments from participants.

EFFECTIVENESS

The effectiveness of this alternative is analyzed to be a 0.05 percentage reduction in annual infant mortality (**0.016 deaths avoided**) (see Appendix F). There was little evidence of CP on maternal risk factors.

COST EFFECTIVENESS

An additional CenteringPregnancy site is estimated to cost **\$270,440 per infant death avoided** (see Appendix F).

EQUITY

Equity is assessed to be **high** as the CP site would be located in an area serving low-income, minority women.

EASE OF IMPLEMENTATION

Ease of implementation is assessed to be **neutral** as CP training will require low involvement from RCHD, the complexity of the program is low and will require little phase-in time, yet the alternative requires outside stakeholder buy-in from a single health provider site.

ALTERNATIVE 4: CREATE HEALTHY START IN HOUSING

This alternative recommends partnering with the Richmond Redevelopment and Housing Authority (RRHA) and the Department of Social Services (RDSS)'s Healthy Start program to create a priority and intensive case-management program for women who are pregnant or have a child under three years old. Having access to stable housing has major implications for health and welfare that impact pregnant women and children. Access to public housing compared to homeless shelter access has shown to decrease high-risk birth outcomes like low birthweight and preterm births (Reilly et al., 2018). Modeled after Boston's Healthy Start in Housing program (see Appendix C), it is recommended that RRHA create 30 priority spots in public or subsidized housing for pregnant women, using MIECHV funds to create an intensive case management program through Healthy Start.

COST

Cost is estimated to be **\$27,859** to serve 30 women (see Appendix G). Boston Healthy Start received \$950,000 in 2019 and served 1,023 women in 2017 (BPHC, 2018; HRSA, 2019b).

EXTERNAL FUNDING POSSIBILITY

The possibility for external funding of this alternative is **likely** as the MIECHV provides opportunities for local partnerships to launch programs like Boston's Healthy Start in Housing (Scally, Waxman, & Gourevitch, 2017). Yet, this would require collaboration with RDSS in applying for the funding and it is unclear whether this funding would fully finance the program.

EFFECTIVENESS

The effectiveness of this alternative was analyzed to be a 0.01 percentage reduction in annual infant mortality (**0.002 deaths avoided**) and a 0.01 percentage reduction in annual maternal mortality (**0.001 deaths avoided**) (see Appendix G).

COST EFFECTIVENESS

This alternative is estimated to cost **\$17,412,000 for every infant death avoided** and **\$419,343,915 for every maternal death avoided** (see Appendix G)

EQUITY

The equity of this alternative is **moderate** because it targets the lowest income and most at-risk women, though does not specifically target minority women.

EASE OF IMPLEMENTATION

Due to the fact that a new program would be implemented as a partnership between three

agencies implementation of this program would be **difficult**. It would require some involvement from RCHD, a bit of complexity due to coordinating agencies and creating a new program, some phase-in time, especially with applying for MIECHV funds and a considerable amount of stakeholder buy-in when working with RRHA and RDSS.

ALTERNATIVE 5: CREATE A RICHMOND HEALTHY BIRTHS COLLABORATIVE (RHBC)

This alternative recommends engaging local health centers and hospitals, nonprofit birth collectives, and social service organizations to convene regular meetings with the goal of reducing infant and maternal mortality. Modeled after the Worcester Healthy Baby Collaborative, B'More for Healthy Babies, and New York Department of Health's Maternal and Infant Community Health Collaboratives, this collaborative would work with the community to develop localized strategies to reduce infant and maternal mortality through stakeholder action across the city.

Community Action Networks exist in Petersburg, Norfolk and Westmoreland County centered around reducing infant mortality through strengthening the Healthy Start program (called Healthy Start/Loving Steps). These Community Action Networks partner the Virginia Department of Health, Early Impact Virginia, and Regional Perinatal councils to engage the community and coordinate and extend home visiting programs. Similarly, the City of Richmond's Education Compact engages stakeholders to collaborate around goals, strategies and priorities relating to providing high quality education and holistic development of children in the city (City of Richmond, 2019). Utilizing the network of stakeholders currently working to improve infant and maternal health in Richmond, this alternative would coordinate the strengths and connections of community-level and city-wide stakeholders to improve birth outcomes. A list of potential stakeholders is included in Appendix H.

COST

Funding for RHBC is estimated to be **\$924,980** using funding estimates from the State of New York's Maternal and Infant Community Health Collaboratives initiative (see Appendix H).

EXTERNAL FUNDING POSSIBILITY

The possibility of external funding is assessed to be **very likely** as the March of Dimes recently funded the Worcester Healthy Baby Collaborative's "Implementing a Community Engagement Model for Reducing Hispanic Infant Mortality" project (March of Dimes, 2015). Additionally, Healthy Start programs may provide community action network funding, as in the Loving Steps

community action networks in Norfolk, Petersburg, and Westmoreland County.

EFFECTIVENESS

Reductions in infant mortality are estimated to be 3.45 percent annually (**1.1 deaths avoided**) (see Appendix H). There are few studies on reductions in maternal mortality as a result of city-wide collaboratives, though this is estimated to be positive as they can have significant impacts on infant mortality rates.

COST EFFECTIVENESS

Cost effectiveness is estimated to be **\$840,891 per infant death avoided** (see Appendix H).

EQUITY

This initiative is assessed to have **high** equity because it targets low-income, minority women across the city.

EASE OF IMPLEMENTATION

Implementation is assessed to be **difficult** as it would require highly increased RCHD involvement, a multitude of policies with various phase-in times, and buy-in from many stakeholders. Yet, as exemplified through events held by Birth in Color RVA over Black Maternal Health Week, it is feasible for many stakeholders (including the mayor's office, black birth workers, local vendors, community members, and dental organizations) within the city to come together around the improvement of maternal and infant health outcomes (King, 2019).

Outcomes Matrix

The following summarizes the outcomes of each alternative compared to criteria. Due to the fact that an average of 32 infants die annually in Richmond and the annual maternal deaths average to around 0.4 deaths a year, small, annual reductions would have a substantial impact on overall mortality rates. Because of the relatively low probability of risk, the cost-effectiveness of these initiatives tends to be relatively high, though there may be gains in cost-effectiveness across other more common health risks. Detailed analyses can be found in Appendices D – H.

TABLE 2: OUTCOMES MATRIX

EVALUATIVE CRITERIA	REPRODUCTIVE HEALTH PILOT ONE KEY QUESTION	COMMUNITY SUPPORT		SOCIAL DETERMINANTS HEALTHY START IN HOUSING	MULTI-SECTOR RICHMOND HEALTHY BIRTHS COLLABORATIVE
COST	\$45,000	\$40,000	\$4,300 ¹²	\$27,859	\$924,980
POSSIBILITY FOR EXTERNAL FUNDING	Very Likely	Likely	Very Likely	Likely	Very Likely
EFFECTIVENESS <i>Total Infant Deaths Reduced</i>	0.715 deaths (2.2% reduction ¹³)	0.008 deaths (0.03% reduction)	0.016 deaths (0.05% reduction)	0.002 deaths (0.005% reduction)	1.104 deaths (3.45% reduction)
<i>Total Maternal Deaths Reduced</i>	0.002 deaths (0.54% reduction ¹⁴)	0.001 deaths (0.26% reduction)	Unclear	0.001 deaths (0.013% reduction)	Unclear
COST EFFECTIVENESS <i>Cost per Infant Death Avoided</i>	\$62,937	\$5,000,000	\$270,440	\$17,412,000	\$840,891
<i>Cost per Maternal Death Avoided</i>	\$22,500,00	\$40,000,000	Unclear	\$419,343,915	Unclear
EQUITY	Moderate	High	High	Moderate	High
EASE OF IMPLEMENTATION	Difficult	Very Easy	Neutral	Difficult	Difficult

¹³Based on an average of 32 infant deaths in Richmond annually.

¹⁴Based on an average of 0.4 maternal deaths in Richmond annually

Recommendations

RECOMMENDATIONS

In order to establish a holistic and coordinated effort to reduce infant and maternal mortality, two short term alternatives are recommended as well as a longer-term, more integrative option. In the short term, piloting One Key Question and providing grants to increase doula access are recommended to provide the best outcomes for RCHD across the criteria domains. In the long term, creating a Richmond Healthy Births Collaborative is recommended as providing the most significant and coordinated impact on birth outcomes for the city. Implementing these initiatives is estimated to reduce annual infant mortality by six percent (1.8 deaths avoided) and reduce annual maternal mortality by one percent (0.003 deaths avoided) (see Appendix J).

PILOT ONE KEY QUESTION

Piloting One Key Question was evaluated to produce the highest estimated reductions in infant mortality and maternal mortality for any single program, with an estimated annual infant mortality reduction of 2.2 percent (0.7 deaths avoided) and a 0.05 percent reduction in maternal mortality (0.002 deaths avoided) (see Appendix D). This alternative had the lowest cost-effectiveness, meaning the least amount of spending per deaths avoided and a high likelihood of external funding. Though implementation of OKQ may be difficult, requiring buy-in from stakeholders outside of RCHD and training within RCHD programs (WIC providers), the alternative's cost-effectiveness and gains in mortality reductions outweigh these barriers.

INCREASE ACCESS TO DOULAS

Providing access to doula services by funding 50 Medicaid-supported births in the city is estimated to also provide relatively significant impacts on reducing maternal deaths, a 0.26 percent reduction (0.001 deaths avoided) and infant mortality reduction, 0.03 percent decline (0.008 deaths avoided) compared to other alternatives (see Appendix E). Although this alternative is somewhat costlier regarding per deaths avoided, it directly impacts low-income, minority women and will have few barriers to implementation.

RICHMOND HEALTHY BIRTHS COLLABORATIVE

In the long term, whether in a year or a couple of years, creating a Richmond Healthy Births Collaborative is recommended. Multiple cities have created stakeholder collaboratives that bring together stakeholders from across the city to coordinate strategies to reduce infant and maternal mortality with promising results. Though this alternative has some tradeoffs like higher costs and more implementation difficulty, it comes with high payoffs for infant mortality reduction. Additionally, reductions in maternal mortality are anticipated, though they were not able to be quantified. This will help streamline efforts across the city and leverage community assets to produce a widespread and targeted affect.

IMPACT

In five years, implementing these initiatives would lead to an estimated *26 percent reduction* in Richmond infant mortality, from an average of 32 infant deaths annually to an estimated 23.6 infant deaths annually. This would result in an infant mortality rate of 7.1 per 1,000 live births by 2025 and close the gap between Richmond and the state's infant mortality rate (5.9 per 1,000 births) by more than 70 percent (See Appendix K). Reductions of this magnitude would result in an infant mortality rate that reflects rates in cities like Charlotte (7.2), Nashville (7.3) and Washington, D.C. (7.1) (Kids Count, 2018). Over five years, the maternal mortality rate is estimated to decrease by 11 percent, leading to an annual maternal mortality rate of 12.45 per 100,000 births compared to an estimated rate of 14.05 in 2018 (see Appendix K). As OKQ and the doula initiatives are proposed as pilots affecting a smaller portion of the population, expanding these programs would have an even greater city-wide impact.

Implementation

IMPLEMENTATION

Acquiring funding and engaging stakeholders are the most important next steps in terms of implementing the recommended alternatives. The following outlines funding and stakeholder considerations for each recommended alternative.

ONE KEY QUESTION TRAINING

Funding

OKQ's Power to Decide campaign offers a number of grants to fully fund training and implementation for providers serving high-needs populations¹⁵. Funding could also be requested from the Virginia Department of Health as part of the VDH's recent LARC access initiative, with OKQ shown to increase LARC usage among reproductive aged women (Power to Decide, 2019; VDH, 2018a).

Stakeholder Selection and Engagement

OKQ can be implemented in a variety of environments where providers are engaging with women of reproductive age including primary care offices, community health clinics, WIC health clinics, and home visiting settings. Though this analysis recommends implementing OKQ in WIC health clinics and home visiting settings, RCHD could gauge interest and buy-in from health or social service providers engaging with low-income, minority women throughout the city to determine the best-fitting providers for the initiative.

¹⁵More information can be found here: <https://powertodecide.org/one-key-question>

INCREASING ACCESS TO DOULAS

Funding

Funding for this initiative could come from a variety of sources including small philanthropy organizations, larger external organizations or state funds. For example, the Groundswell Fund provides funds for culturally relevant birthing services supporting minority women like midwives and doulas (Groundswell Fund, n.d.). Merck for Mothers invests \$500 million in improving birth outcomes for women and children, including supporting an initiative to increase doula training in New York City (Mehra et al., 2019). Additionally, a similar doula access initiative in Milwaukee matches funds with Wisconsin's State of Department of Health (Hess, 2019).

Stakeholder Selection and Engagement

There are multiple doula collectives already serving minority or low-income women in Richmond. These include the Richmond Doula Project, Birth in Color RVA, and Urban Baby Beginnings. To implement this initiative, RCHD could consider creating a reimbursement application process for doulas serving Medicaid-eligible women or a voucher program for Medicaid-eligible women to pay for doulas. Pilot doula programs in New York City and Milwaukee reimburse doulas directly, so this may be the action that RCHD would prefer to take (Hess, 2019; NYSDH, 2019).

RICHMOND HEALTHY BIRTHS COLLABORATIVE

Funding

In the preliminary stages of this initiative, little funding will be required as implementation takes the form of stakeholder strategy meetings. Once strategies and initiatives come to fruition, funding could come from multiple places. These include the March of Dimes, which helped fund the Worcester Healthy Baby Collaborative's "Implementing a Community Engagement Model for Reducing Hispanic Infant Mortality" project; Healthy Start, which has funded community action networks in Norfolk, Petersburg and Westmoreland County, Virginia; and the MIECHV, which has funded innovative home visiting programs like Boston's Healthy Start in Housing (March of Dimes, 2015; Scally, Waxman, & Gourevitch, 2017).

Stakeholder Selection and Engagement

This initiative will require the most effort in selecting and engaging stakeholders. Yet, there is some current infrastructure in place for organizing local nonprofits around infant and maternal death, largely led by the group Birth in Color RVA (as exemplified through their organization of Black Maternal Health Week). Thus, it is advised that RCHD partner with Birth in Color RVA to organize stakeholders across multiple sectors who are impacted by and have an impact on the issue. Following identifying and organizing these groups, the Richmond Healthy Births Collaborative would benefit from following New York State Department of Health (NYSDH)'s collaborative approach model¹⁶. This model focuses on preconception health, prenatal and postpartum health, and the interconceptional period through actively enrolling women in health

¹⁶For more on this model, see: <https://www.scaany.org/wp-content/uploads/2014/08/SCAA-MICH-Presentation-slides.pdf>

insurance, better engaging women in health care, coordinating services across programs, and promoting support for healthy behaviors. The model has four steps (Schuyler Center, 2014):

1. Assessment of Needs and Strengths
2. Development of Improvement Strategy (through strong collaboration)
3. Implementation of Improvement Plan
4. Track Outcomes (preterm birth, low birthweight, infant & maternal mortality)

Following these steps would allow for a guided implementation of the Healthy Births Collaborative by including stakeholder input and assets, focusing all entities around specific goals and ensuring outcomes are tracked.

OTHER CONSIDERATIONS

Regardless of alternatives pursued by the City of Richmond, two other considerations are offered. First, RCHD should pursue efforts to actively enroll eligible women in Medicaid. In 2016, 10 percent of non-elderly Virginia residents eligible for Medicaid were not enrolled and this share has probably grown since Medicaid expansion in January, 2019 (Rudowitz et al., 2016). Enrollment in Medicaid increases access to care and engagement with healthy habits, which are crucial in all stages of a woman's life and have direct impacts on birth outcomes. Efforts to enroll eligible women before pregnancy are cost-effective ways of reducing program costs in the long run (Gross et al., 2006).

Further, regardless of actions taken by RCHD, city efforts would benefit from the creation of a central webpage containing links to all resources relating to preconception, prenatal, and postpartum health as well as a map that pinpoints where services are available. Washington, D.C.'s Maternal and Infant Health Summit *Resources* page offers a strong example of centralized information and mapping¹⁷ (See Appendix L for layout).

¹⁷See: <https://dcmaternalhealth.com/resources/>

Appendix

APPENDIX A: Evidence Review of Maternal Safety Bundles

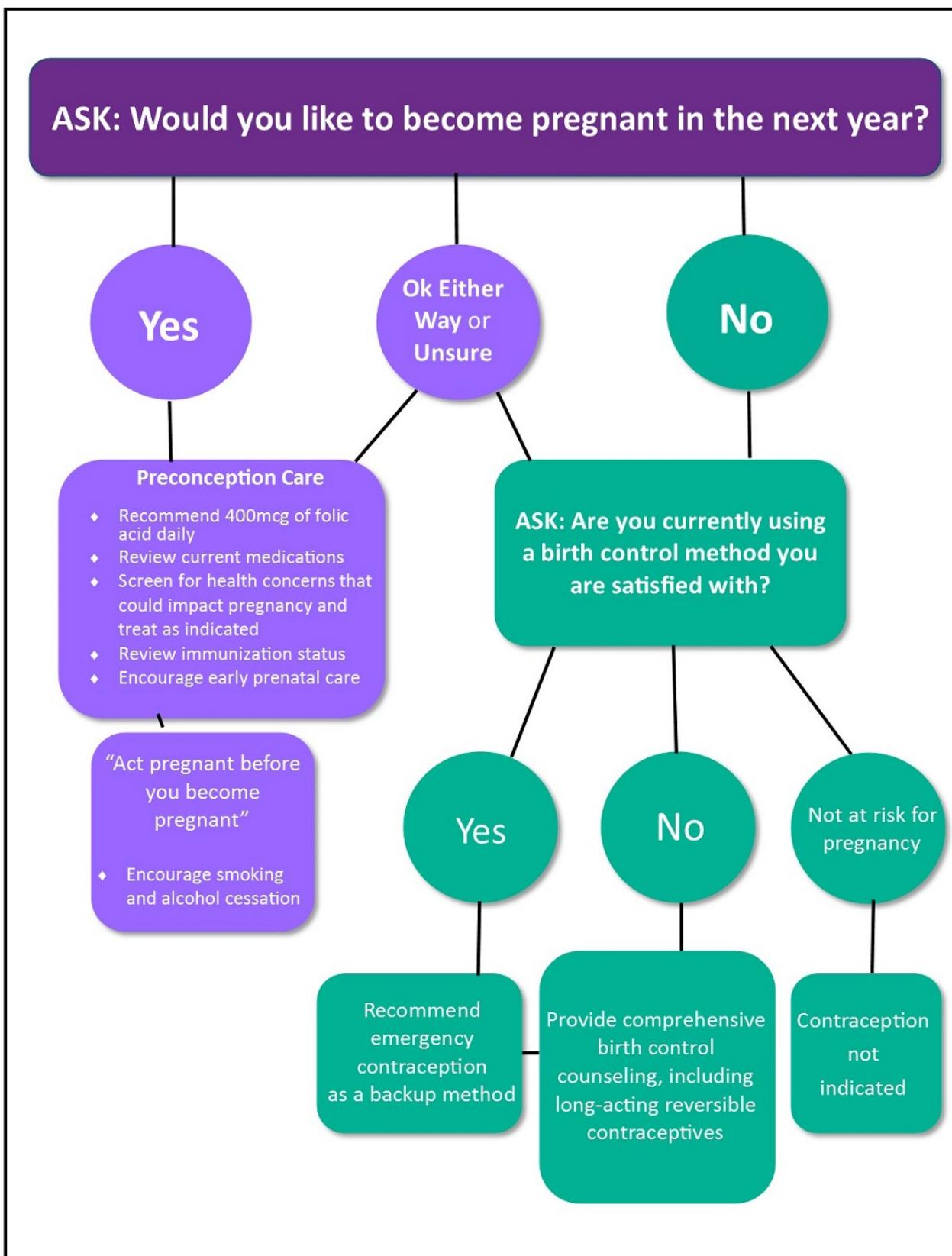
QUALITY IMPROVEMENT TOOLKITS

The California Maternal Quality Care Collaborative (CMQCC) was launched in 2006 as a multi-stakeholder cooperative with the goal of reducing preventable and inequitable maternal mortality in California. Between 2006 and 2013, the United States saw a nearly 70 percent increase in maternal deaths per 100,000 live births, while the State of California saw a 55 percent decline in maternal deaths during that same period (CMQCC, n.d.a).

Among the initiatives during this time was CMQCC's development of comprehensive, evidence-based Quality Improvement Toolkits by multidisciplinary taskforces that include step-by-step procedures for health care responses to high risk events during pregnancy (Main, 2018). These toolkits can be downloaded for free, providing resources in areas like improving health care response to obstetric hemorrhage, preeclampsia, and cardiovascular disease in pregnancy and postpartum and an implementation guide to support vaginal birth and reduce primary cesarean delivery (CMQCC, n.d.b). The hemorrhage toolkit provides instruction for the creation of a "hemorrhage cart" which includes various medical supplies specific to dealing with an obstetric hemorrhage, created after doctors recounted how these tools were often not in a centralized location on the maternity ward, leading to crucial time lost in stopping a hemorrhage (Casper & Lee, 2009). Though the toolkits are relatively new, between 2014 and 2016, California implemented a controlled trial of implementing the hemorrhage and preeclampsia evidence-based toolkit practices through collaborative learning models among 126 hospitals. The study revealed that implementing the hemorrhage and preeclampsia learning collaboratives reduced maternal mortality by 20.8 percent (Main, 2018).

APPENDIX B: One Key Question Methods

FIGURE 3: ONE KEY QUESTION DIAGNOSTIC TOOL



APPENDIX C: Boston Infant Mortality Case Study

CASE STUDY 3: THE BOSTON PUBLIC HEALTH COMMISSION

WHAT WAS ACCOMPLISHED

- Boston's infant mortality rate was reduced by 27% between 2001 and 2016 (7.4 to 5.4 per 1,000 births)
- Black infant mortality was cut by 40% during this period (13.5 to 8.1 per 1,000 births)
- The Black – White disparity decreased by almost 21% (from a disparity of 8.1 per 1,000 births in 2001 to 6.4 per 1,000 births in 2016) (BPHC, 2017)

HOW

Beginning in 2001, the Boston Public Health Commission has worked to address inequities in birth outcomes with efforts designed to specifically decrease disparities in black infant mortality. BPHC created a life spectrum strategy:

PRIMARY FOCUS: Reducing the impact of poverty, racism and related stress on maternal health.

SECONDARY FOCUS: the need to form collaborative and broad efforts to support all women facing these stressors on a daily basis (BPHC, 2014).

KEY INITIATIVES

EXTEND CASE MANAGEMENT SERVICES

Created a strong link between BPHC case management and citywide health care providers to foster the health status of women through the spectrum of their lives beginning before a first pregnancy (known as the interconceptional period) and following women through next pregnancies (BPHC, 2014)

CASE MANAGEMENT SERVICES

- Boston Healthy Start Initiative (BHSI) provides one-on-one support to pregnant women and mothers with children up to the age of two who identify as black or Latina.
- BPHC's Healthy Baby Healthy Child (HB/HC) initiative is a home visiting program for all women who are pregnant or have a child between birth and five years old, and live in the City of Boston.

ADDITIONAL HB/HC SERVICES

- Father Friendly Initiative (FFI)– case management services to promote the engagement of male partners for women enrolled in HB/HC.
- Welcome Family – a home visiting pilot program funded by the State where home visits are conducted by multilingual nurses between one day and eight weeks of a

newborn's life. The goals of the program are to improve parental skills and self-confidence, improve maternal and infant health, increase parent access to community services, and improve the coordination of community resources and supports.

- The Violence Intervention Advocate Program (VIAP) – a home visiting program for women who have experienced violence and are expecting to or have children under five years (BPHC, 2019b).

INCREASE ACCESS TO PEER SUPPORT

- BPHC helped fund transitions from Healthy Start prenatal care sites to Women's Circles within and outside of the public care network (Centering Pregnancy) (BPHC, 2014).
- Partners in Parenting – offers parenting support to pregnant and parenting women from voluntary community members who serve as advocates, mentors and community liaisons.
- Summer Enrichment Program (SEP) – meets one day a week for seven weeks in the summer offering educational and recreational services to HB/HC clients with the goal of reducing social isolation and providing health and wellness education.

FOCUS ON SOCIAL DETERMINANTS OF HEALTH

- Healthy Start in Housing (HSiH) – provides priority to public housing and intensive case management for women who are pregnant or parenting a child under five years old and are at risk of homelessness.
- HB/HC Food Pantry – provides emergency food assistance to City of Boston residents who are pregnant or parenting a child under the age of five (BPHC, 2019b).

IMPROVE CLINICAL RESPONSE

- Implementing One Key Question for birth and family planning through media campaigns and in clinical care.
- Promote use of progesterone to prolong pregnancy for women with risk of preterm birth (BPHC, 2014).

CREATE A COMMUNITY ACTION NETWORK

- This is a group of diverse stakeholders like community members, community-based organizations, government, and health care providers working together to reduce racial inequalities in birth outcomes through policy and community-level changes.

- CAN is funded by the Boston Healthy Start Initiative which receives federal funding from HRSA (BPHC, 2019a).

APPENDIX D: One Key Question Analysis

EFFECTIVENESS

Infant Mortality

OKQ is estimated to reduce infant mortality by 1.7% annually.

1. By implementing training to Healthy Start and Healthy Families home visiting staff and WIC screening staff, it is assumed that 1,360 women will be impacted by this initiative. Healthy Start community programs require serving a minimum of 500 participants (Banks et al., 2017). In 2016, 3,000 families were served by Healthy Families in Virginia through 32 programs (Early Impact Virginia, 2017). This averages to 94 families per program. The average monthly clients served by WIC between 2013 and 2015 was 5,892 (RCHD, 2015). In Jackson County's implementation of One Key Question during WIC screenings, 13.5% of the clients served were screened (this assumes that 13.5% of WIC clients were new during the pilot period) (OHA, 2016). This would lead to 766 Richmond WIC participants screened. In total, this leads to 1,360 impacted by the One Key Question initiative.

Healthy Start: 500 women

Healthy Families: (total served in VA) / (total programs in VA) = 3,000/32 = 94 families

WIC: (average monthly clients) x (% new clients screened) = $5,892 \times 0.135 = 766$ women

Total affected: (Healthy Start) + (Healthy Families) + (WIC) = $500 + 94 + 766 = 1,360$

2. Though the program is relatively new, a study of One Key Question in an Oregon health clinic found that it increased contraception use by 14% and initiated a change in preferred method of use by 9% (Power to Decide, 2019).

New users: (total women affected (step 1)) x (rate of contraception increase) =
 $1360 \times 0.14 = 190.40$

Switched users: (total women affected (step 1)) x (rate of switched use) =
 $1360 \times 0.09 = 122.40$

3. A study of a program that offered free choice of contraceptives for women not using contraceptives but interested in using them in St. Louis found that when offered any type of birth control for free, 75% of women chose LARCs, while 25% used a non-LARC method (McNicholas et al., 2014). This will be used to estimate the LARC take-up rate in light of the new Virginia initiative to expand LARC access to low-income individuals.

LARCs among new users: (new users (step 2)) x (LARC increase) =
 $190.40 \times 0.75 = 142.8$

Non-LARC contraceptive use among new users:
 $(\text{new user contraception use}) - (\text{LARC increase}) =$
 $190.40 - 142.8 = 47.6$

LARCs among switched users: $(\text{switched users (step 2)}) \times (\text{LARC increase}) =$
 $122.40 \times 0.75 = 91.8$

Non-LARC contraceptive use among new users:
 $(\text{switched user contraception use}) - (\text{LARC increase}) =$
 $122.40 - 91.8 = 30.6$

TABLE 4: OKQ CONTRACEPTION TAKEUP

INTERVENTION AFFECT	LARC	NON-LARC CONTRACEPTION	TOTAL
NEW USERS	142.8	47.6	190.40
SWITCHED USERS	91.8	30.6	122.40

4. Around 52% of women not using contraception have an unintended pregnancy (Gold et al., 2009). This means that a baseline of 74 women not using contraception would become pregnant in a year. Data from the CDC shows that the chances of getting pregnant from using the two most popular non-LARC contraception (the pill and the male condom) are 9% and 18%, respectively (CDC, 2015). Assuming that those switching preferred birth controls commonly use these two methods, this would give way to an average unintended pregnancy rate of 13.5%, leading to 91 unintended pregnancies at the baseline.

$(\text{new users (step 2)}) \times (\text{unintended pregnancy rate}) = 190.40 \times 0.52 = 99.01$

$(\text{switched user (step 2)}) \times (\text{unintended pregnancy rate}) = 122.40 \times .135 = 16.5$

Baseline total unintended pregnancy = $99.01 + 16.5 = 116.01$

5. Changes in pregnancy rates would occur through LARC take-up, non-LARC take-up (assuming the pill), and the switch from the pill to LARC take-up and male condom to the pill take-up. It is assumed that non-LARC contraceptive take-up for the affected population would result in pill take-up. LARC take-up results in a pregnancy rate of 1%, pill take-up results in an average pregnancy rate of 9% (this assumes non-perfect use) (CDC, 2015).

Pregnant population from no contraceptive use to LARC =
 $(\text{LARC use}) \times (\text{LARC pregnancy rate}) =$
 $142.8 \times 0.01 = 1.428$

Pregnant population from no contraceptive use to pill use =

(non-LARC use) x (pill pregnancy rate) =
 $47.6 \times 0.09 = 4.28$

Pregnant population switching from pill or condom to LARC =
 $91.8 \times 0.01 = 0.918$

Pregnant population switching from condom to pill =
 $30.6 \times 0.09 = 2.754$

Total unintended pregnancy =
 $1.428 + 4.28 + 0.918 + 2.754 = 9.38$

6. This results in roughly 81 unintended pregnancies reduced.

(total non-initiative unintended pregnancy) - (total OKQ unintended pregnancy) =
 $116.01 - 9.38 = 106.15$

7. A meta-analysis of the risks associated with pregnancy found that unintended pregnancies have a 13.4% risk of LBW (Shah et al., 2011). This would lead to an estimated 11 LBW births. The infant mortality rate for LBW births in 2013 was 5%, leading to an estimated 0.5 deaths avoided and a reduction of infant death by 1.7%, based on annual average of 32 infant deaths in Richmond between 2015 and 2017 (VDH, 2017a). This estimate is conservative as it does not factor in pregnancy reduced during the interconceptional period, which is more than three times as likely to result in infant mortality than births occurring after one year of the previous birth (VDH, 2017b).

(unintended pregnancies (step 6)) x (LBW risk) = $106.15 \times 0.134 = 14.2$

(LBW pregnancies) x (infant mortality rate for LBW) = $14.2 \times .05026 = 0.715$

(infant deaths avoided) / (average annual infant deaths in Richmond) = $0.715/32 = 0.022$

TABLE 5: IMPACT OF OKQ ON INFANT MORTALITY

	Total Population	Unintended Pregnancies from No Contraception	Unintended Pregnancies Contraceptive Users	Total Unintended Pregnancies	Infant Mortalities
BASELINE	1,360	99	17	116	0.8
OKQ PILOT	1,360	5.7	3.7	9	0.1
New LARC Use	143	1.4	-	-	-
New Non-LARC Use	48	4.3	-	-	-

Switched LARC Use	92	-	0.9	-	-
Switched Non-LARC Use	31	-	2.8	-	-
Difference		93	13	106	0.72

Maternal Mortality

While unintended pregnancy probably results in heightened maternal death outside of abortion risk (they often occur in older women, women who are low-income, and women with heightened risk factors as they are not intending to become pregnant). Prenatal care for unintended pregnancies is often delayed and the increased exposure to pregnancy in general heightens risk. However, few studies have evaluated the direct link between unintended pregnancy and maternal death. Thus, to identify maternal mortality risk, the risk of maternal death for abortion procedures will be used. Maternal mortality is estimated to be reduced by 0.5% as a result of this initiative, though this estimate is conservative as it only measures deaths associated with abortion.

1. An estimated 40.5% of unintended pregnancies ended in abortion between 2008 and 2011 (Finer & Zolna, 2011). The decline in unintended pregnancies as a result of OKQ is estimated to bring about a reduction of 33 abortions.

$$(\text{unintended pregnancies reduced}) \times (\text{rate of abortion in unintended pregnancies}) = \\ 81.38 \times .405 = 32.96$$

2. According to an analysis of the national Pregnancy Mortality Surveillance System, abortion-related deaths occurred 0.007% of the time between 1998 and 2010 (Zane et al., 2015). Between 1999 and 2013, six women in Richmond died of pregnancy-related causes, averaging to 0.43 deaths annually. Thus, reducing unintended pregnancy would decrease total maternal deaths associated with abortions by 0.5%.

$$(\text{rate of aborted unintended pregnancies}) \times (\text{abortion-related death rate}) = \\ 32.96 \times 0.00007 = 0.00230$$

$$(\text{abortion-related death}) / (\text{annual Richmond maternal death rate}) = \\ 0.00230 / 0.429 = 0.00537 \text{ or } 0.54 \%$$

COST EFFECTIVENESS

Estimated annual cost of initiative: \$45,000

Estimated annual infant deaths avoided: 0.715

Cost effectiveness for infant mortality: $0.715 / \$45,000 = \$62,937$

Estimated annual cost of initiative: \$45,000

Estimated annual infant deaths avoided: 0.002

Cost effectiveness for maternal mortality: $0.002 / \$45,000 = \$19,504,161$

APPENDIX E: *Increasing Doula Access Analysis*

COST

\$40,000 each year to support 50 new mothers¹⁸ living in at-risk areas with doulas from Urban Baby Beginnings, the Richmond Doula Project, and Birth in Color RVA. This number was estimated from average doula fees in Richmond, between \$600 and \$1000, (estimate from Richmond Doulas) and funding for a pilot program being implemented in Milwaukee (Richmond Doulas, 2017; Hess, 2019). The amount contributed to this initiative is flexible.

EFFECTIVENESS

The effectiveness of this alternative was analyzed to be a 0.03% reduction in total infant mortality in the city of Richmond.

1. The preterm birth rate for black women in Virginia is 32.26% higher than the state average (March of Dimes, 2019b). For Richmond, this means a PTB rate of 14.55 per 1,000 live births or a probability of 1.5%.

$$\begin{aligned} & (\text{Richmond PTB rate per 1,000}) \times (\text{PTB probability for black women in VA}) \\ & = 11 \times 1.3226 = 14.55 \end{aligned}$$

2. Thus, the baseline number of preterm births for 50 black women would be 0.73 infants.

$$(\# \text{ of participating women}) \times (\text{PTB rate for black women (step 2)}) = 50 \times 0.01455 = 0.7274$$

3. Providing doulas for black women qualifying for Medicaid has estimated to reduce PTB by 22% (Kozhimannil et al., 2016). This would lead to a reduction of 0.16 PTB infants.

$$(\text{baseline # of PTB (step 2)}) \times (\% \text{ reduction in PTB}) = 0.7274 \times .22 = 0.16$$

4. The probability of infant mortality rates for black babies born preterm in the U.S. in 2013 was 5% (Mathews et al., 2015). With an average of 32 infant deaths in Richmond between 2015 and 2017, this would lead to a 0.03% reduction in total infant mortality.

$$\begin{aligned} & (\text{estimated reduction in # PTB (step 3)}) \times (\text{probability of PTB death}) \\ & = 0.16 \times 0.05001 = 0.008 \\ & (\text{estimated difference in infant mortality}) / (\text{2017 infant mortality}) = 0.008/32 = 0.0003 \text{ or} \\ & 0.03\% \end{aligned}$$

The effectiveness of this alternative was analyzed to be a 0.26% reduction in total maternal mortality in the city of Richmond.

¹⁸Funding 50 births is recommended because the population of Richmond is roughly half of the population of Milwaukee, which funded 100 births through this initiative.

1. The state of Virginia's average cesarean delivery rate for black women between 2014 and 2017 was 33% (CDC, 2018d). Thus, the baseline level of cesarean delivery for 50 women in Richmond is estimated to be 18 births.

$$(\% \text{ cesarean delivery}) \times (\text{women participating}) = .33 \times 50 = 16.5$$

2. Studies of doula support have revealed reductions in cesarean delivery rates. In a nationally representative sample of women, Kozhimannil et al. estimated a statistically significant 50% reduction in the odds of cesarean delivery between women who wanted a doula and did not receive one and women who received a doula (2014). Using this statistic, cesarean delivery would be reduced by around eight deliveries.

$$(\# \text{ of cesarean deliveries (step 1)}) \times (\text{reduction in cesarean rate}) = 16.5 \times .5 = 8.25$$

3. According to a review of evidence-based reports by the American College of Obstetricians and Gynecologists, the maternal mortality risk of cesarean delivery is 0.013% (ACOG, 2014).

$$(\# \text{ of reduced cesarean deliveries (step 2)}) \times (\% \text{ of cesarean deliveries resulting in maternal morbidity}) = 8.25 \times .000133 = 0.0011$$

4. With six pregnancy-related deaths in Richmond between 1999 and 2013, this would average to 0.43 deaths a year (RCHD, 2018). This would lead to a 0.26% reduction in maternal mortality.

$$(\# \text{ of deaths reduced}) / (\text{deaths per year}) = 0.0011 / 0.429 = 0.0026 = 0.26 \%$$

COST-EFFECTIVENESS

\$5,000,000 per infant and \$40,000,000 per maternal death avoided.

Estimated annual cost of initiative: \$40,000

Estimated annual infant deaths avoided: 0.008

Cost effectiveness for infant mortality: $0.008 / \$40,000 = \$5,000,000$

Estimated annual cost of initiative: \$40,000

Estimated annual infant deaths avoided: 0.001

Cost effectiveness: $0.001 / \$40,000 = \$40,000,000$

APPENDIX F: *CenteringPregnancy Analysis*

COST

\$20,000 over the first two years and \$500 in subsequent years. Total program cost cited in Rowley et al., 2016.

Program for 5 years would cost =

$$20,000 + 500 \times 3$$

$$= \$21,500$$

Annual cost= \$4,300

EFFECTIVENESS

The effectiveness of this alternative was analyzed to be a 0.05% reduction in total infant mortality in the city of Richmond. There was mixed evidence on the impact of CP on LBW and little to no evidence of CP on maternal risk factors. VCU Health is currently evaluating CP in Richmond, though the date of the completion of evaluation is unclear¹⁹.

1. In Richmond, the preterm birth rate is 11.6 per 1,000 live births or 1.16% (March of Dimes, 2019a). Thus, the baseline PTB for 120 women²⁰ would be 1.32 infants.

$$(\# \text{ of participating women}) \times (\text{PTB rate}) = 120 \times 0.012 = 1.392$$

2. CP has shown to reduce PTB by 33% (RCT with majority African American women; Ickovics et al., 2007), which would reduce PTB in this group by 0.44 infants. (Other, less rigorous studies show 36% or 40% reductions)

$$(\text{baseline } \# \text{ of PTB infants (step 1)}) \times (\% \text{ PTB reduction}) = 1.392 \times .33 = 0.459$$

3. The infant mortality rate in 2013 for preterm infants in the United States was 34.76 infants per 1,000 preterm infants or 3.476% (Mathews et al., 2015). With an average of 32 infant deaths in Richmond between 2015 and 2017, this would lead to a 0.05% reduction in total infant mortality (VDH, 2017a).

$$\begin{aligned} &(\text{estimated reduction in } \# \text{ PTB (step 2)}) \times (\text{PTB mortality rate}) \\ &= 0.459 \times .0346 = 0.0159 \end{aligned}$$

$$\begin{aligned} &(\text{estimated difference in infant mortality}) / (\text{2017 infant mortality in Richmond}) \\ &= 0.0159/32 = 0.0005 \text{ or } 0.05\% \end{aligned}$$

COST-EFFECTIVENESS

¹⁹ <https://familymedicine.vcu.edu/epidemiology/research/maternal/>

²⁰CP recommends providers serve at least 120 women annually - a new group starting each month with an average of 10 women in each group (Planning your Centering Budget, n.d.).

\$270,440 per infant death avoided.

Estimated annual cost of initiative: \$4,300

Estimated annual infant deaths avoided: 0.0159

Cost effectiveness for infant mortality: $0.0159 / \$4,300 = \$270,440$

APPENDIX G: *Healthy Start in Housing Analysis*

COST

Cost is estimated to be \$32,502.40 to serve 30 women²¹. Boston Healthy Start received \$950,000 in 2019 and served 1,023 women in 2017 (BPHC, 2018; HRSA, 2019b).

$\$950,000 / 1,023 \text{ women} = \$928.64 \text{ per woman served}$

$\$928.64 \times 30 = \$27,859.20$

EFFECTIVENESS

The effectiveness of this alternative was analyzed to be a 0.005% reduction in total infant mortality in the city of Richmond.

1. In Richmond, the preterm birth rate is 11.6 per 1,000 live births or 1.16% (March of Dimes, 2019a). Thus, the baseline PTB for 30 women would be 0.348 infants.

$$(\# \text{ of participating women}) \times (\text{PTB rate}) = 30 \times 0.0116 = 0.348$$

2. Women with access to public housing are 13% less likely to deliver preterm, which would reduce PTB in this group by 0.05 (Reilly et al., 2018).

$$(\text{baseline } \# \text{ of PTB infants (step 1)}) \times (\% \text{ PTB reduction}) = 0.348 \times 0.13 = 0.0452$$

3. The infant mortality rate in 2013 for preterm infants was 34.76 infants per 1,000 preterm infants or 3.476% (Mathews et al., 2015). With an average of 32 infant deaths in Richmond annually, this would lead to a 0.005% reduction in total infant mortality (VDH, 2017a).

$$\begin{aligned} &(\text{estimated reduction in } \# \text{ PTB (step 2)}) \times (\text{PTB mortality rate}) \\ &= 0.0452 \times .03476 = 0.0016 \end{aligned}$$

$$\begin{aligned} &(\text{estimated difference in infant mortality}) / (\text{2017 infant mortality in Richmond}) \\ &= 0.0016 / 32 = 0.00005 \text{ or } 0.005\% \end{aligned}$$

²¹Serving 30 women is recommended as the population of Richmond is around one third less than Boston and the Boston Healthy Start in Housing program serves 100 women.

The effectiveness of this alternative was analyzed to be a 0.009% reduction in total maternal mortality in the city of Richmond.

1. Hypertension during pregnancy occurs in 6% to 8% of all pregnancies in the United States, thus participants would have a baseline of 2.1 incidences of hypertension disorders during pregnancy (CDC, 2018c).

$$(\# \text{ of women participating}) \times (\text{probability of hypertension}) = 30 \times 0.07 = 2.1$$

2. In a study of pregnancy-associated deaths in Florida between 1999 and 2012, the Florida Department of Health estimated that hypertensive disorders result in maternal death 0.0027% of the time (FDH, 2013). Thus, leading to a 0.009% reduction in maternal deaths for the city. The actual reductions in maternal deaths may be higher than this estimate as it only evaluates reductions in deaths through reductions in pregnancy-reduced hypertension and there are multiple other known risks to homelessness on woman's health.

$$(\# \text{ hypertensive pregnancies (step 1)}) \times (\text{probability of maternal death}) = 2.1 \times 0.000027 \\ = 0.0000567$$

$$(\text{estimated maternal deaths}) / (\text{average annual maternal deaths in Richmond}) \\ = 0.0000567 / 0.429 = 0.00013 \text{ or } = 0.013\%$$

COST-EFFECTIVENESS

\$17,412,000 per infant and \$491,343,915 per maternal death avoided.

Estimated annual cost of initiative: \$27,859.20

Estimated annual infant deaths avoided: 0.0016

Cost effectiveness for infant mortality: $0.0016 / \$27,859.20 = \$17,412,000$

Estimated annual cost of initiative: \$27,859.20

Estimated annual infant deaths avoided: 0.0000567

Cost effectiveness: $0.0000567 / \$27,859.20 = \$491,343,915$

APPENDIX H: *Richmond Healthy Births Collaborative Analysis*

The following is a list of stakeholder recommendations for the Richmond Healthy Births Collaborative.

TABLE 3: STAKEHOLDER RECOMMENDATIONS

HEALTH CARE PROVIDERS	GOVERNMENT ENTITIES	NONPROFIT ORGANIZATIONS	OTHER
Bon Secours Hospital System	Richmond City Health District	Birth in Color RVA	Virginia Atlas of Community Health
The Capital Area Health Network (CAHN)	Richmond Department of Social Services	The Richmond Doula Project	Early Impact Virginia
The Daily Planet	Richmond City Mayor's Office	Urban Baby Beginnings	Virginia Neonatal Perinatal Collaborative
The HCA Virginia Hospital System	Virginia Department of Health	The Virginia Sexual and Domestic Violence Action Alliance	
Planned Pregnancy	Virginia Department of Social Services	The YMCA of Greater Richmond	
The Richmond Academy of Medicine		YWCA of Richmond	
Richmond Behavioral Authority			
Virginia Capital Area Health Network			
Virginia Commonwealth University Health System			

COST

Maternal and Infant Community Health Collaboratives in New York had maximum awards between \$1.2 million and \$500,000 in 2012 (NYSDH, 2012). Thus, an average of these figures would lead to an estimated cost of \$850,000. Adjusted for inflation, this would lead to an estimated cost of \$924,980 (BLS, 2019).

EFFECTIVENESS

1. In Worcester, Massachusetts, the Worcester Healthy Baby Collaborative reduced the black infant mortality rate by 41% between 1993 and 2015 (averages to 1.9% annually) (City of Worcester, 2017). In Baltimore, B'More for Healthy Babies, an intensive city-wide partnership model (see Case Studies section), reduced the black infant mortality rate by 35% between 2009 and 2016 (averages to 5% annually) (AECF, 2018). As Richmond's model is anticipated to establish involvement somewhere in between Worcester's summit model and Baltimore's more intensive model, the impact of this initiative is estimated to fall in the average of the two, at 3.45%, reducing infant deaths by 1.1 each year.

$$\begin{aligned} &(\text{estimated average reduction}) \times (\text{annual infant deaths in Richmond}) = \\ &= 0.0345 \times 32 = 1.104 \end{aligned}$$

COST EFFECTIVENESS

Cost effectiveness is estimated to be \$840,891 per infant death avoided.

Estimated annual cost of initiative: \$924,980

Estimated annual infant deaths avoided: 1.1

Cost effectiveness for infant mortality: $1.1 / \$924,980 = \$840,891$

APPENDIX I: *Cost Effectiveness Table*

TABLE 6: COST EFFECTIVENESS					
Alternative	Total Annual Cost	Annual Infant Deaths Avoided	Annual Maternal Deaths Avoided	Annual IM Cost Effectiveness	Annual MM Cost Effectiveness
ONE KEY QUESTION	\$45,000	0.715	0.0023072	\$62,937	\$19,504,161
INCREASING DOULA ACCESS	\$40,000	0.008	0.001	\$5,000,000	\$40,000,000
CENTERING PREGNANCY	\$4300	0.0159	-	\$270,440	-
HEALTHY START IN HOUSING	\$27,859.20	0.0016	0.0000567	\$17,412,000	\$491,343,915
RICHMOND HEALTHY BIRTHS COLLABORATIVE	\$924,980.00	1.1	-	\$840,891	-

APPENDIX J: Annual Estimated Reductions

INFANT MORTALITY

Total annual reduction:

OKQ + Increasing Doula Access + Richmond Healthy Births Collaborative =

OKQ = 0.715 deaths avoided (See Appendix D)

Increasing Doula Access = 0.008 deaths avoided (see Appendix E)

Richmond Healthy Births Collaborative = 1.104 deaths avoided (see Appendix H)

= 0.715 + 0.008 + 1.104 = 1.83 deaths avoided annually

MATERNAL MORTALITY

Total annual reduction:

OKQ + Increasing Doula Access + Richmond Healthy Births Collaborative =

OKQ = 0.005 deaths avoided (See Appendix D)

Increasing Doula Access = 0.001 deaths avoided (see Appendix E)

Richmond Healthy Births Collaborative = 0 deaths avoided²² (though, anticipated to be greater than zero)

= 0.0023 + 0.0011 + 0 = 0.0034 deaths avoided annually

²²Anticipated to be greater than zero (see Appendix H)

APPENDIX K: Five-Year Projections

FIVE-YEAR PROJECTIONS

To estimate the five-year reductions in infant mortality for the City of Richmond, the average percent change in live birth rates between 2014 and 2017²³ (1.23%) (Table 7) was used to estimate live birth rates between 2018 and 2025 (Table 8). The projected infant mortality without intervention was estimated in the same way, using the average percent change in annual infant deaths between 2014 and 2017.

Estimated infant deaths avoided with intervention used the analysis from Appendix J, finding an annual reduction of 1.83 infant deaths.

As examples of healthy birth collaboratives in Baltimore, New York City and Worcester have reduced infant mortality in a cumulative way (reducing infant death by more and more each year), the estimated infant mortality was evaluated by calculating the infant mortality after year one²⁴ (2021) as $32.75 - 1.83 = 30.92$; then calculating the subsequent year's reduction from the outcome of the previous year $30.92 - 1.83 = 29.09$. This step was repeated to estimate infant mortality over the next three years (Table 8). The infant mortality rate per 1,000 live births is calculated using the following formula (March of Dimes, 2019c):

(Annual Infant Deaths / Annual Live births) x 1000 = Infant Mortality Rate per 1,000 Births

TABLE 7: RICHMOND BIRTHS DATA, 2014 - 2017

Year	Live Births	Annual Birth Growth Rate	Infant Mortalities	% Change in Annual Infant Deaths	Infant Mortality Rate per 1,000 Live Births
2014	2,916		36		12.35
2015	3,107	6.55%	38	0.056	12.23
2016	2,994	-3.64%	25	-0.342	8.35
2017	3,017	0.77%	32	0.28	10.61
Average	3,009	1.23%	32.75	0.00	10.88

²³2017 is the most recent data.

²⁴This assumes that initiatives will begin in 2020.

TABLE 8: 5 YEAR INFANT MORTALITY PROJECTIONS

Year	Projected Birthrate	Projected Infant Mortality	Infant Mortality Rate per 1,000 Live Births	Estimated Infant Deaths Avoided with Intervention	Estimated Infant Mortality with Intervention	Infant Mortality Rate with Intervention per 1,000 Live Births
2018	3,054	32.75	10.72	-	32.75	10.61
2019	3,091	32.75	10.59	-	32.75	10.61
2020	3,129	32.75	10.47	-	32.75	10.61
2021	3,168	32.75	10.34	1.83	30.92	9.76
2022	3,207	32.75	10.21	1.83	29.09	9.07
2023	3,246	32.75	10.09	1.83	27.26	8.40
2024	3,286	32.75	9.97	1.83	25.43	7.74
2025	3,326	32.75	9.85	1.83	23.60	7.10

MATERNAL MORTALITY

To estimate the reductions in maternal mortality over five years, the same birthrate projections were used from the infant mortality analysis above. Average annual maternal mortality was used from Appendix J to project maternal mortality from 2018 to 2025. Estimated maternal deaths avoided used the estimates from Appendix D – H. Estimated maternal mortality with the three interventions was estimated in the same way as with infant mortality projections, by calculating the maternal mortality after year one²⁵ (2021) as $0.429 - 0.003 = 0.426$; then calculating the subsequent year's reduction from the outcome of the previous year $0.426 - 0.003 = 0.423$. This step was repeated to estimate maternal mortality over the next three years (Table 9). The maternal mortality rates with and without intervention were calculated using the following formula (March of Dimes, 2019c):

$$(\text{Annual Maternal Deaths} / \text{Annual Live births}) \times 100,000 =$$

Maternal Mortality Rate per 100,000 Births

²⁵This assumes that initiatives will begin in 2020.

TABLE 9: 5 YEAR MATERNAL MORTALITY PROJECTIONS

	Projected Birthrate	Projected Maternal Mortality	Maternal Mortality Rate per 100,000 Live Births	Estimated Maternal Deaths Avoided	Estimated Maternal Mortality with Intervention	Maternal Mortality Rate per 100,000 Live Births with Intervention
2018	3,054	0.429	14.05	-	0.429	14.05
2019	3,091	0.429	13.88	-	0.429	13.88
2020	3,129	0.429	13.71	-	0.429	13.71
2021	3,168	0.429	13.54	0.003	0.426	13.45
2022	3,207	0.429	13.38	0.003	0.423	13.19
2023	3,246	0.429	13.22	0.003	0.420	12.94
2024	3,286	0.429	13.06	0.003	0.417	12.69
2025	3,326	0.429	12.90	0.003	0.414	12.45

APPENDIX L: *Webpage Layout Recommendation*

Below is an example of Washington, D.C.'s Maternal and Infant Health Summit Resources Page.

Resources

Find Resources Near You

Before Pregnancy

Pondering pregnancy? Prenatal care that starts before the 1st trimester is one of the best ways to ensure mother and baby are happy and healthy.

Well-Women Visit

Your annual well-woman visit is a time to make sure you have access to care and manage chronic conditions so that you can be at your healthiest self before, during, and after pregnancy.

[LEARN MORE](#)

DC Healthy Start

Pave the way for a healthy start for your baby before and during pregnancy. DC Healthy Start supports women of childbearing age, pregnant women, and mothers and fathers in Wards 5, 6, 7 and 8.

[LEARN MORE](#)

During Pregnancy

Let your baby's gender be a surprise. Not your baby's health. Pre-natal care is one of the best ways to ensure everyone thrives.

Community of Hope DC

Find prenatal education and care from certified midwives throughout pregnancy and beyond.

[LEARN MORE](#)

Mary's Center

Care and education through regular pregnancy check-ups, group care, and maternal mental health services help you stay healthy before, during, and after pregnancy.

[LEARN MORE](#)

Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Take care of key pregnancy success factors such as maternal weight and health through supplemental foods, health care referrals, and nutrition education.

[LEARN MORE](#)

After Pregnancy

When mothers thrive, babies blossom. Every family deserves the best possible start in a safe and healthy environment.

Help Me Grow

Reduce the impacts of adversity on your health through programs and support so that your children can grow, thrive, and reach their full potential.

[LEARN MORE](#)

Early Childhood Innovation Network

Find education and take part in programs that will strengthen your family and help you raise resilient kids.

[LEARN MORE](#)

Thrive By Five

Discover local resources and initiatives to ensure that your baby thrives.

[LEARN MORE](#)

My Child Care DC

Find conveniently located child care facilities in DC that best meet your needs.

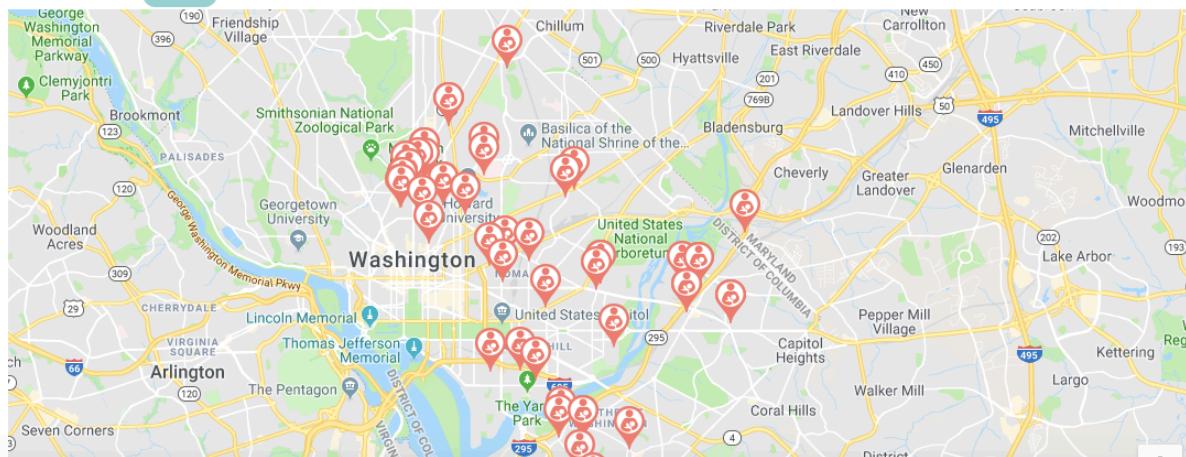
[LEARN MORE](#)

Resource Map

Whether you're a mother- or father-to-be, a provider, or an advocate looking for a way to get involved, find maternal health resources near you.

ZIP / Address:

Radius: [SEARCH](#)



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