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A Cost-Benefit Analysis of Community Health Workers’ Impact Upon The Birth Outcomes of At-Risk Pregnant Women in Muskegon County

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A Cost-Benefit Analysis of Community Health Workers’ Impact Upon The Birth Outcomes of At-Risk Pregnant Women in Muskegon County

Edward Michael Jados

A Thesis Submitted to the Graduate Faculty of

GRAND VALLEY STATE UNIVERSITY

In

Partial Fulfillment of the Requirements

For the Degree of

Master of Health Administration

School of Public, Nonprofit, and Health Administration

December 2013
Dedication

I dedicate this thesis to my Grandparents Barbara and Floyd; Aunt Sally and Uncle Wayne; Aunt Donna, Uncle Dan, and Katey; and my Mom, Bok.
Acknowledgements

Completing this Master’s Thesis has been a wonderful event, and I would have done it all over again. I would like to express my gratitude to my advisor, Dr. Greg Cline, whose understanding, thought provoking comments, and patience, enhance my experience. This journey was a very special undertaking and I have no words to fully express my thanks.

Special thanks to Dr. Cynthia Coviak and Dr. Lara Jaskiewicz for their guidance, insight, and helpful suggestions. I have learned so much from this process and I am glad to have the opportunity to learn from the both of you.

Peter Sartorius and Tressa Crosby of the Muskegon Community Health Project, thank you for allowing me to witness the wonderful work that you do for the community of Muskegon. Your time and effort have allowed me to research a wonderful topic that I thoroughly enjoyed.

Gulp! I would like to thank my friends John Witkowski, RJ Krzyzanowski, Josh Stevenson, and Andrew Talbot for keeping me sane throughout my Master’s Thesis experience. I would probably have gone crazy if it weren’t for all of you.
Abstract

The purpose of this case study was to investigate the effects of community health workers (CHWs) on at-risk pregnant women in Muskegon County through a cost-benefit analysis. CHWs are selected, trained and working in the communities from which they live. The role of the community health worker is extremely diverse, usually due to the communities and programs that they serve. Their purpose is to improve health outcomes in the communities they serve by increasing access to and coverage to basic health services and needs, notably for underserved and medically needy populations. Previous studies have showed that CHWs have a positive effect on the healthcare system and overall health outcome for the population.

However, there are limited studies available that specifically analyze the effects of CHWs in a cost-benefit analysis to measure the outcomes created, especially for CHWs targeting at-risk pregnant women. To assess the effectiveness of such a program, program data from The Pregnancy Pathways Pilot Program, which is operated by the Muskegon Community Health Project, and claims data from Mercy Health Partners were used to calculate the estimates of potential health benefits and cost-savings.

The Muskegon Area Pregnancy Pathways Pilot Project appears to have been successful in preventing the occurrences of low weight births for the 7 program participants. All 7 newborns fell within the acceptable standard of 2500 – 4500 grams. Of the 7 newborns, 6 of them were considered to be healthy but one was considered to have problems. When the total costs of the clients’ normal newborns from the 2500 – 4500 grams group were compared to neonates with problems with a low birth weight delivered by non-program mothers, there was an average savings of $337.75 per participant in this study.
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Community health workers (CHWs) reach underserved or at-risk populations through outreach, basic health education, case management, advocacy, home visits, and referral (World Health Organization, 2007). Through outreach, they are able to increase the vulnerable population access to health care and services. Through basic health education, including topics such as substance abuse, family planning, and nutrition, one goal is to increase knowledge and awareness in the community to improve the odds that adverse outcomes will be prevented. Case management, advocacy, home visits, and referrals are ways to develop and maintain relationships with the at-risk populations (World Health Organization, 2007).

The incidence of low birth weight newborns has stubbornly resisted reduction, resulting in healthcare organizations using a variety of solutions to combat this issue. A benefit to this reduction is that of saving money in the long run. Nearly 8.9 percent of all births in the United States were low birth weight in 2009 (Maternal and Child Bureau, 2012). Medical expenses to treat all preterm and low birth weight newborns are estimated to be $51,600 per child and $26 billion total nationwide in addition, compared to a healthy term newborn (Berhman, 2007).

The Patient Protection and Affordable Care Act (PPACA), passed in 2010, has increased emphasis on efforts to solve the issue of low birth weight deliveries. Federal, state, and local agencies have turned to CHWs as agents of prevention and intervention. The Agency for Healthcare Research and Quality (AHRQ) developed programming for CHWs to target vulnerable populations through outreach, education, and prevention, as methods to improve the health outcomes (Agency for Healthcare Research and Quality,
As part of this effort, Drs. Mark Redding and Sarah Redding developed the Pathways Model. Using CHWs as adjuncts to health care providers, the model addresses issues or risk factors, such as depression, access to care, and substance abuse, that an individual is exposed to, with the goal of completing the pathway or solving the client’s problem (Agency for Healthcare Research and Quality, 2011).

The Executive Director of the Muskegon Community Health Project (MCHP) learned about the Pathways Model and decided to try and test it in Muskegon County. The first use of the model was implemented in 2007 and was used to facilitate and care for newly released prisoners into the community (Agency for Healthcare Research and Quality, 2009). The Michigan Prisoner Reentry Initiative, a statewide program that provided services to paroled individuals from state prisons in the area. MCHP’s contribution was to facilitate access to healthcare of these parolees (Agency for Healthcare Research and Quality, 2009).

In 2011, with funding from the Michigan Chapter of March of Dimes, the Pathways Model was implemented as the Pregnancy Pathways Pilot Program targeting women with a high risk pregnancy. After developing a local coalition of health services and other program goals, the project’s CHW was trained by Dr. Sylvia Mupepi of Grand Valley State University’s College of Nursing regarding normal pregnancies and their characteristics. The project was expected to improve the health and birth outcomes of newborns through provision of services to their mothers that included access to prenatal care; improved participant diets and nutrition; education regarding pregnancy; and assistance in adopting health seeking behaviors. It was hoped that success in reducing the
rate of births would also reduce the overall long term costs to the local healthcare system, Mercy Health Partners, in its treatment of preventable low birth weight births.

1.1 Problem Statement

The problem with healthcare cost-benefit analysis (CBA) is that not all the benefits provided can be easily monetized. In healthcare the details and concepts of cost-benefit analysis can be foreign for clinicians and, in this case, CHWs, meaning items that can be monetized will be missed.

The classical CBA framework was used to perform the cost-benefit analysis and is discussed later in this chapter. Several assumptions were made in order to monetize all benefits. These are drawn from the assumptions that underpin the Pathways model developed by Drs. Mark and Sarah Redding (Agency For Healthcare Research and Quality, 2011):

1. the pregnancy pathways project participants, regardless of age and race, are at risk of delivering a low birth weight child. The target population that the project represents are considered to be at risk and have multiple risk factors that have an impact on their birth.

2. a discount rate was used. A 5 percent discount rate was used for the CBA. This is the most common discount rate used in health related studies by The Health Economic Resource Center (n.d). The center assists researchers in evaluating the cost-effectiveness of medical care, the efficiency of programs and providers, and conducting high-quality health economics research.

3. cost-benefit analysis is only completed when all benefits are measured and monetized and issued in the calculations. However, indirect benefits in this
study can be defined as delaying or avoiding loss of productivity from morbidity or mortality related to the target condition. Applying a monetary value to these components is nearly impossible and can be inaccurate. Therefore, only the direct benefits will be used in the CBA.

1.2 Study Objectives

This study answered two general questions:

1. Can CHWs that target at-risk pregnant women improve upon the birth outcomes of the participants and the newborn?
2. How much cost-savings was being generated by the program?

The secondary objectives are to discover:

1. how much of a difference, if any, occurred in the birth outcomes of newborns from at-risk pregnant women in the program, compared to < 2500 gram newborns with issues from women in a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County.
2. how much of a difference, if any, occurred in the birth outcomes of the newborns from the at-risk pregnant women in the program, compared to 2,500 – 4,500 gram healthy newborns from women in a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County.
3. how much of a difference, if any, occurred in cost-savings of newborns delivered from the at-risk pregnant women in the program, compared to < 2,500 gram neonates with problems from women on Medicaid in Muskegon County.
4. how much of a difference, if any, occurred in cost-savings of newborns delivered from the at-risk pregnant women in the program, compared to 2,500-4,500 gram healthy newborns from women on Medicaid in Muskegon County.

5. how much of a difference, if any, occurred in cost-savings for the at-risk women who were pregnant in the program compared to women on Medicaid who delivered < 2,500 gram neonates with problems in Muskegon County.

6. how much of a difference, if any, occurred in cost-savings for the at-risk women who were pregnant in the program compared to women who delivered 2,500 – 4,500 gram healthy newborns and were on Medicaid in Muskegon County.

1.3 Framework of Study

This case study used archival records from Mercy Health Partners and Muskegon Community Health Project from 2011-2012. The objective of this study is to measure the Pregnancy Pathways Pilot Program on at-risk pregnant women in Muskegon County who are Medicaid eligible. Using a cost-benefit analysis, the costs was measured to see how much of a benefit is provided for the women.

1.3.1 Cost-Benefit Analysis

The cost-benefit analysis was used to determine whether the benefits exceed the costs for the program. The program costs and benefits are given a monetary value. The results were measured as a ratio of benefits to costs or a rate of return. The cost-benefit
analysis is more comprehensive and a more complete measure of the change in social welfare compared to any other similar, simpler approaches (Pew Charitable Trust, 2013).

1.3.2 Costs

There are four types of program costs that can be measured in the cost-benefit analysis; Investment or Start-up Costs, Operating and Maintenance Costs, In-Kind, and Opportunity Costs. The costs are the value of the resources that were used to operate the program. The costs of the program will be addressed in the cost-benefit analysis section of the paper. Costs of care provided are the fourth and final cost to be included.

1.3.3 Benefits

Benefits can be defined as all positive outcomes or consequences of the program in the economic evaluation. There are two measurable benefits for the study: the reduction in the occurrences of low weight births, and the reduction in medical costs. These will be discussed in more detail in the Cost-Benefit section of the thesis.

1.4 Implication of the Study

For the past two decades, the number of programs that use CHWs have increased (World Health Organization, 2011). Studies have shown that CHWs are able to produce better health outcomes for at-risk populations (Fedder et al., 2003; Krieger et. al, 2002; Whitley, et al., 2006). This study attempts to provide another piece of information for organizations considering employing CHWs as a way to help increase access to care and to prevent negative health outcomes.

1.5 Need For Study

Research exploring the health outcomes of programs that use community health workers is plentiful. The purpose of the study is to investigate return on investment, at the
time of delivery and birth, to gain an insight regarding whether any negative birth outcomes were reduced and how much cost was avoided, if at all.

1.6 Organization of Thesis

Chapter two will provide background literature describing what is known about the use of community health workers. Chapter three will provide background on Medicaid eligibility, enrollment data, and Medicaid in Michigan. Chapter four will discuss CHWs as a method to reduce LBW occurrences for low income women. Chapter five provides background in potential risk factors and complications. Chapter six will provide a description of the Pregnancy Pathways Program. Chapter seven will discuss the methodology of the study. Chapter eight will have the results of the study and chapter nine will contain the conclusions.
Chapter Two: Background of CHWs

This chapter covers the background literature describing use of CHWs, including information about the definition of their jobs from a global and United States perspective; the history of CHWs in the United States; and the potential future for CHWs in the United States. This chapter details published CBA studies of programs using CHWs. Lastly, this chapter discusses other existing healthcare professionals in this role; and reasons why CHWs exist, and tend to succeed.

2.1 Definitions and Role of Community Health Workers

The definition of a CHW is broad because the role can encompass many responsibilities. The World Health Organization (WHO) and the United States have similar and some differences in the descriptions of the role. In quick summation, WHO defines the role of a CHW as an activist/outreach specialist, educator, and a person who is able to provide care while the United States defines it as an activist/outreach specialist and educator. The following sections will outline how the two organizations define the position in greater detail.

Community health workers represent the link between the delivery of healthcare from primary care providers, and the underserved population. The main goal of CHWs is to improve the overall health of the community, resulting in a reduction in healthcare costs. The World Health Organization, in 2011, estimated that there was a total of 1,300,000 CHWs worldwide (World Health Organization, 2011). The United States Bureau of Labor Statistics showed that there were approximately 83,000 CHWs employed in the United States (United States Department of Labor, 2010). Both statistics show that CHWs have a large presence in the field of community health.
2.1.1. World Health Organization Definition

The World Health Organization’s definition of a CHW is widely accepted. They define CHWs as “members of the communities where they work, should be selected by the communities, should be answerable to the communities for their activities, should be supported by the health system but not necessarily a part of its organization, and have shorter training than professional workers.” The tasks that the WHO defines that CHWs can perform are: agents of social change for the community; technical and community management; home visits; environmental sanitation; provision of water supply; first aid and treatment of simple and common ailments; health education; nutrition and surveillance; maternal and child health and family planning activities; tuberculosis and HIV/AIDS care; counseling, peer, and treatment support; palliative care; malaria control; treatment of acute respiratory infections; communicable disease control; community development activities; referrals; recordkeeping and collection of data on vital events (World Health Organization, 2007, pg. 5). The role of a CHW defined by WHO is diverse. The CHW is able to provide care, manage caseloads, and assist in administrative tasks.
2.1.2 United States Definition

The definition of in the United States is much narrower than the definition used by the WHO. The definition of a CHW by the Department of Labor Standard Occupational Classification (21-1094) includes: “serving as a liaison between community and healthcare agencies; providing guidance and social assistance to community residents; enhancing community residents’ ability to effectively communicate with healthcare providers; providing culturally and linguistically appropriate health or nutrition education; advocating for individuals and community health; providing referral and follow-up services or otherwise coordinating care; proactively identifying and enrolling eligible individuals in federal, state, local, private or nonprofit health and human services program” (United States Department of Labor, 2010, para. 1).

The United States Department of Labor does not include providing care in its definition of CHWs. CHWs are not trained to provide direct care to individuals. A community health nurse is able to do all of the tasks assigned to CHWs and are able to provide care.

2.2 Existing Healthcare Professions in This Role

Community health nurses are often found assuming the role of CHWs. This is the case because they are often the first and only link between the organization and the community. The results of community health nurses compared to CHWs are mixed, with most of the studies showing that they are not as effective as their counterparts (HRSA, 2007).

Early community health nurses have been used in a role similar to CHWs. “Lillian Wald, founder of the Henry Street Settlement in 1893 in New York City, invented the
term of public health nursing to put emphasis on the community value of the nurse whose work was built upon an understanding of all the problems that invariably accompanied the ills of the poor” (Buhler-Wilkerson, 2001, p. 1). The role of a community health nurse “required an understanding of how culture, economics, politics, psychosocial problems, and sanitation influenced health and illness and the lives of patients and families” and was “extended beyond the care of the sick to encompass advocacy, community organizing, health education, and political reform” (Kulbok, P.A, 2012, para. 11).

Due to rising costs in healthcare, the United States government and healthcare organizations attempted to correct this problem with two healthcare delivery models; integrated delivery systems and managed care organizations (Ervin, 2002). Integrated delivery models are able to provide a variety of care within the same system while managed care organizations use contracted providers. Under these service delivery models, organizations are able to provide services that public health departments can do but accomplish them at a lower cost. As a result, public health departments are eliminating services for the community, and the result has been the loss of public health nursing positions (Ervin, 2002).

2.3 Why Use Community Health Workers

There is a shortage of qualified nurses available to meet the demand of healthcare organizations. As a result, there is more competition for these nurses resulting in higher wages. Public health departments, dealing with shrinking budgets due to state budget cuts, cannot afford to employ nurses. It is cheaper to replace and employ CHWs than community health nurses (Agency for Healthcare Research and Quality, 2013).
Currently, CHWs do not need to have a certification or licensure and are able to direct individuals to receive care from nurses instead of providing care themselves.

Most nurses are prepared using the medical model instead of the nursing, leaving them unprepared working in community. The medical model has a narrow view with its concerns of diagnosis, treatment, and cure (Reed, 1994). The nursing model has a holistic approach, not only incorporating the medical model but also treats patients’ environment, lifestyle, and other needs.

To fill the needs of public health departments, CHWs help bridge the gap between primary health care providers and the community by reducing the barriers the underserved populations need to overcome in order to receive proper health care. They are able to help these populations through education, guidance and assistance, advocating for the community, and by helping people to sign up for social programs (HRSA, 2007).

Community health workers are able to provide a high level of service because their roles are much more specific related to a particular culture compared to other healthcare professions. Their main focus is to build a relationship between the community and primary care providers by reducing barriers. CHWs rely on community engagement and relationships that other professions, such as visiting home nurses, cannot solely focus upon with their current duties.

Community health workers have a distinct job classification and description that is unique compared to any other healthcare professionals as they serve as a link between health and social services and to the community (American Public Health Association, 2013). CHWs and their corresponding roles can be grouped into five categories: (1) member of care delivery team; (2) navigator; (3) screening and health education provider;
(4) outreach-enrolling-informing agent; and (5) organizer (HRSA, 2007). In these roles, they are able to provide a level of service and care that physicians, visiting home nurses, or any other care providers cannot.

While providers may treat and care for clients from the medical model approach, CHWs are able to provide a preventative type of service for the community. Their primary objective and goal is to make sure that the community is healthy, and able to avoid unnecessary emergency care and treatment. The primary focus for CHWs is on the community as a whole, while providers tend to focus on individuals. This is not to state that CHWs tend to neglect individuals and their health, but that they want the overall community to be as healthy as possible.

Community health workers aid healthcare organizations in keeping the cost to provide care to a minimum. Community health workers aim to serve the populations who are the highest contributors to healthcare organization costs. For most cases, the responsible parties are those who are enrolled in the Medicaid program, or the uninsured. Medicaid does not fully reimburse healthcare systems for the actual costs of services. In 2010, Medicaid reimbursed $0.93 cents for every $1.00 spent by hospitals nationwide. Medicaid underpaid 4985 hospitals nearly $7.8 billion dollars for the year (American Hospital Association, 2012). For those who are uninsured and unable to pay for the services rendered, the hospital has to absorb the costs with limited, if any financial reimbursement.
2.4 History of CHWs in the United States

Community health workers have been a component of the United States healthcare system since the 1960s. The CHW organization and grassroots efforts have allowed the creation of a healthier environment for individuals, families, and the community. The 2007 *Community Health Worker National Workforce Study* detailed four eras of CHWs in the United States healthcare system. The four periods are named Early Documentation (1966-1972); Utilization of CHWs in Special Projects (1973-1989); State and Federal Initiatives (1990-1998); and Public Policy Options (1999-2006) (Health Resources and Service Administration, 2007).

2.4.1 Early Documentation Era (1966-1972)

During the Early Documentation era, CHWs were created and used by the New York City Health Department. During this time period, CHWs were referred to as neighborhood health aides. In the 1960s, they were primarily employed to help vaccinate people against tuberculosis (Wilkinson 1992, as cited in HRSA, 2007). This effort by CHWs resulted in a sharp decrease in the number of tuberculosis cases.

Under the Office of Economic Opportunity Act of 1964, signed by President Lyndon Baines Johnson, the federal government was trying to eliminate poverty, expand educational opportunities, increase the safety net for the poor and unemployed, and tend to the health and financial needs of the elderly (Economic Opportunity Act of 1964). To help aid in this cause, the government encouraged the use of CHWs as part of the antipoverty program to help address problems that were associated with people who were
poor, in place of using a model to improve health (Economic Act of 1964, as cited in Perez, 2008).

### 2.4.2 Utilization of CHWs in Special Projects (1973-1989)

During the stage of Utilization of CHWs in Special Projects era, CHWs were used to tackle special projects that were studied and researched. Many of these projects were publically and privately funded as a way to promote primary health care (HRSA, 2007). With the increasing number of studies carried out during this time period, it allowed for more publications and documentation to be released to the public regarding the work done by CHWs.

In 1978, WHO gave a huge boost to the importance of CHWs in the healthcare field. WHO proposed that each nation should create a viable national CHW program (World Health Organization, 2008, as cited in HRSA, 2007). The idea behind creating a national CHW program was that it would help create a better social, economic, and political environment. A healthier nation would result in a stronger, more robust nation.

Work done during this era led to the development of CHW program models that are currently in use today. An early CHW curriculum was developed in 1993 in Virginia known as “Resources Mothers” to mentor pregnant teenagers (Minow, 1994, as cited in HRSA, 2007). This particular model was received with such great enthusiasm that it was later developed and distributed nationally for other CHW programs to mirror. In 1994, the state of Indiana used this model to help develop its CHW program and strengthen its maternity and child program (HRSA, 2007).
2.4.3 State and Federal Initiatives Era (1990-1998)

During the State and Federal Initiatives era, support from several states coupled with a few federal bills emphasized the use of CHW interventions. However, none of these bills were successfully passed in both levels of government (HRSA, 2007). With federal and state governments considering initiatives using CHWs as part of the healthcare system, recognition of the benefits of CHWs was gained.

In 1992, the state of Arizona created Arizona Health Start appropriations for CHWs. The program was one of the first to receive ongoing funds (HRSA, 2007). This sort of support nurtured the idea that CHWs can be introduced to the health care system as a way to improve preventative health care programs and the basic health care system at a governmental level.

In 1996, CHW training conferences were being developed and delivered for those in the field (HRSA, 2007). The professional development of CHWs was essential for the field because they provide a level of service that differs from physicians and other healthcare workers. This specialized role needed more attention because CHWs became the link between healthcare providers and the community.

2.4.4 Public Policy Options Era (1999-2006)

During the Public Policy Options era, legislation that involved CHWs was being passed and endorsed. Texas passed the first legislation in 1999 that allowed CHWs to be involved in Medicaid managed care service delivery in some mandated pilot programs (HB-1864, 1999). The enactment of this bill and the subsequent success of the CHWs led other states and federal agencies to follow suit.
Many of the major influential organizations, such as the National Rural Health Association, the American Public Health Association, and the American Association of Diabetes Educators, supported the role of CHWs and the value they are able to provide in the healthcare system (HRSA, 2007). The growing support helped aid the notion that CHWs are needed in the healthcare industry and are able to provide a service that no other healthcare professionals are able to provide.

In 2005, the federal government passed The Patient Navigator Outreach and Chronic Disease Prevention Act. This is considered to be the first piece of federal legislation supporting CHWs (HR-1812, 2005). The model that was outlined in the bill had the primary objective to help prevent or reduce the number of individuals who were slipping through the cracks or receiving poor healthcare experiences (HRSA, 2007). This was just the beginning of a major shift in emphasis on how healthcare should be delivered in the United States.

In 2009, the Department of Labor Bureau of Labor Statistics created a specific occupation for CHWs (United States Department of Labor, 2010). The classification provided CHWs their own distinct job category with specific functions. This was significant for CHWs because it validated their role as part of the healthcare delivery system.

2.5 Factors in Community Health Workers Success

Community health workers are successful when it comes to their mission and objectives for a couple of different reasons. The 2001 study by the United States Agency for International Development called, *Community Health Worker: Incentives and Disincentives*, states there are monetary, nonmonetary, and community-level factors that
affect how CHWs proceed with their tasks and functions. CHWs are able to influence the community and policymakers based on their work in the community (USAID, 2001). They are able to garner support from communities and government leaders to help sustain programs that use CHWs. Having outside support from the community and from the government aids the success of CHWs.

On the individual level, monetary factors can motivate CHWs to do their best in their community. These factors are satisfactory remuneration, workplace benefits, and the amount of resources at their disposal (USAID, 2001). All of these factors give CHWs the sense of having a steady future of paid employment. Also on the individual level, nonmonetary factors that motivate CHWs are community recognition; acquisition of valued skills; personal growth and development; accomplishment; peer support; CHW association; identification and job aids; status within community; preferential treatment; and flexible hours with a clear role (USAID, 2001).

There are several key factors on the community level that allow for success. Factors that influence communities to support and sustain CHW programs are that they are witnessing visible change, contributing to community empowerment, associating with CHWs, and referring successfully to health facilities (USAID, 2001).

CHWs are often the first people to interact with the community, especially the underserved population. Community engagement is important as it is a key stepping stone for building a bridge between primary health care providers and the community. Relationships between the CHWs and the community are important for any program. The level of trust built and maintained by the CHW is important for a successful program.
Trust allows CHWs to interact more frequently with the population that they serve, resulting in better health outcomes.

On the policy level, factors that motivate policymakers and government leaders to create policies and legislation to support CHWs, witnessing visible positive changes in the community, and funding for supervisory activities from government and community (USAID, 2001). Some states, such as New York and California, consider these services provided as billable for reimbursement. All of these factors help aid the progress that CHWs can provide to the community.

CHWs require specialized training. They need formal training in community interaction and population psychology, as well as communication skills. Universities and colleges that provide certificates and degrees for CHWs help legitimize the work that is being done in the field by this profession. Just as in any other profession, properly trained and developed CHWs will be much more effective in their roles.

2.6 Future of CHWs in the United States

The Patient Protection and Affordable Care Act (PPACA), passed in 2010, contains provisions that will impose additional requirements for nonprofit hospitals in order for them to maintain their tax-exempt status. This will create an atmosphere of accountability and transparency for the hospitals when it comes to maintaining their nonprofit status. The new requirements will ensure that these healthcare systems are fulfilling their charitable duties.

To earn or maintain a 501(c)(3) tax-exempt status under the PPACA, healthcare organizations must:
1. conduct a “community health needs assessment” every three years and then adopt and make a strategic plan to meet the health needs of the community. Health experts and community leaders have input in the strategic plan as they represent the community’s interest. The assessment must be made available to the public (found in § 9007 (a) (1) (3)).

2. submit Form 990 to the Internal Revenue Service with an overview on how the organization is addressing those community needs and the reasons why some needs are not being met (found in §9007 (d)).

3. establish a written policy concerning emergency medical care, requiring the organization to provide care for emergency medical conditions regardless of the patient’s ability to pay (found in §9007 (a) (1) (4) (B)).

4. establish a written financial assistance policy, to include:
   a. The criteria for eligibility for financial assistance
   b. The method for applying for financial assistance
   c. The basis for calculating amounts charged to patients
   d. The action to be taken in the event of nonpayment
   e. A description of the procedures to publicize the policy (found in §9007 (a) (1) (4) (A)).

5. limit the amounts charged for emergency or non-emergency medical care to patients eligible for financial assistance to not more than the amount
generally billed and prohibit the use of gross charges (found in § 9007(a)(1)(5), §10903(a)).

6. refrain from engaging in extraordinary billing and collection actions until after reasonable efforts have been made to determine whether a patient is eligible for financial assistance (found in § 9007(a)(1)(6)).

7. provide audited financial statements of the organization (found in § 9007(d)).

Source: PPACA, 2010

In addition to monitoring adherence to the PPACA regulations, the Department of Treasury will conduct an audit of an organization’s community benefit activities once every three years. In §4959 of the PPACA, it states that if an organization does not meet any of the requirements, it will be assessed an excise tax of $50,000 (PPACA, 2010). It will have to report this tax on its tax return. The healthcare organization will then be at risk of losing its tax-exempt status. If a healthcare system loses its status, it will have to pay millions of dollars per year in taxes, most notably property taxes. It would be in the best interest for a healthcare organization to maintain its tax-exempt status and to provide a considerable amount of community benefit.

To meet the requirements for the future, more CHWs may be employed to help an organization to maintain its tax-exempt status by providing community benefit. Not only will this help nonprofit hospitals to maintain their status, but CHWs may help keep the community healthy. CHWs may become a key component in keeping high financial risk people out of the hospital and reducing the number of patients that contribute to accumulating bad debt and loss of Medicaid reimbursement.
The Patient Protection and Affordable Care Act also contains a provision that promotes the creation and use of CHWs through community health programs. Section 5313, also referred to as *Grants to Promote the Community Health Workforce*, authorizes the Director of the Centers for Disease Control and Prevention (CDC) to award grants based on five criteria. The criteria focus on aid to the medically underserved, and promote positive health behavior and outcomes:

1. educate, guide and provide outreach in a community setting regarding health problems;
2. educate and provide guidance regarding effective strategies to promote health behaviors and discourage risky behaviors;
3. educate and provide outreach regarding enrollment in health insurance, including Children's Health Insurance, Medicare and Medicaid;
4. identify, educate, refer and enroll underserved populations to appropriate healthcare agencies and community-based programs to increase access to quality healthcare;
5. educate, guide, and provide home visitations services regarding maternal health and prenatal care.

Source: PPACA (HR-3590) 2010. Sec.399V

2.7 Existing Literature on CBA of CHWs:

Despite the increase in use of CHWs, there are few published studies using a cost-benefit analysis as an economic evaluation of health care. There were no studies found that evaluate CHWs when they interacted with women who were pregnant. Three studies will be used as a point of comparison in an economic evaluation. The programs were
used to increase primary care for underserved men, to reduce the occurrence of asthma related emergency care, and for reduction in care for uncontrolled diabetes.

2.7.1 Increasing Primary Care Use For Underserved Men

Whitley, et al. (2006) conducted a return on investment (ROI) study of a CHW intervention to decrease the overall utilization of urgent care, for expected reductions in overall healthcare costs. From January 1, 2003 to June 30, 2004, CHWs employed by Denver Health Community Voices interacted with 590 underserved men. It was found that the return on investment was 2.28 to 1, with an annual saving of $95,941 (approximately $118,500 in 2013) when compared to underserved men who did not receive program treatment (Whitley, et al., 2006). The program emphasized the increased usage of primary and specialty care with the idea that urgent care, inpatient, and outpatient care would decrease. The authors were able to track primary care, specialty care, emergency care by a medical record number (MRN) assigned to the individuals in the program. Using the MRN, Whitley, et al. were able to track all patient encounters, third party insurance, and reimbursement status.

Using data from nine months prior to invention and nine months after intervention, they were able to analyze pre- and post- intervention data. They examined and compared utilization, charges, and reimbursement data to establish the financial impact of the program (Whitley, et al., 2006). They used charge data because cost data were not available to them at the time of their study. The average costs to operate the program were determined by records of CHW salaries and benefits on top of the program costs (for example: employee mileage reimbursements, bus tokens for clients, visit co-pays, and medical supply costs during the 18-month enrollment time period). The authors
came up with the $95,941 annual savings value by subtracting the monthly savings ($14,224) by program costs ($6,229) after multiplying each value by 12 to represent each month in the year.

2.7.2 Asthma Intervention

Community health workers in the Seattle-King County Health Homes Project and their impact in the intervention to decrease the exposure to indoor asthma triggers was measured in a randomized controlled trial by Krieger et al. (2002). There were 274 households, with children aged 4-12 who had asthma that participated. A household was able to participate if they had a child between the ages of 4 and 12 with a diagnosis of asthma and household income below 200 percent of poverty level. The households were assigned either to a high or low intensity group.

The high intensity group of 110 children received an initial environmental assessment, received individualized action plans, and received additional visits by the CHW over a 12-month period. The interventions were designed to provide education and social support; encouragement of participant actions; provision of materials to reduce exposures; assistance with pest eradication; and advocacy for improved housing conditions. The low intensity group received an initial assessment, a home action plan, limited education, and bedding encasements (Krieger et. al, 2002). After the one year study, the low-intensity group received the full package of resources and education that the high-intensity group received.

The participants reported the number of urgent care services 2 months prior to the program and after program participation. The researchers obtained five sets of unit costs from health service literature and Washington State Medicaid data and adjusted the
values to 2001 prices (Krieger et al., 2002). The data set included unit costs of three services: hospital admissions, emergency department admissions, and clinic visits. The cost of operating the program was found in records containing information on salary and fringe benefits; supplies; rent; travel; office expenses; and indirect charges. In contrast to the low intensity group, the high intensity group of 110 children showed more improvement, with evidence of decreased urgent care use and savings ranging from $57 to $80 (approximately $72 to $109 in 2013 value) per household during a 2 month period (Krieger et al., 2002).

2.7.3 Diabetes

A third CHW outreach program, which targeted African American Medicaid patients in West Baltimore, was evaluated over a 27 month period. The program had CHWs contact patients five or more times through in-home visits or by phone as a way to increase and to improve health care utilization from the targeted population. Thirty-eight CHWs were employed with a caseload from 1 to 10 patients (Fedder et al., 2003).

Maryland Medicaid Claim files were analyzed to compare utilization of emergency rooms, hospitalization, and costs for the participants from the program. It was found that emergency room visits and utilization by this population decreased by 40 percent and 30 percent respectively. Charges to Medicaid decreased, as well as reimbursements, by 27 percent. As a result, there was $2,245 (approximately $3,600 in 2013 value) per individual and a total of $262,080 (approximately $413,000 in 2013 value) in costs saved across 117 patients (Fedder et al., 2003).
2.8 Conclusion

Community health workers are on the frontlines when it comes to bridging the gap between the community and health care providers. CHWs tend to focus on at-risk or underserved populations because these are populations that often seek care only when they are in an emergency. By aiding these individuals to access non-emergency healthcare services more appropriately, health outcomes should improve.

Underserved populations often produce high cost, unreimbursed care. As a result, healthcare organizations try to recoup some of their losses elsewhere and spread it amongst those who have insurance. It is important for the underserved individuals to be identified and covered through a government-sponsored safety net such as Medicaid, so they can access care in a potentially cost-saving manner.

The level of impact that CHWs can provide to the community should be studied to see if there is a value, or even whether the CHW programs are worth the cost to provide the number of benefits. The results of the previously mentioned studies have shown the benefits of using CHWs. It is important for CHWs to interact with pregnant at-risk women during the first trimester. It is posited that benefits will be evident when the program is targeting the prevention of low birth weights (LBW) of infants through intervention. CHWs are also able to enroll the pregnant women into Medicaid and are able to further reduce costs when the women are placed onto a qualified health plan. Therefore, a cost-benefit analysis of a program that uses CHWs in the prevention of LBW infants through intervention is necessary.
Chapter Three: Medicaid and the Potential Benefit of CHWs

CHWs can provide potential benefits for state and federal governments by helping those on Medicaid to become healthier, resulting in reduced costs. For healthcare organizations, it may be beneficial to have CHWs targeting the vulnerable populations that are uninsured to help them enroll in the Medicaid program. This would help ensure that these people are covered by insurance which will help reduce the amount of unreimbursed services being provided.

3.1 Brief History of Medicaid

Medicaid, which was created in 1965 as part of an amendment to the Social Security Act, is currently the largest source of funding for medical and health-related services for people in the United States with limited income (Kaiser Commission, 2012). Medicaid is a joint federal and state program which both entities support and fund (Kaiser Commission, 2012). The program, which originally targeted children in low-income families, now aids low-income adults, including those who are over the age of 65 who are also on Medicare (Center for Medicare and Medicaid Services, 2010). Medicaid is able to provide comprehensive inpatient and outpatient health care coverage, including the costs of service and equipment used. Without this program and the compensation that it can provide, most hospitals would have been responsible for uncompensated care, leading to a much higher debt load.
3.2 Medicaid Enrollment

As of 2011, there were approximately 57 million people enrolled in Medicaid nationwide. In the state of Michigan, there were 1.8 million people enrolled in Medicaid. Currently, the federal government spends approximately $105,103 million for the residents of Michigan while the state of Michigan spends $51,577 million (Kaiser Commission, 2012).

Under PPACA, Medicaid will expand to allow more people to become eligible to participate in this program, if the individual state decides to do so (Kaiser Family Foundation, 2012). In July 2012, the United States Supreme Court ruled that Medicaid Expansion was unconstitutionally coercive of states. The states lacked the proper notice to voluntarily consent, thus allowing them to choose if they want to participate in the planned Medicaid expansion, or not (Kaiser Family Foundation, 2012). As of December 2013, 25 states and Washington D.C. have expanded their Medicaid program (Kaiser Family Foundation, 2013).

3.3 Medicaid Eligibility

As of 2012, incomes up to 100 percent of the federal poverty level are eligible for Medicaid. To meet the current requirements, an individual could make up to $11,170 per year and a couple could make up to $15,130 per year. The expansion will allow people with incomes up to 133 percent of the federal poverty level to be covered under Medicaid (Center for Medicare and Medicaid Services, 2010). The expansion will allow for an estimated 21.3 million additional people, a 41 percent increase, to be covered by 2022 (Kaiser Commission, 2012).
As a result of the increased enrollment, states will spend an estimated $76 billion, approximately a 3 percent increase from 2013 to 2022. Federal spending will also increase. The federal government will spend approximately $952 billion, a 26 percent increase over the same time period (Kaiser Commission, 2012). The Medicaid expansion, in theory, will save healthcare organizations in the 50 states a substantial amount of money. Across the country over the period from 2013 to 2022, healthcare organizations are expected to save or receive $18 billion for care that would have been uncompensated (Kaiser Commission, 2012).

3.4 Uninsured Populations

It is a reasonable assumption that expanded coverage of Medicaid will allow those who are uninsured to seek care, and that there will ultimately be an increase in costs in relation to services rendered for every healthcare system. To reduce the financial burden upon these systems, it is important to provide support to those in the community who are at risk, such as mothers who are more likely to give birth to a low weight newborn. This support would be expected to help lower the cost of care (present and future) and to provide a better health outcome for mother and newborn post-birth.

From the 2012 report titled The Uninsured in Michigan: A Profile, authored by the Michigan Department of Community Health, 13.8 percent of Michigan’s total population was uninsured, while 15.5 percent of individuals under the age of 65 from that population were uninsured in 2009. On average, 18.9 percent of the population under the age of 65 in the United States was uninsured. From 2007 to 2009, ages 0 to 17 had an 11 percent uninsured rate, ages 18 to 34 had a 44.9 percent rate, and ages 35 to 64 had a 44.9
percent uninsured rate in the state of Michigan (Michigan Department of Community Health, 2012).

In Michigan, African Americans and Hispanics were more likely than Caucasians to be uninsured. Twenty percent of African Americans, and 21.9 percent of Hispanics were uninsured, while Caucasians had a 12.5 percent rate. Compared to the United States (African Americans 21.4 percent, Hispanics 33.2 percent), Michigan had a lower uninsured rate (Michigan Department of Community Health, 2012).

The highest level of education received has an impact on whether a person is uninsured or not in the state of Michigan. Six percent of people who hold at least a bachelor’s degree are uninsured, compared to the 33.7 percent who did not attend high school (Michigan Department of Community Health, 2012). In 2009, it was estimated that there were 20,775 people who were uninsured in Muskegon County, the location where this study was conducted. This total represented approximately 14.2 percent of the population (Michigan Department of Community Health, 2012). A reasonable assumption can be made that a majority of these people sought and received uncompensated care. Under the new Medicaid eligibility rules under the PPACA, more people will become eligible for the program, resulting in hospitals receiving some compensation for care provided.

3.5 Changes in Reimbursement Rates

In 2012, Medicaid paid physicians, on average, 66 percent of Medicare fees. The state of Michigan reimbursed, on average, less than 50 percent of fees to physicians accumulated by Medicaid patients. With new regulations and changes on the horizon,
Michigan will have to dedicate more financial resources, as much as a 125 percent increase, to the Medicaid program (Kaiser Commission, 2012).

Starting January 1, 2013, the PPACA will require states to pay at least 100 percent of Medicare physician fees for close to 150 different primary care services provided to Medicaid enrollees (Kaiser Commission, 2012). Physicians who primarily deal with Medicaid patients will be reimbursed at the same level as physicians who deal with Medicare patients. On average, primary care fees will increase by 73 percent nationwide.

Physicians in the specialties of family medicine, general internal medicine, and pediatrics are designated to qualify for the increased fees, and any subspecialists can also receive a higher reimbursement. To qualify for the increased reimbursement rate, physicians must be board-certified and have at least 60 percent of their Medicaid services in the previous year devoted to primary care services (Kaiser Commission, 2012).

3.6 Medicaid in Michigan

3.6.1 Shift From Fee-For-Service To Managed Care

The shift from a fee-for-service (FFS) to a managed care model in Medicaid in the state of Michigan was due to increasing political pressure to reduce spending in the program. Medicaid expenditures had increased from $2.1 billion dollars in 1990 to $4.1 billion dollars in 1995 (Weissert, 2002). The FFS system did little to reduce unnecessary spending, resulting in the higher Medicaid expenditures. The state of Michigan had “little or no ability to control utilization, technology, and other health care cost ‘drivers’ in FFS that result in increased and uncontrollable expenditures” (Michigan Association of Health Plans, 2013, p.15).
The Michigan Department of Management and Budget strongly urged and recommended that the state shift its Medicaid clients from the FFS system, to a capitated managed care program (Weissert, 2002). In the latter model, managed care organizations are paid a fixed amount on a yearly basis to cover the cost of their coverage population. This would require organizations to become more efficient and more accountable when it came to healthcare spending. When Michigan first implemented the changes for the FY 1997-1998 budget, it was found that the state saved $120 million. The savings have grown to between an estimated $350 and $400 million for FY 2010 (Michigan Association of Health Plans, 2013).

Through a more thorough competitive bidding process between the state and managed care organizations (MCOs) (bidding began in 1997-1998, 2000, 2004, and 2009), the state is able to save money. They are able to do this by creating a marketplace environment where organizations bid to provide service in order to receive substantially large payment from the government. The lower the bid amount, the more likely it was that the state and organization would agree to terms. The changes in the system were not only made to reduce costs, but were also made to create a system that had provided a more efficient service for the clients with a higher level of accountability.

3.6.2 Managed Care Organizations in Muskegon County

In the setting of this study, the healthcare system, Mercy Health Partners not only accepts reimbursement from FFS Medicaid, but also receives payment from MCOs that serve the Medicaid population. As of April 2012, there were five organizations that provide coverage for Muskegon County. The organizations and health plans are Meridian Health Plan of Michigan, Molina Healthcare of Michigan, UnitedHealthcare Community
Plan, Priority Health Government Program, and Caresource of Michigan (MDCH, 2013). Meridian, Molina, and Priority Health have a significant market presence in the community (see Table 1).

<table>
<thead>
<tr>
<th>Health Plan</th>
<th>Number of Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meridian Health Plan</td>
<td>12,915</td>
</tr>
<tr>
<td>Molina Healthcare of Michigan</td>
<td>7,500</td>
</tr>
<tr>
<td>Priority Health Government Program</td>
<td>5,721</td>
</tr>
<tr>
<td>UnitedHealthcare Community Plan</td>
<td>1,596</td>
</tr>
<tr>
<td>Caresource of Michigan</td>
<td>541</td>
</tr>
</tbody>
</table>

*Table 1: Health Plan Enrollment, Muskegon County Medicaid Managed Care, 2011*

*Note. Adapted from MDCH April 2012 Enrollment Data*

3.7 Medicaid Eligibility Process In Michigan

The expectant mother would have to visit the Family Independence Agency (FIA) to apply for enrollment into the Medicaid program. Once she applies, the pregnant woman would be placed into the Maternity Outpatient Medical Services (MOMS) program, as shown in Figure 1 (MDCH, 2013). The program provides immediate health coverage for pregnant women. MOMS only provides prenatal care coverage, and is only available during the timeframe in which eligibility is being determined (which is about 45 days in total) (MDCH, 2013). The MOMS program is not MCO sponsored but is a FFS program.
The only information needed to determine Medicaid enrollment is self-declaration by the individual. This helps to determine under which maternity assistance program the individual will be placed. Once eligibility is determined and the applicant receives her Medicaid card, she is placed in the Healthy Kids for Pregnant Women or Group 2 Pregnant Women programs and has to choose a health plan in which to enroll (MDCH, 2013).

The earliest that the mother can choose a health plan is when she receives her determination of eligibility. She has up to 60 days to choose a plan before one is assigned to her by the state (MDCH, 2013). The health plans are operated by managed care organizations, and in Muskegon County, there are 5 in operation. The newborn will be covered on the health plans starting on the first of the next month after the health plan has been chosen.
3.8 Medicaid Sponsored Prenatal and Postnatal Programs in Michigan

3.8.1 Programs for Pregnant Women

Healthy Kids for Pregnant Women program covers citizens or permanent residents of the United States, and the enrollee must be a resident in Michigan. In addition, she must have an income below 150 percent of the federal poverty level. The program coverage includes prenatal checkups and care, lab and x-ray tests, prenatal vitamins, delivery of the baby, and hospital care. For those who are not citizens of the United States, only the delivery of the child and associated hospital care are covered (MDCH, 2013).

Women who exceed the income limit for the Healthy Kids for Pregnant Women program may be eligible to participate in the Group 2 Pregnant Women program. Based on her income level, the mother will be assigned a deductible to cover the medical expenses relating to her pregnancy (MDCH, 2013).

Maternity Outpatient Medical Services (MOMS) is a program that provides immediate health coverage for pregnant women. The program covers outpatient prenatal care while the Medicaid application is pending. Once Medicaid eligibility has been determined, the mother must use a Medicaid plan as coverage for all services provided (MDCH, 2013).

3.8.2 Programs for Newborns

Children are also covered under Medicaid once they are born and are placed into either the Healthy Kids or MIChild program. Like the mothers, placement into the program is dependent on family income.
To qualify for MIChild, the child must be under the age of 19; have no comprehensive health insurance including Medicaid; have a social security number; or be in the process of attaining one; be a United States citizen; and have a monthly family income between 150 and 200 percent of the federal poverty level. The program requires a $10 per month payment for the entire family to have coverage (MDCH, 2013). The coverage includes the same care that is found in the Healthy Kids program.

In the Healthy Kids program, newborns are eligible for up to one year after birth and must be part of families with incomes below 150 percent of the federal poverty level. Children have the option to be covered until the age of 19. The program has no monthly premiums except for small co-pays. Healthy Kids covers ambulance, dental, doctor visits, family planning, health check-ups, hearing and speech, home health care, hospice care, hospital care, immunizations, lab and x-ray tests, nursing home care, medical supplies, medicine, mental health, personal care services, physical therapy, prenatal care services, substance abuse, surgery, vision, and well-child visits (MDCH, 2013).

3.9 Conclusion

It is important for pregnant women to sign up for Medicaid as soon as they become eligible. These programs help reduce negative health outcomes that will result in cost-savings for healthcare organizations that may have to endure potentially high and unnecessary costs otherwise.

Treating women at an earlier stage in their pregnancy increases the chance for a positive health outcome for both the mother and newborn. A healthy, normal birth weight newborn will require less intensive procedures and care compared to a newborn with a low birth weight with birth complications or congenital conditions. This difference
should result in cost-savings. The services provided by programs that care for these women tend to be all-inclusive and help ensure that a healthy outcome for both the mother and newborn occurs.

A cost-benefit analysis of CHWs’ impact on at-risk pregnant women enrolled in Medicaid is needed. This population of women have a low income and are often considered to be at higher socio-economic risk of delivering a low birth weight newborn. As part of the Pregnancy Pathways Program, the CHW will be interacting with women who are on Medicaid.
Chapter Four: CHWs’ Goal to Reduce LBW Occurrences for Low Income Women

There is no hard evidence suggesting that one program or strategy is more effective than the other when it comes to the prevention of low weight births. To provide the best level of service for at-risk women, it would be important to provide a comprehensive program that incorporates improving access to medical care and services, education, and access to substance abuse cessation and prevention programs.

4.1 Improving Access to Medical Care and Health Services

Improving access to medical care and health services for at-risk women, especially during the early stages of pregnancy, will help identify and treat any medical conditions sooner that could affect the pregnancy. Community health workers encourage at-risk women to sign up for Family Planning Waivers so that they are able to have access to reproductive health services such as screening and treatment for HIV/AIDS, cervical cancer, and sexually transmitted diseases (Robert Wood Johnson Foundation, 2001). Medicaid, if allowed by the individual states, can fund programs that deliver nutrition, behavioral health, and case management services for at-risk women.

At-home visitations help ensure that expectant mothers are on the correct path towards delivering a healthy newborn. It was found that the risk of delivering a low birth weight child was lower (at 5.1 percent) for women in a home visiting program, compared to a control group without an intervention (9.8 percent) (Lee et al., 2009). At-home visitation programs with the focus on providing social support, education, and access to health services have shown that they provide a valuable service for the community.
4.2 Promoting Proper Nutrition and Lifestyle

A healthy nutrition regimen and lifestyle will aid the proper development of the fetus and child. There are federal and state funded programs that provide support to ensure that expecting mothers are able to live a healthy lifestyle. For example, the Women, Infant, and Child program (WIC) and folic acid consumption programs help to carry out these measures.

The Women, Infant, and Child program is used primarily to provide nutritional support for low-income women, infants and children. This program helps to provide families with the ability to purchase nutritious foods to enhance diets, to learn how to eat healthy, and refer these individuals to care (Food and Nutrition Services, 2012). Community health workers can help guide at-risk women towards this widely available program.

Programs that educate women about the benefits of folic acid consumption are also important. These programs raise awareness that folic acid prevents birth defects of the brain and spinal cord when taken daily prior to and during the early weeks of pregnancy. Seventy percent of neural tube defect-related births can be prevented through folic acid consumption (Spinal Bifida Association of America, 2012).

4.3 Reduction in Use of Harmful Substances

Alcohol, smoking, and other substances produce a harmful effect on the mother as well to the child. Such strategies as providing education and improving access to cessation programs have been shown to work. It is important for at-risk women to be able to have support from these programs as part of their prenatal care.
Educational programs have been used to help make the community more aware of the harmful effects of smoking and drinking during pregnancy. These education programs have the ability to reach a mass audience in a cost effective way (Davis, 2009). The knowledge gained from these programs can easily be spread throughout the community from those who participated.

Cessation programs can help those who experience substance abuse issues. Programs of this type can help create a structured step-by-step process through at-risk individuals can develop coping mechanisms (Davis, 2009). These specialized programs will create a healthy mother and child before, during, and after the pregnancy. As part of their role, CHWs would refer at-risk individuals to these programs. The services provided by CHWs may help reduce the number of poor pregnancy outcomes.
Chapter Five: Background in Maternal and Newborn Conditions

Women who have a higher number of identified risk factors are more likely to deliver a newborn with a low birth weight or with an adverse health outcome. This chapter details what constitutes a low, normal, or macrosomic birth weight; defines maternal risk factors; and describes a few consequences of having a low birth weight. It is important for CHWs to identify all maternal risk factors and provide a plan to prevent these factors having a negative effect on the newborn.

5.1 Characteristics of Newborn Birth Weight

Newborns are placed into the three categories based on the classification of their weight at birth established by The Centers for Disease Control and Prevention (CDC, 2009). The categories are low, normal, and high-birth weight or macrosomia as defined and recognized by the American College of Obstetricians and Gynecologists (Chatfield, 2001). Newborns with a low or high birth weight are at a higher risk of developing or having problems at birth.

5.1.1 Low Birth Weight

Low birth weight is defined as being of less than 2,500 grams or 5.5 pounds at birth (World Health Organization, 2011). Low birth weight is commonly associated with a preterm birth (birth before 37 weeks of gestation) or restricted intrauterine growth. As a consequence, newborns will have a higher probability of developing cognitive development disorders as well as being prone to chronic diseases. Mothers from lower socio-economic strata are at a higher risk of having a low birth weight infant (UNICEF, 2004). Lower levels of education, poor nutrition and poor maternal health during pregnancy also increase the risk of low birth weight.
Nearly 16 percent of all births worldwide result in an infant with a low-birth weight. Ninety-six percent of low birth weights occur in developing countries where the socio-economic conditions are poor. In 2000, North America had 7.7 percent of births result in a low-birth weight, approximately 343 births out of 4,479. In 2002, the United States, 8.2 percent of all live births resulted in a low birth weight (UNICEF, 2004).

5.1.2 Normal Birth Weight

A normal birth weight ranges from 2,500 grams to 4,499 grams (5.5 pounds to 9.9 pounds) (CDC, 2009). Newborns in this range are often found to be in a healthier state at the time of birth.

5.1.3 High Birth Weight / Macrosomia

High birth weight, or macrosomia (the term that will be used henceforth) does not have a specific or defined birth weight. A birth weight over 4,000 grams (8.8 pounds) or 4,500 grams (9.9 pounds) are two values that are commonly used to define macrosomia. The American College of Obstetricians and Gynecologists supports the use of 4,500 grams as the weight to define whether or not a newborn can be considered as macrosomic, and that value will be used for this study (Chatfield, 2001).

According to the Mayo Clinic, macrosomic newborns can have complications that include higher than normal blood sugar levels, childhood obesity, and from metabolic syndrome (Mayo Clinic, 2012). Also, the mother has a higher chance of having labor problems as the baby can become wedged in the birth canal. Additionally, she may sustain genital tract lacerations; uterine rupture; and bleeding after delivery.
5.2 Maternal Risk Factors

The risk or probability of delivering a low birth weight newborn increases significantly when the mother is exposed to certain risk factors. These include drug use; tobacco use; previous birth in the last 18 months; domestic violence; and having a mental illness. Socio-economic conditions also play a role in the pregnancy of the mother. Such factors as race, marital status, maternal age, education, and income have an influence on the birth weight of the newborn. The maternal risk factors are established and used by the AHRQ as part of the Pathways Model (Agency for Healthcare Research and Quality, 2011).

5.2.1 Drug Use

Cocaine

Several studies have shown that maternal exposure to cocaine has an impact on the birth weight and the development of the newborn (Bateman, Ng, Hansen, Heagarty, 1993; Kliegman, 1994; Shankaran, et al., 2004). Newborns of users have an increased risk of a preterm birth; slowed or lack of physical and mental development; congenital malformations; and vascular and neuro-behavior complications. Researchers have measured a deficit between 44 to 461 grams from newborns who were exposed to cocaine during as pregnancy, compared to non-exposed newborns (Bateman, Ng, Hansen, Heagarty, 1993; Shankaran, et al., 2004).

In a 1993 study, 361 mothers who were users were compared to a group of 387 women who were non-using. It was found that 35 percent of the using women delivered a low-birth child compared to only 10 percent for the non-using group (Bateman, Ng, Hansen & Heagarty, 1993). When the mother was using cocaine near delivery, it was 9.90
times more likely that the newborn would be born with a low birth weight (Kliegman, 1994). Mothers with an unspecified duration or intensity of cocaine use were 2.10 to 4.52 more likely to have a low birth weight child (Kliegman, 1994; Bateman, Ng, Hansen & Heagarty, 1993).

**5.2.2 Alcohol Consumption**

Alcohol consumption during pregnancy can result in birth defects such as fetal alcohol syndrome. Consequences of fetal alcohol syndrome are growth problems, learning and behavior problems, and problems feeding (Little, 1977; Patra, 2011). Other consequence of heavy alcohol use include miscarriages or stillbirths (Patra, 2011).

One of the first studies done on the impact of maternal alcohol consumption was conducted in 1977 using 263 women in Seattle. The researcher found that moderate (0.10 ounces to 1.00 ounces consumed) to heavy drinking (1.00 ounces or more) can result in decreased birth weight for the newborn. She found the consumption of one ounce of alcohol, late in pregnancy, led to a 160 ounce decrease in the birth weight of the child (Little, 1977).

Patra et al. (2011), found that mothers are at higher risk of delivering a low birth weight newborn as their daily alcohol consumption increases. They found that mothers who consumed approximately one alcoholic drink per day (36 grams), had a risk of having a low birth weight newborn equal to those who did not drink during their pregnancy (Patra, 2011). However, mothers who consumed 84 grams per day of alcohol were three times as likely to deliver a low weight newborn. Further, mothers consuming 108 grams of alcohol per day had five times the risk, and those who consumed 120 grams
per day had seven times the risk of delivering a low weight newborn as compared to those who did not consume alcohol (Patra, 2011).

5.2.3 Tobacco Use

Direct maternal smoking as well as exposure to tobacco smoke has been linked to adverse effects on a newborn. Environmental tobacco smoke can cause intrauterine growth retardation resulting in an increased risk for perinatal mortality and morbidity, short stature, cognitive delays, and neurologic disorders (Miyake, 2013; Windham, Hopkins, Fenster & Swan, 2000). The percentage of low birth newborns coming from smokers ranged from 10.3% to 21.4%. This is compared to roughly 7 percent from non-smokers (Higgins et al., 2010; Miyake, 2013). A newborn, on average, can weigh 150-200 grams less than a child of a non-smoking mother (Windham, Hopkins, Fenster & Swan, 2000). Other studies have shown similar results (Higgins et al., 2010; Miyake, 2013).

Windham et al. (2000) also found that non-smokers (2887 women) on average, delivered a newborn weighing 3514 grams. Heavy smokers (87 women, more than 10 cigarettes per day smoked) delivered a newborn weighing 3312.0 grams, on average. This is a 238.3 gram difference in weight compared to newborns from non-smokers. Moderate smokers (186 women, 5-10 cigarettes/day), delivered a newborn weighing 3388 grams, on average; a 144.3 gram difference. Low smokers (180 women, 1-4 cigarettes/day) delivered a newborn weighing, on average, 3411 grams, a 141.4 difference compared to the non-smoking group. (Windham, Hopkins, Fenster & Swan, 2000).

Miyake (2013) measured the effects of smoking during pregnancy and compared the results to non-smokers for first trimester, second, and/or third trimester, and
throughout the pregnancy. Newborns who had non-smoking mothers weighed, on average, 3011 grams. Women who smoked only during the first trimester, delivered a 3028 gram newborn, on average. Mothers who smoked during the second or third trimester but not throughout delivered a newborn weighing, on average, 2958 grams, and those who smoked throughout delivered a 2841 gram child, the lowest birth weight value (Miyake, 2013).

Higgens et al., in their 2010 study, measured newborns from smokers and compared them to a group of newborns whose mothers were in a cessation program. At birth, the newborns from mothers on the cessation program had a 3296 gram weight on average, compared to 3094 grams for the non-treated group. This was a difference of 200 grams (Higgens et al., 2010).

Average birth weight has been found to vary little by level of maternal passive tobacco smoke exposure. Women who were exposed to a moderate level of smoke (1 to 6 hours a day) delivered a newborn weighing an average of 3495.8 grams (n = 625), while the high exposure group (greater than seven hours a day) had a newborn weighing an average of 3516.6 grams (n = 134). The researchers found that the results were not significantly different when compared to the average birth weight of a child from the non-exposed group. The average weight in non-exposed newborns was 3514.1 grams (n = 2887) (Windham, Hopkins, Fenster & Swan, 2000).

5.2.4 Previous Birth in the Last 18 Months

A number of studies have shown that pregnancy intervals have an impact on the outcome of the newborn at birth. In their 2006 meta-analysis, Conde-Agudelo et al., compiled results from 26 cohort and cross-sectional studies. They found that birth
spacing does have an impact on the outcome of the newborn. Inter-pregnancy intervals shorter than 18 months and longer than 5 years between births are associated with low birth weight newborns.

Conde-Agudelo et al. (2006) also found that women with intervals of 6 to 17 months between pregnancies were 8 to 23 percent more likely to have adverse outcomes when giving birth. Starting at 18 months, for every month the pregnancy interval was shortened, the risk of delivering a low birth newborn increased by 3 percent. At the pregnancy interval of three months, the risk of delivering a low weight newborn is 49 percent. The risk of delivering a low birth weight child after nine months is 29 percent (Conde-Agudelo et al., 2006).

Infants born to mothers with intervals longer than 5 years faced a 20 to 43 percent increase in the risk of giving birth to a newborn with an adverse outcome. At year 6, the risk of delivering a low weight newborn would be 11 percent. At year 10, the risk would be 55 percent and at year 12, the risk would be 76 percent (Conde-Agudelo et al., 2006). The increased risk could reflect advancing maternal age.

5.2.5 Domestic Violence

Abuse, either physical or emotional, can have a lasting impact on the mother and newborn. Neggers et al. (2004) studied 3103 women from March 1997 to March 2001. The women filled out an Abuse Assessment Screen in order for the researchers to assess various abuses. Six questions were directed to assess for: emotional abuse (ever); physical abuse (ever); injuries associated with physical abuse within the last year; physical abuse during the pregnancy; sexual abuse (within the last year); and fear of a partner (Neggers et al., 2004).
Expecting mothers who suffered from abuse delivered newborns with an average birth weight of 3221 grams. However, those who were identified as injured due to abuse delivered newborns who were 74 grams lighter when compared to the abused, non-injured group (Neggers et al., 2004). They found that LBW was significantly higher in newborns whose mother was injured from abuse (17.1 percent versus 10.2 percent non-abused). It was found that the risk of preterm delivery was 60 percent higher in abused women compared to women who were not (Neggers et al., 2004).

5.2.6 Mental Illness

Mental illnesses, such as depression and schizophrenia, have an impact on the expecting mother during pregnancy and for the development and growth for the newborn. There is an association between mental illness and growth retardation for the fetus during pregnancy and for the newborn post-birth.

Maternal depression, especially when it is present during the third trimester, has the ability to impact the health outcome of the newborn. Rahman (2004) and Patal (2006) measured the effect of maternal depression on the birth weight of the newborn. Patal found that mothers suffering from depression were 3.29 times more likely to deliver a low birth weight newborn (Patal, 2006). Rahman found that 44 percent of the women experiencing depression gave birth to a low weight newborn and were 2.1 times more likely to do so when compared to non-depressed mothers (Rahman, 2004).

A 2010 study conducted by Lee, Lin, Tang, and Chen supports this claim. Using the Taiwan National Health Insurance Research Dataset, they were able to establish a link between the newborn birth certificate registry and the mothers’ data, to determine if there was an association between mental illness and newborn birth weight. They only studied
women who were diagnosed with bipolar disorder and/or schizophrenia, comparing them to women with no history of mental illnesses. They found that pregnant women with bipolar disorder were more likely to have LBW infants compared to mothers with no history of mental illness (11.8 vs. 6.8 percent). They calculated that the risk of a low weight newborn for women with mental illness was 1.47 times more likely compared to women without mental illness between the ages of 30 to 39. It was found that mothers were 2.80 times more likely to deliver a low birth newborn when they are 40 years and older (Lin, Lee, Tang & Chen YH, 2010).

5.2.7 Race

Several studies have indicated that genetics alone does not have a significant impact on the occurrence of low weight births and that the incidences of low birth weight can mostly be attributed to socio-economic status. However, studies have concluded that African American women tend to have a higher rate of low birth weight newborns compared to Caucasian women, and that socio-economic conditions, such as marital status, maternal age, education, and income, all have an influence more so than race (Collins Jr., 2008; Reichman & Pagnini, 1997; Shah, Zao & Ali, 2011; Shmueli & Cullen, 1999).

5.2.8 Marital Status

Shah et al. (2011) found in their study that maternal marital status affects birth outcomes. They systematically analyzed peer-reviewed articles that took into account the marital status of the mother and the effect that it had on the newborn’s birth weight. Compared to married mothers, unmarried women were 1.46 times more likely to deliver a low birth weight newborn. Single women were 1.65 times and co-habitating women
were 1.15 times more likely to deliver a low birth weight newborn. (Shah, Zao & Ali, 2011).

5.2.9 Maternal Age

Age has an effect on birth weight in a U-shaped pattern. Multiple studies have shown that the individuals under the age of 20 and older than the age of 30 have a higher risk of delivering a low birth newborn while women in their twenties have the lowest risk (Ziadeh, 2001; Reichman & Pagnini, 1997; Shmueli & Cullen, 1999).

Ziadeh measured the incidences of low birth weight newborns among women under the age of 19. The incidences were compared to women between the ages of 20-29. Findings from the study indicated that approximately 6.7% of the women under the age of 19 delivered a low birth weight newborn (Ziadeh, 2001). Only 3.2 percent of women between the ages of 20-29 delivered low birth weight newborns. The under 19 women delivered newborns weighing on average 3015 grams compared to 3148 grams for the 20-29 group (Ziadeh, 2001).

On the opposite end of the spectrum, women who are over the ages of 30 are more likely to deliver a low weight newborn. Cook, in her 2006 meta-analysis, found women over the age of 30 were 1.6 more times likely, and women over the age of 40 were 1.8 times more likely to deliver a low weight newborn (Cook, 2006).

Two studies examined the effects of maternal age on low birth weight and also detailed the incidences of low weight births based by race. There was a 15.4 percent of Caucasian women under the age of 15 who delivered a low birth weight newborn. The percentage of low birth weight births for women under the age of 19 was between 6 and 8 percent, showing a substantial decrease (Reichman & Pagnini, 1997; Shmueli & Cullen,
From the ages 20 to 30, approximately 5 percent of the women in this group delivered a LBW infant. Just as in the Cook study, women after the age of 30 showed a slight increase in percentage of low weight births with a substantial increase after the age of 40 (approximately 12 percent), resulting to a 5 percent increase per year (Reichman & Pagnini, 1997; Shmueli & Cullen, 1999).

In the study, 12.5 percent of African American women under the age of 15 delivered a newborn with a low birth weight. African American women between the ages of 15-40 held a steady low birth weight incidence at or near 11.5 percent (Reichman & Pagnini, 1997). Shmueli and Cullen also found that infant birth weights were not statistically different by age in African American women. An individual under the age of 18 had a 9.5 percent probability of delivering a low birth weight infant. From the age of 18 to 30 the probability of LBW ranged from 9.5 percent to 10.5 percent. For the age 30 to 40, the probability of LBW was 10.5 percent to 12.5 percent (Shmueli & Cullen, 1999).

5.2.10 Education Level

Education, and the amount of schooling an individual has obtained can impact the low birth weight risk. Shmueli and Cullen (1999) found that education has an impact for both Caucasians and African Americans. As a woman completes more years of schooling, the risk or probability of low weight births decreased. The researchers determined that it takes approximately 12 years of schooling to complete and graduate from high school. For those who gave birth before graduating, the probability of a low birth weight infant was significantly higher compared to those who graduated. It was
found that 0 to 11 years of schooling resulted in approximately a 10 percent chance of low weight births.

At 12 years of schooling, the rate of LBW decreased to 7.2 percent (Shmueli & Cullen, 1999). For women with 13 to 15 years of schooling, or partial college attendance, the rate decreases once again to 5.8 percent. At 16 years of schooling, a reasonable assumption could be made that the person would have graduated from school and presumably from college with a bachelor’s degree (Shmueli & Cullen, 1999). The risk of low weight birth decreased 0.3 percent.

5.2.11 Income Level

Limited income can cause the expectant mother to develop poor behaviors, as she does not have the resources to seek healthcare (Singleton, 1994). James W. Collins Jr. (2008), investigated the effect that lifelong residential environments had on low birth weight. He studied women who resided in low-income neighborhoods ($10,000-$21,600) and compared the dataset to women who lived in high-income areas ($46,000 to $150,000) (Collins, Jr., 2008). He found that women who resided in the low-income neighborhoods had a higher low birth weight incidence compared to women in a high-income areas. Non-Latino White women in low-income neighborhoods had a low birth weight incidence of 10.1 percent compared to the 5.1 percent for White women in a high-income area. African American women who resided in low-income areas had a low birth weight incidence of 17 percent compared to 11.7 percent for those in a high-income area (Collins Jr., 2008). Overall, women in low-income neighborhoods were 1.3 times more likely to deliver a low birth weight child compared, to women in high-income neighborhoods (Collins. Jr., 2008).
5.3 Maternal and Newborn Complications

Complications can arise for both the mother and newborn if any medical issues are left untreated. In most cases, post-birth complications can be treated and managed, but left untreated, prenatal complications can be severe enough to cause death for the mother, or newborn, or both.

5.3.1 Maternal Complications

Hypertension

Hypertension can lead to preterm births. It is more likely that the women who experience hypertension will have their labor induced or undergo a caesarian section procedure to prevent any further complications during the pregnancy and delivery. Gestational hypertension, also known as pregnancy induced hypertension, occurs when the pregnant woman has a blood pressure higher than 140 systolic and 90 diastolic without the presence of protein in the urine. It is usually diagnosed after 20 weeks of pregnancy. Approximately 7 percent of all pregnant women experience this condition (BabyCenter Medical Advisory Board, 2011). Pre-eclampsia, another state of hypertension, occurs when the blood pressure is greater than 140/90 and there is protein (>300 mg in a 24-hour period) found in urine after 20 weeks of pregnancy called proteinuria. This condition affects 5 percent of all pregnant women (BabyCenter Medical Advisory Board, n.d.).

For both conditions, the blood vessels are constricted, which results in a high blood pressure and reduced blood flow to the vital organs in the body as well as the uterus. As a consequence, the newborn will experience poor growth, too little amniotic fluid, and placental abruption (occurring when the placenta separates from the uterine
wall before delivery) (BabyCenter Medical Advisory Board, 2013). The newborn will have a higher chance of suffering from chronic health conditions due to a premature birth. There are studies currently being done to investigate the cause of pregnancy-induced hypertension. There is evidence that changes in blood flow to the placenta may trigger a response that includes constricted blood vessels.

**Anemia**

During pregnancy, the body of the pregnant woman will produce more blood cells to support the development of the baby. The red blood cells will provide oxygen to the various tissues and organs in the body. Anemia occurs when there is a deficiency in the amount of red blood cells in the body. There are three types of anemia common in pregnancy: iron-deficiency, folate-deficiency, and vitamin B12 deficiency. All three types result from deficiencies of nutrients that have a vital function in the creation of red blood cells and the delivery of oxygen throughout the body. As a consequence of the deficiencies, the development of the fetus will be slowed, resulting in a poor birth outcome and defects.

Iron-deficiency anemia occurs when the body does not have enough iron to produce enough hemoglobin in the red blood cells. Hemoglobin is the iron-containing oxygen transport protein found in red blood cells. The function of hemoglobin is to transport oxygen from red blood cells to various tissues and organs in the body (Mayo Clinic, 2011). It is the most common type of anemia found in pregnant women.

Folic acid and vitamin B12 help in the production of healthy red blood cells. Folic acid is needed for healthy red blood cell division. Lack of folic acid can result in immature and enlarged cells containing excess hemoglobin (Antony, 2011).
Vitamin B12 provides the metabolic energy that aids in the synthesis of DNA material in red blood cells. The lack of vitamin B12 can result in the formation of abnormal red blood cells (Antony, 2011). Red blood cells then have trouble getting out of the bone marrow and into the blood stream.

_Gestational Diabetes_

Gestational diabetes occurs when a woman develops diabetes during her pregnancy. Between 2 and 10 percent of all women develop this condition. It occurs when there is an abnormal amount of glucose found in the bloodstream. When there is too much glucose in the mother’s bloodstream, there will be a high amount of glucose found in the blood of the fetus as well. This can lead to macrosomia for the newborn. The newborn may be too large to enter the birth canal, therefore, the delivery of the newborn may result in broken bones. Obstetricians may resort to breaking bones so that the newborn can safely pass through the birth canal (National Diabetes Information Clearinghouse, 2012).

Because the newborn is still producing insulin after delivery in response to the extra sugar in the bloodstream while in the womb, the blood sugar level will be below normal values. Serious conditions such as seizures, coma, and brain damage will occur if the condition remains unnoticed or untreated (National Diabetes Information Clearinghouse, 2012).

_Hemorrhaging_

Postpartum hemorrhaging occurs when a woman experiences an uncontrolled loss of blood of at least 500 mL following vaginal delivery, or 1000 mL following cesarean section. Approximately 4 percent of all women in the United States have postpartum
hemorrhaging (Anderson, 2007). The causes of postpartum hemorrhage can be attributed to uterine atony, a retained placenta, trauma, or coagulopathy. Uterine atony is the inability for the uterus to contract and is responsible for 70 percent of all postpartum hemorrhaging. A retained placenta occurs when the placenta does not leave the body. It is responsible for 10 percent of all postpartum hemorrhaging. Trauma occurs when tissue and vessels are damaged during delivery. This accounts for 20 percent of all hemorrhaging. Lastly, coagulopathies are bleeding disorders resulting from failure of clotting. This occurs in one percent of all hemorrhaging cases (Anderson, 2007).

The most common reasons for postpartum hemorrhaging are attributed to (1) women who never gave birth before (nulliparas); (2) women who have had two or more births (multiparas); (3) prolonged and augmented labor; (4) preeclampsia; (5) undergoing a surgical incision of the perineum to enlarge the vagina in order to facilitate the delivery of the child; (6) multiple infant pregnancies; (7) forceps or vacuum delivery; (8) Asian or Hispanic ethnicity; and (9) retained placenta (Anderson, 2007).

**Depression**

Depression can lead to a higher risk of a preterm or low birth weight delivery. Kurki et al. (2000) investigated the effect that depression has on the newborn when the mother experiences symptoms during pregnancy. Using records of 623 nulliparous women with a single child birth, Kurki et al. measured the number of depression diagnoses between 10 to 17 weeks of gestation and delivery. Of the women studied, 28 (4.5 percent) women developed preeclampsia, 185 (30 percent) women exhibited symptoms of depression, and 99 (16 percent) women showed signs of anxiety. Kurki found that depression or anxiety or both were associated with an increased risk for
preeclampsia (odds-ratio of 3.1; 95 percent confidence interval of 1.4, 6.9) (Kurki, 2000). It was found that newborns were at a high risk for either preterm or low birth weight at delivery if the mother was experiencing symptoms of depression.

5.3.2 Newborn Complications

Cerebral Palsy

Jianmeng, Song, and Qing in their 1999 study Low Birth Weight and Cerebral Palsy found that the prevalence of cerebral palsy for children with a low birth weight was much higher compared to children with a normal birth weight. Using information from 388,192 children under the age of seven years, they found that children weighing under 2,500 grams contributed 19.4 percent to the total cerebral palsy diagnoses. Normal weight newborns contributed 1.2 percent to the cerebral palsy diagnosis (Jianmeng, Song & Qing, 1999).

Respiratory Problems

A potential life-long problem for a low birth weight newborn is respiratory problems. Walter et al. (2009) found that newborns who were born with a low birth weight were at-risk for increased hospitalization throughout their entire adulthood compared to those newborns with a normal birth weight. Using hospitalization records from 1998 to 2007, the researchers used information from individuals born from 1980 to 1988 who were diagnosed with having a low birth weight and determined if they developed a respiratory illness. These 4674 individuals with a low birth weight were compared to 18,445 individuals who were considered to have a normal birth weight (Walter, Ehlenback, Hotchkin, Chien & Koepsell, 2009). The authors found that a low birth weight individual had a 34 to 85 percent higher hospitalization rate for respiratory
illness compared to normal newborns. They proposed that low birth weight newborns lacked lung development and suffered from respiratory illnesses.

*Hypertension*

Curhan et al., in a 1996 study, found that newborns with low birth weight were more likely to develop hypertension compared to their normal newborn counterparts. Using information received from 51,529 male dentists, optometrists, osteopaths, pharmacists, podiatrists, and veterinarians between the ages of 40 and 75 in 1986, they were able to determine a link between birth weight and their current blood pressure. Hypertension is considered to be 140/90 mmHg or higher. They calculated the age-adjusted odds ratio to be 1.25 (Curhan et al., 1996). Birth weight and hypertension had an inverse relationship, as birth weight increased, the odds ratio value decreased.

*Diabetes*

As part of the same study, Curhan determined the odds ratio for the occurrence of diabetes in relation to birth weight. He found that there was also an inverse relationship between diabetes and birth weight: 1.75 odds ratio value for individuals identified in the low birth weight category; and 1.17 odds ratio value for those between 5.5 to 6.9 pounds (Curhan et al., 1996).

**5.4 Conclusion**

Having a program that incorporates practices and strategies that reduce the number of low weight and high risk births will help produce a healthier mother and newborn. CHWs can provide a comprehensive service to the at-risk women and CHWs can always direct individuals to a more specialized program. They are able to provide guidance and support based for at-risk women on their various individual needs.
Maternal risk factors can be used as a good indicator to predict if the mother is at an increased risk for delivering a low birth weight child. The Pregnancy Pathways Pilot Program at The Muskegon Community Health Project is an intervention program that aims to reduce the risk, defined by the AHRQ, for delivery of a low birth weight child, and to improve the chances of the delivery of a healthy newborn. Early intervention is crucial for the success for both the mother and for the program.
Chapter Six: Pregnancy Pathways Pilot Program Description and Purpose

The following Pregnancy Pathways Pilot Program description and purpose was taken from Muskegon Community Health Project’s grant narrative to Trinity Health’s Call-To-Care fund:

The Muskegon Community Health Project’s (MCHP) Muskegon Area Pregnancy Pathways Pilot Project focuses on providing community care coordination services and risk reduction education to low-income, pregnant women in Muskegon County. Many of these women have risk factors due to their poverty, young age, race or ethnicity, substance abuse, exposure to lead and other environmental hazards, as well as family structure. These risk factors also impact the initiation and adequacy of prenatal, peri-natal, and post-natal care received, which are important indicators of low birth weight, premature birth, postnatal infant health and infant mortality.

The project uses the Ohio Community Health Access Project “Pathways” model, developed by Dr. Mark Redding, to facilitate access to adequate medical care and education for at-risk, low-income pregnant women, and ensure positive health outcomes. Dr. Redding’s model is an AHRQ a “national innovation” best practice (Agency for Healthcare Research and Quality, 2011).

The Muskegon Area Pregnancy Pathways Pilot Project initially began in Muskegon County in April 2011, as a small pilot project funded by a Michigan Chapter Grant from the March of Dimes with a $25,000 dollar grant. The program addresses a significant health problem in Mercy Health Partners’ service area: the
high incidence of low birth weight babies, especially born to teen age, minority and low-income mothers.

The project focuses on areas that exhibit high rates of poverty, low birth weight, teen pregnancy, sexually transmitted diseases, and that show high expenditure of charitable care. It builds upon the use of CHWs to connect women to pre- and post-natal care, ancillary health and social service support services through “care pathways,” to produce healthy outcomes. The model promotes timely, efficient care coordination and prevents service duplication through a network of agencies involved in providing pre and post-natal care (MCHP, 2012).
Chapter Seven: Methodology

7.1 Case Study Method

This study used the case study method as proposed by Robert K. Yin. Case studies are preferred when “how” or “why” questions are being asked and that “the investigator has little control over events and the focus is on contemporary phenomenon within a real-life context” (Yin, 1994). This case study used archival records from Mercy Health Partners and Muskegon Community Health Project from 2011-2012. The question of this study was to measure the effects of the Pregnancy Pathways Pilot Program on at-risk pregnant women in Muskegon County who are Medicaid eligible. The design of the research project followed Robert K. Yin’s methods and has three components. As listed by Robert K. Yin in *Case Study Research: Design and Methods*, the case study contained the study questions, propositions, and the units of analysis. These components are explained in detail later in this section.

Yin also talks about two components, in less detail, *the logic linking the data to the propositions* and *the criteria for interpreting the findings*. He states that these items should “represent the data analysis steps in case study research and a research design should lay the foundations for this analysis” (Yin, 1994, p. 25). The two components are combined to help explain the reasoning behind the proposition and how it was analyzed.

7.1.1 First Component: The Study Question

The purpose of the study question was to propose the how and the why to a problem or experiment. The questions proposed by the case study was used as an explanatory measure of an operational link of the Muskegon Community Health Project
over the one year time period. The “how” or “why” question will help explain a set of events over which the investigator has little or no control (Yin, 1994).

7.1.2 Second Component: The Proposition

Even though one of the study questions asks whether or not CHWs help reduce overall costs and occurrence of low birth weight children, the participants can be compared to multiple groups of people who are part of the control group (which will be discussed later). The study proposition directs the attention of the reader to something that should examined more closely within the study (Yin, 1994). It is important to explore as many relevant issues as possible.

7.1.3 Third Component: Unit of Analysis

The third component, unit of analysis, defines what ultimately is being studied. The unit of analysis would need the selection of the appropriate results from the primary research question.

7.2 Research Questions For This Study

This study answered two general questions:

1. Can CHWs that target at-risk pregnant women improve upon the birth outcomes of the participants and the newborn?

2. How much cost-savings is being generated by the program?

The more, in-depth study questions were:

1. how much of a difference, if any, occurred in the birth outcomes of newborns from at-risk pregnant women in the program, compared to < 2,500 gram newborns with issues from women in a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County?
2. how much of a difference, if any, occurred in the birth outcomes of the newborns from the at-risk pregnant women in the program, compared to 2,500–4,500 gram healthy newborns from women in a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County?

3. how much of a difference, if any, occurred in cost-savings of newborns delivered from the at-risk pregnant women in the program, compared to < 2,500 gram neonates with problems from women on Medicaid in Muskegon County?

4. how much of a difference, if any, occurred in cost-savings of newborns delivered from the at-risk pregnant women in the program, compared to 2,500-4,500 gram healthy newborns from women on Medicaid in Muskegon County?

5. how much of a difference, if any, occurred in cost-savings for the at-risk women who were pregnant in the program compared to women on Medicaid who delivered < 2,500 gram neonates with problems in Muskegon County?

6. how much of a difference, if any, occurred in cost-savings for the at-risk women who were pregnant in the program compared to women who delivered 2,500 – 4,500 gram healthy newborns and were on Medicaid in Muskegon County?
7.3 Proposition Used In This Study

Proposition #1: Community Health Worker engagement using the Pathways Model produces a better overall health outcome for the newborn at birth compared to low birth weight newborns in the community which will reduce costs and generate savings.

Unit of Analysis: Newborn Outcomes

Community health workers have the ability to influence the health of the newborn, through case management, resulting in a positive outcome. The positive health outcomes, as a result, will reduce cost and generate savings. The CHW will be able to direct the individual to programs in the community for needs outside health care and will ensure that the participant will maintain her prenatal care. As a result, when comparing participant newborns with a low birth weight (<2500 grams) to newborns born with a birth weight between 2500 and 4500 grams, the information will help determine or paint a clearer picture whether newborns from the participants in the program are exceeding those that are not a result from the community health worker’s programming.

7.4 Study Location: Muskegon County Area Profile

According to the 2010 United States Census Bureau, Muskegon County has a total population of 172,188 people. Of this population, 137,679 (79.96 percent of the total population) were identified as Caucasian, 24,882 (14.45 percent) were African American, and 8,261 (4.80 percent) were Hispanic. The racial characteristics of the area is mostly composed of Caucasians and African Americans, making up nearly 95 percent of the population. Details are found in Table 2.
### Table 2: Racial Characteristics of Muskegon County Residents, 2010

<table>
<thead>
<tr>
<th>Race</th>
<th>Population</th>
<th>Percentage of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>137,679</td>
<td>79.96</td>
</tr>
<tr>
<td>African American</td>
<td>24,882</td>
<td>14.45</td>
</tr>
<tr>
<td>Hispanic</td>
<td>8,261</td>
<td>4.80</td>
</tr>
<tr>
<td>Other</td>
<td>1,366</td>
<td>0.79</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>172,188</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: United States Census Bureau, 2010

In 2010, the per capita income for an individual was $19,327. The median for the income earned was $26,226 for males and $20,123 for females. The mean and median household income totals for the area was $50,223 and $38,621. The median income for Caucasians was $42,151, for African Americans was $21,236, and $30,784 for Hispanics.

The total individual population that was considered to be at or below the poverty line was 35,270 (21.10 percent of the population). There were 8,245 (17.67 percent) families in Muskegon County with incomes at or below the poverty line.

Individuals living in Muskegon County are poorer compared to those living elsewhere in Michigan and in the United States by approximately $5,000-$8,000. Caucasians in the area have a higher income, nearly 1.5 times more than Hispanics, and twice as much as African Americans.
Table 3: Data For Muskegon County, 2010

<table>
<thead>
<tr>
<th></th>
<th>Muskegon County</th>
<th>State of Michigan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Income</td>
<td>$19,347</td>
<td>$23,622</td>
<td>$26,059</td>
</tr>
<tr>
<td>Individual Median</td>
<td>$26,226 / $20,123</td>
<td>$31,624 / $21,460</td>
<td>$33,276 / $24,157</td>
</tr>
<tr>
<td>Income (Male/Female)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Income</td>
<td>$50,223 / $38,621</td>
<td>$59,772 / $45,413</td>
<td>$68,259 / $50,046</td>
</tr>
<tr>
<td>(Mean/Median)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Median Income by Race

<table>
<thead>
<tr>
<th>Race</th>
<th>Muskegon County</th>
<th>State of Michigan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>$42,151</td>
<td>$48,125</td>
<td>$52,480</td>
</tr>
<tr>
<td>African American</td>
<td>$21,236</td>
<td>$28,718</td>
<td>$33,578</td>
</tr>
<tr>
<td>Hispanic</td>
<td>$30,784</td>
<td>$36,355</td>
<td>$40,165</td>
</tr>
</tbody>
</table>

Number (Percent) of Population in Poverty in Muskegon County

<table>
<thead>
<tr>
<th>Population</th>
<th>Muskegon County</th>
<th>State of Michigan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals in</td>
<td>35,290 (21.10)</td>
<td>16.76 percent</td>
<td>15.33 percent</td>
</tr>
<tr>
<td>Poverty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Families in Poverty</td>
<td>8,245 (17.67)</td>
<td>17.07 percent</td>
<td>11.28 percent</td>
</tr>
</tbody>
</table>

-Source: United States Census Bureau, 2010

According to the data provided by the Michigan Department of Community Health, Muskegon County had 198 low-weight births or a total of 8.7 percent of births.

The City of Muskegon had 87 (9.2 percent) of those births.

Table 4: Number (Percent) of Low Birth Weight in Muskegon County

<table>
<thead>
<tr>
<th>Population</th>
<th>City of Muskegon</th>
<th>Muskegon County</th>
<th>State of Michigan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Low-Birth</td>
<td>87 (9.2)</td>
<td>198 (8.7)</td>
<td>9,957 (8.5)</td>
<td>8.3 percent</td>
</tr>
<tr>
<td>weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Source: Michigan Department of Community Health, 2010

79
7.5 Participants Profile

In order for the research goals to be met, an empirical case study was conducted. The participants performed tasks outlined by the Muskegon Community Health Project under their own free will and discretion. The details of the participants’ characteristics are as follows.

The pilot program had a total of 15 women enrolled. Information for 7 women were recovered and were used as part of this study. The women were chosen because they fell under one or more risk factor groups associated with low-birth weight pregnancies, and were Medicaid eligible. The other 8 women were not included as part of the study as they either did not complete the program or the claim data was not found.

The participants were recruited through their collaborating partners: Muskegon Family Care, Hackley Community Center, Muskegon County Department of Human Services, Muskegon Public, Oakridge Public, and the Reeths-Puffer Public School district\(^1\). The Muskegon Community Health Project has been actively engaging students and teens at Muskegon High School and the Teen Health Center at the Hackley Community Center. The Department of Human Services and the Federal Qualified Health Center (FQHC) refers women of all ages to the MCHP for walk-in or in-house consultation. MCHP also reaches out to women through outreach events in the community. Women who join the program, free of charge, have access to a prenatal curriculum, the identification of volunteer nurses and nutritionists, outreach and

\(^1\) Muskegon Family Care and Hackley Family Center are both Federally Qualified Health Centers (FQHC).
educational materials in various languages, access to specific community resources (for example: food, housing, and basic living necessities).

Each participant were exposed to at least one of the following risk factors defined by the AHRQ:

1. Low income (having a gross monthly income that must be 130 percent or less of the federal poverty guideline. Net monthly income must be 100 percent or less of the federal poverty guideline);
2. Unwanted or unplanned pregnancy;
3. Unmarried;
4. No transportation or lack of access to a car;
5. Residing in ZIP code with history of high percentage of low birth weight;
6. No insurance;
7. Personal problems (any type of issue that was pertinent to client that is negatively impacting her life, whether it was relational, financial, medical, etc.);
8. Need translation service;
9. Tobacco use;
10. Homelessness (absence of a permanent or reliable address, temporary housing situations lasting more than three days, living in a public shelter, vehicle, or on the street);
11. Prior poor birth outcomes;
12. Women with a previous birth in the last 18 months.

-Source: Muskegon Community Health Project, 2012
Table 5 details the demographics of the participants in the Pregnancy Pathways Pilot Program. The demographics of the participants used in the study are similar to those found for the dropped participants. Majority of the participants were between the ages of 15-19 and had a less than a high school degree or General Education Development (GED) certification. The racial demographics are evenly spread among African Americans, Caucasians, and Hispanics. Common risk factors amongst the participants were that they had a net income 100 percent below the federal poverty level, an unwanted or unplanned pregnancy, unmarried, and a lack of access to reliable transportation.
Table 5: Demographics of Participants in Program

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Study Participants</th>
<th>Dropped Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>20-24</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25-30</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Age 31 and Over</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>Study Participants</th>
<th>Dropped Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Caucasian</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Study Participants</th>
<th>Dropped Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Income</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Unwanted/Unplanned Pregnancy</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Unmarried</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>No Transportation</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Residing in ZIP Code with</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>History of High Percentage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of Low-Birth Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Insurance</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Personal Problems</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Need Translation Service</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Tobacco Use</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Homelessness</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Prior Poor Birth Outcomes</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Women with Previous Birth</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>in the Last 18 Months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor Health of Mother</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Mental Illness</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Unaware of Pregnancy</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Level of Education</th>
<th>Study Participants</th>
<th>Dropped Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed Less Than High</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>School/GED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School/GED</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

- Source: Muskegon Community Health Project, 2012
7.6 Institutional Review Board Approval

This study was exempt from an Institutional Review Board approval.

7.7 Data Collection

To calculate the cost-benefit ratio of the Pregnancy Pathways Pilot Program, two types of data were needed; program and claims data. Data was acquired from Mercy Health Partners and included information regarding age, race, gender, admission type, length of admission, diagnosis-related group used for billing purposes, newborns birth weight and condition, and payer type. The data also provided information on the total cost, total charge, payment received, and length of stay due to the pregnancy.

Program data from the Pregnancy Pathways Program recorded the education level for program participants, risk factors, and the week of gestation at enrollment into the program, and at the time of delivery. This additional information was not tracked or provided for Mercy Health Partners for the entire population. Therefore, the information was compared on a national level for further analysis.

The participants from the Pregnancy Pathways Program were identified from the data provided by the Mercy Health Partners. The data contained information from mothers who received care within the system. If the mother delivered outside of the system, information was not available.

7.8 Classification of Newborn Condition

Within the birth weight classification, the newborns were categorized based on their condition at birth. The newborns were placed into one of three categories; neonates who died, neonate with problems, or normal newborns. As part of the classifications, abortions were also included. Abortion data were used to compare outcomes only, not
cost. It is important to show the health of the newborn within his/her respective birth weight classifications. For example, a newborn who had a normal birth weight but either died or had problems. On the other hand, a newborn with a low birth weight may have been considered to be a normal newborn. The ICD-9 DRG codes assigned to the newborn were found from the data given by Mercy Health Partners.

7.8.1 Abortion

It is important to include any abortions and the costs associated with them for the study. All of the abortions were placed into two diagnosis-related groups, 770 (Abortion with Dilation and Curettage) or 779 (Abortion without Dilation and Curettage). For this study, it was important to classify the type of abortion based on the ICD-9 code and to separate them from each other. Table 6 contains a list and description of the four ICD-9 codes relating to abortions. The four classifications are Missed Abortions (ICD-9 Code 632), Spontaneous Abortion (ICD-9 Code 634), Legally Induced Abortion (ICD-9 Code 635), and Unspecified Abortions (ICD-9 Code 637).

Missed and spontaneous abortions will be interpreted as a non-choice procedure and will be the focal point. Legally induced and unspecified abortions will not be used because it is either an abortion by choice or it does not have a specific classification.

<table>
<thead>
<tr>
<th>Table 6: Abortion ICD-9 Code Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICD-9 Code</strong></td>
</tr>
<tr>
<td>632</td>
</tr>
<tr>
<td>634</td>
</tr>
<tr>
<td>635</td>
</tr>
<tr>
<td>637</td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
7.8.2 Newborn MS-DRG Classification

Table 7 contains a list of MS-DRG Code Descriptions. Neonates who died have only one diagnosis-related group classification. Code 789 described neonates that died or were transferred to another acute care facility. Neonates with problems have four diagnosis-related group codes and descriptions: prematurity with major problems; prematurity without major problems; full term neonate with major problems; and neonate with other significant problems. Code 795 is a code that describes normal newborns.

<table>
<thead>
<tr>
<th>Diagnosis Related Group Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>789</td>
<td>Neonates, Died or Transferred To Another Acute Care Facility</td>
</tr>
<tr>
<td>791</td>
<td>Prematurity with Major Problems</td>
</tr>
<tr>
<td>792</td>
<td>Prematurity without Major Problems</td>
</tr>
<tr>
<td>793</td>
<td>Full Term Neonate with Major Problems</td>
</tr>
<tr>
<td>794</td>
<td>Neonate with Other Significant Problems</td>
</tr>
<tr>
<td>795</td>
<td>Normal Newborn</td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data

7.9 Data Conversion and Data Identification

Grams were used as the official unit of measurement of newborn weight for this study. For some instances, data had to be converted from pounds and/or ounces into grams. The reason behind the conversion to grams was to have all data in a globally acceptable value. The following information details how much a pound or ounce is in grams.
7.9.1 Birth Weight Conversion

All birth weight was converted from United States pounds to grams. *Table 8* has the conversion rate.

<table>
<thead>
<tr>
<th>Table 8: Birth Weight Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Customary System Measurement Value</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>1 Pound (lb)</td>
</tr>
<tr>
<td>1 Ounce (oz)</td>
</tr>
</tbody>
</table>

7.9.2 Data Identification

Birth weight and newborn condition each had a code assigned to them. After birth weight and newborn condition had their individual numbers, the numbers were combined to create a new number that classified newborn condition by their respective birth weight. *Table 9* explains the coded data and the classification of the newborns.

<table>
<thead>
<tr>
<th>Table 9: Newborn Birth Weight and Condition Coded Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight and Condition</td>
</tr>
<tr>
<td>&lt;2500 grams Newborns who Died</td>
</tr>
<tr>
<td>&lt;2500 grams Neonates with Problems</td>
</tr>
<tr>
<td>&lt;2500 grams Normal Newborns</td>
</tr>
<tr>
<td>2500 – 4500 grams Newborns who Died</td>
</tr>
<tr>
<td>2500 – 4500 grams Neonates with Problems</td>
</tr>
<tr>
<td>2500 – 4500 grams Normal Newborns</td>
</tr>
<tr>
<td>&gt;2500 grams Newborns who Died</td>
</tr>
<tr>
<td>&gt;2500 grams Neonates with Problems</td>
</tr>
<tr>
<td>&gt;2500 grams Normal Newborns</td>
</tr>
</tbody>
</table>
7.10 Tracking of Mother and Newborn

To link the newborn to the mother, the mother’s bill number was used as the common identifier. Using the mother’s bill number found with the newborn, a simple look up was done to determine the mother and the type of delivery that had occurred.

7.11 Software Used for Analysis

Data were collected and sorted using Microsoft Excel. After the data were sorted, the Excel document was uploaded into IBM SPSS Statistics version 21 for analysis.

7.12 Cost-Benefit Analysis Rationalization

A cost-benefit analysis, according to welfare economic theory, is the net benefits to society from a project or policy. It is the sum of each individual’s willingness to pay for an object or service (Mishan and Quah, 2007). In other words, the impact from a program will need to be evaluated through its costs to generate a specific output or benefit.

The cost-benefit analysis used costs and benefits that have an impact or value to an individual or society. Another requirement for the CBA to be successful is that all costs and benefits can be measured; and in this instance, a monetary value is to be associated with each (Mishan and Quah, 2007).

7.12.1 Cost Effectiveness Analysis

Cost Effectiveness Analysis (CEA) is another method that can compare costs and outcomes of programs and events. CEA is a widely accepted methodology for measurement, which is supported by the Agency for Healthcare Research and Quality
(AHRQ, 2001) and the United States Public Health Service (Weinstein et al., 1996). The analysis assesses cost per unit of health effect such as the quality of years of life gained.

The methodology is not universally used to make health care resource allocation decisions due to problems of quality, comparability, and the length of time required to capture complete financial data (Whitley, 2006). In addition, Mishan and Quan believe that as “useful as cost-effectiveness analysis can be, a cost-benefit analysis is effectively superior” (Mishan and Quan, 2007, p. 10).

### 7.12.2 Pathways Data CBA Details

The analysis of the Muskegon Area Pregnancy Pathways Program measured the impact created by the costs and benefits being provided during the one year pilot program and the cost-benefit analysis was used as the analysis tool of choice.

The identification of the costs and benefits was essential for the thesis. The list of costs and benefits, found in Table 10, are provided by both the Muskegon Community Health Project and by the Mercy Health Partners.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Costs</td>
<td>Reduction in Low Birth Weight Outcomes</td>
</tr>
<tr>
<td>Operation and Maintenance Costs</td>
<td>Reduction/Potential Savings in Immediate and Future Medical Costs/Events</td>
</tr>
<tr>
<td>In-Kind Donations</td>
<td></td>
</tr>
<tr>
<td>Community Health Worker Salary</td>
<td></td>
</tr>
<tr>
<td>Opportunity Costs</td>
<td></td>
</tr>
<tr>
<td>Clinical Costs for Mother and Newborn</td>
<td></td>
</tr>
</tbody>
</table>

It is important to be able to monetize all costs and benefits associated to the Pregnancy Pathways Program in order to conduct a CBA. It is quite impossible to identify and determine all costs and benefits being provided. The cost-benefit analysis
was able to make a measurable estimation that can be close or near to the actual cost and benefit.

7.12.3 Costs

Expenditures such as salaries, purchase of rental space and equipment, operating costs of equipment, and the costs of material supplies represented the direct costs. Those costs can be represented with monetary value and are directly responsible for the operation of the program (Mishan and Quah, 2007). There are three types of direct costs that can be measured in the cost-benefit analysis; investment or start-up, operating and maintenance, and clinical.

Indirect costs represent resources that are not budgeted but are present during operating the program (Mishan and Quah, 2007). The costs can represent the amount of time the CHW spent driving to a case or the amount of time doing paperwork. The resources used on activities other than participant interaction represents an indirect cost. Opportunity Costs are an indirect cost and will not be assigned to the program. All figures and costs were be measured in United States dollars.

Investment Costs

The costs associated with starting up this program were fairly minimal. Muskegon Community Health Project already has space and material due to the functions of the various other programs that the organization maintains. Funding for the pilot program came from a $25,000 Michigan Chapter Grant from the March of Dimes.

Prior to the implementation of the program, a Community Health Needs Assessment was completed. Mercy Health Partner's 2009 Community Health Needs Assessment, prepared by MCHP, employed an epidemiologist to gather data about the
prevalence of low weight births in the community and to see if a program like this would be needed for the community.

It cost Mercy Health Partners $26,000 to prepare its Community Health Needs Assessment report, which is required under the Affordable Care Act. For this particular study and thesis, I did not include the costs of the Community Health Assessment as part of the cost portion of the CBA, as it is not a direct cost for the Pregnancy Pathways Pilot Program.

The rationale behind the decision was that in reality, the cost of the Community Health Assessment would have been a requirement regardless of whether the Pathways Project existed or not. The purpose of the report was different from the program. The Pregnancy Pathway Pilot Program was developed because of the Community Health Assessment report.

The objective of this study was to view the overall operating and maintenance costs in relation to running the program. However, it was important to note that there was an additional, indirect investment cost and should be noted in the study and for this thesis.

*Operation and Maintenance Costs*

The costs that can be attributed to Operation and Maintenance Costs will make up the majority of the costs associated with the program. This included all expenses (such as rent, security, cleaning, utilities, and storage), operating costs (such as supplies, technical support, and postage), professional fees (such as bookkeeping and auditing), and compensation fees (including CHW salaries). The costs are exact and are reliable
representation of costs and expenditures for the program. The data were retrieved from Muskegon Community Health Project.

**Clinical Costs**

Clinical costs can be defined as the costs associated with the care for the mother and newborn. The costs provided are an aggregate total of all the procedures and tests done during and immediately after delivery. The data was retrieved from Mercy Health Partners through their electronic medical records claims data.

**Opportunity Costs**

Opportunity Cost are much harder to define and to track. Opportunity costs are any activity measured in terms of value of the next best alternative that is not chosen. It is the sacrifice related to the second best choice available. An example of an opportunity cost would be the CHWs taking time out of their normal schedules to do administrative work instead of providing a service to the at-risk women in the community. There was no available data, and could not be tracked.

**7.12.4 Benefits**

There are two measurable benefits that was identified for the study; the reduction in the occurrences of low weight births, and the reduction in medical costs.

**The Reduction In The Occurrences of Low Birth Weight Babies**

This outcome was the primary benefit that was measured. Under reasonable assumptions, supported by literature and prior research, the cost to care for healthy newborns was lower than for neonates with problems. Records provided by Mercy Health Partners were used to determine the LBW rate during the duration of the pilot program. Hospitalization records were used to determine the costs for those who participated in the
program compared to those who did not. Rates were determined by Diagnosis-Related Groups (DRGs) and by the payments made by private and public payers. The savings were considered as benefits in the analysis and were calculated in United States dollars.

**Reduction In Medical Costs**

Secondary, archival data can be used as part of the CBA. Through the tracking of costs associated with diagnosis related groups assigned to low weight newborns and normal newborns (the mother of the newborn was also tracked) over a defined period of time, illustrated the impact of the program. Hospitalization records were used to determine the costs avoided for any procedures done, emergency room utilization, and the number and duration of any hospitalization due to a low-birth weight newborn. The savings were considered as a benefit in the analysis and was calculated in United States dollars.

**7.12.5 Calculating Net Present Value**

The net present value gives the best possible answer to whether a project improves social welfare. To calculate the benefit-cost ratio, the NPV of the benefits were divided by the NPV of costs.

*Figure 2: Net Present Value Equation*

\[
NPV(i) = \sum_{t=0}^{N} \frac{R_t}{(1 + i)^t}
\]

| NPV = Net Present Value |
| t = Time of the Cash Flow |
| i = Discount rate |
| \(R_t\) = The Net Cash Flow at Time \(t\) |

*Note: Adapted from Mishan and Quah, 2007.*
Table 11: Net Present Value Decision Rule

<table>
<thead>
<tr>
<th>NPV &gt; $0</th>
<th>Invest in the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV = $0</td>
<td>Organization can either invest or stop investing in the project</td>
</tr>
<tr>
<td>NPV &lt; $0</td>
<td>Organization should stop investing in the project</td>
</tr>
</tbody>
</table>

Note: Adapted from Mishan and Quah, 2007.

The Net Present Value Decision Rule, as shown in Table 11, can be used as the main parameter to make a decision whether or not to invest capital into the program. This rule supports good program investment decisions.

7.12.6 Social Discount Rate

To calculate all monetary values to present value, a social discount rate was needed to be determined. This presented all costs and benefits in a present state. The Health Economic Resource Center recommends that a discount rate of 5 percent should be used (Health Economic Resource Center, n.d.) This value was deemed appropriate by the Public Health Service Panel on Cost-Effectiveness in Medicine (Weinstein et al., 1996).

7.12.7 Inflation

As part of the study, the costs of the program delivery were compared to values from 2008 to 2011. Past year values were adjusted for inflation so that the values could be standardized. The cost data were adjusted for the base year, using the Consumer Price Index. The Consumer Price Index is a price index that measures movements in the weighted average of prices of goods and services purchased by households over the specified time period (Haddix, Teutsch, Shaffer, & Dunet, 1996). For this study, the Medical Care Services Consumer Price Index were used as the index value.
The formula for this calculation shown in Figure 3. The index value for the base year is divided by the index value for the past year. The value is then multiplied by the value from the past year. The result from the calculation resulted in the base year value (Haddix, Teutsch, Shaffer, & Dunet, 1996).

<table>
<thead>
<tr>
<th>Figure 3: Inflation Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_B = Y_P \cdot \left(\frac{D_B}{D_P}\right)$</td>
</tr>
<tr>
<td>$Y_B$ = Base Year Value</td>
</tr>
<tr>
<td>$Y_P$ = Past Year Value</td>
</tr>
<tr>
<td>$D_B$ = Index Value of Base Year</td>
</tr>
<tr>
<td>$D_P$ = Index Value of Past Year</td>
</tr>
</tbody>
</table>

For example, to determine the costs of a procedure done in 2008 in 2012 dollars, the value of the 2008 dollars will be inflated to 2012 values. Using the Medical Care Services component of the Consumer Price index, the ratio of 2012 to 2008 values would be $\left(\frac{435.721}{388.287} = 1.122\right)$. This value is multiplied by the cost of a 2008 procedure ($1,101) resulting in a value of $1,235 in 2012.

7.13 Risk Factor Probability

It is important to understand the risk and probability that the program participants would deliver a low birth weight newborn and the effect that program participation had on the potential prevention. In most situations, the participant is exposed to two or more risks. To calculate the overall probability through addition, the formula shown in Figure 4 were used.

<table>
<thead>
<tr>
<th>Figure 4: Joint Probabilities Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(A \text{ and } B) = P(A) + P(B) - P(A \times B)$</td>
</tr>
<tr>
<td>$P(A) = \text{Probability of Event A Occurring}$</td>
</tr>
<tr>
<td>$P(B) = \text{Probability of Event B Occurring}$</td>
</tr>
</tbody>
</table>
For example, to determine the total probability of an event to occur, probabilities of Event A and Event B are needed. The probability of Event A occurring was 4% and the probability of Event B was 9% for this sample calculation. To find the value of \( P(A \cap B) \), the probabilities will be \( (\frac{4}{100}) \times (\frac{9}{100}) = \frac{36}{10,000} \) or 0.0001. This value will be subtracted from \( (\frac{4}{100}) + (\frac{9}{100}) = \frac{13}{100} \) or 0.13 to equal 12.99 or 12.99% chance of occurring.

7.14 Cost-savings Adjustment Based on Risk Factor Probability

Cost-savings or losses were adjusted for maternal risk factors using the equation found in Figure 5. The adjustment deflated the value, giving it a more realistic value. The risk factor probability used is based on the overall risk probability found using the equation in section 7.12.

<table>
<thead>
<tr>
<th>Figure 5: Cost-savings Adjustment Based on Risk Factor Probability Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings per ( N_p ) Newborn = (Cost of birth ( N_c ) - Cost of ( N_p )) \times P_{LBW}</td>
</tr>
<tr>
<td>Savings per ( M_p ) Mother = (Cost of birth ( M_c ) - Cost of ( M_p )) \times P_{LBW}</td>
</tr>
</tbody>
</table>

\( N_p = \) (Newborn within program)  
\( N_c = \) (Newborn within community)  
\( M_p = \) (Mother within program delivering)  
\( M_c = \) (Mother within community delivering)  
\( P_{LBW} = \) (Probability of \( N_p \) being LBW)

For example, cost of the newborn in the community is $1,000 and the cost of the newborn within the program is $500, the difference will be $500. This value was multiplied by the probability of the newborn in the program being a LBW, which was 0.87 in this example, resulting in an adjusted cost-savings value of $435.
Chapter Eight: Study Results

8.1 Maternal Demographic Comparison

*Table 12* contains a summary of the maternal demographics for the community and for the Pathways program participants. The data were retrieved from the electronic medical records by Mercy Health Partners in Muskegon County. The women in the program were younger when compared to the women who gave birth in the community. Similar to the community, majority of the women in the program were enrolled into a Medicaid HMO plan.

<table>
<thead>
<tr>
<th>Table 12: Maternal Demographics, Muskegon County, 2011-12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Number of Individuals</td>
</tr>
<tr>
<td>% Delivered Low Birth Weight</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Average/Median</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>≤ 14</td>
</tr>
<tr>
<td>15-19</td>
</tr>
<tr>
<td>20-24</td>
</tr>
<tr>
<td>25-30</td>
</tr>
<tr>
<td>≥ 31</td>
</tr>
<tr>
<td>Race</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>African American</td>
</tr>
<tr>
<td>Caucasian</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>Plan Type</td>
</tr>
<tr>
<td>Medicaid HMO Plan</td>
</tr>
<tr>
<td>Medicaid Fee For Service</td>
</tr>
<tr>
<td>Self-Pay</td>
</tr>
<tr>
<td>By Condition</td>
</tr>
<tr>
<td>Died</td>
</tr>
<tr>
<td>With Problems</td>
</tr>
<tr>
<td>Normal</td>
</tr>
</tbody>
</table>
Table 13 contains a summary of the maternal demographics and the percentage of low birth weights per category from pregnant women in Muskegon County. None of the women in the program delivered a low weight newborn. African American women in the community had a higher of LBW newborns compared to the other ethnicities.

Table 13: Maternal Demographics and LBW, Muskegon County, 2011-2012

<table>
<thead>
<tr>
<th>Community</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>≤ 14</td>
<td>50.0% (n = 2)</td>
</tr>
<tr>
<td>15-19</td>
<td>8.4% (n = 15)</td>
</tr>
<tr>
<td>20-24</td>
<td>7.1% (n = 35)</td>
</tr>
<tr>
<td>25-30</td>
<td>7.4% (n = 27)</td>
</tr>
<tr>
<td>≥ 31</td>
<td>12.9% (n = 18)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.00%</td>
</tr>
<tr>
<td>African American</td>
<td>10.7% (n = 37)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>7.3% (n = 56)</td>
</tr>
<tr>
<td>Other</td>
<td>12.0% (n = 3 )</td>
</tr>
<tr>
<td>Unknown</td>
<td>2.9% (n = 1 )</td>
</tr>
<tr>
<td><strong>Plan Type</strong></td>
<td></td>
</tr>
<tr>
<td>Medicaid HMO Plan</td>
<td>8.6% (n = 86)</td>
</tr>
<tr>
<td>Medicaid Fee For Service</td>
<td>6.3% (n = 11)</td>
</tr>
<tr>
<td>Self-Pay</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>By Condition</strong></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>50.0% (n = 19)</td>
</tr>
<tr>
<td>With Problems</td>
<td>20.3% (n = 44)</td>
</tr>
<tr>
<td>Normal</td>
<td>3.7% (n = 34)</td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.2 Participant Probability of Delivering LBW Newborn

Table 14 presents a summary of participant probability of delivering a low birth weight newborn based on their identified risk factors using the joint probability equation found in Figure 4. It does not contain the probabilities for all risk factors, because estimates were not found in the literature. Thus, these probabilities should be considered a good overall estimate of delivering a low birth weight newborn.

A review of the literature has shown the probability of delivering a LBW newborn for three risk factors; age, race and tobacco use, as shown in Table 14. Those probabilities were used to determine the probability of participants delivering a low birth weight newborn. It is almost certain that the probability for delivering a low birth weight baby is higher across all participants, and for some participants with additional risk factors. Unfortunately, a reliable estimate including all identified risks is not available and cannot be estimated from a sample of the size available in this study.

The participants, on average, had a 22.5 percent chance of delivering a low birth weight newborn. After merging the probabilities across all participants, there was an 87 percent joint probability that there would have been at least one low birth weight newborn delivered without program intervention.
Table 14: Participant Probability of Delivering a LBW Newborn

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age(^2)</th>
<th>Race(^2)</th>
<th>Tobacco Use(^3)</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.8%</td>
<td>13.2%</td>
<td>0%</td>
<td>21.1%</td>
</tr>
<tr>
<td>2</td>
<td>9.7%</td>
<td>7.0%</td>
<td>0%</td>
<td>16.7%</td>
</tr>
<tr>
<td>3</td>
<td>7.8%</td>
<td>7.1%</td>
<td>11.5%</td>
<td>26.4%</td>
</tr>
<tr>
<td>4</td>
<td>9.7%</td>
<td>7.1%</td>
<td>11.5%</td>
<td>28.3%</td>
</tr>
<tr>
<td>5</td>
<td>9.7%</td>
<td>7.0%</td>
<td>0%</td>
<td>16.7%</td>
</tr>
<tr>
<td>6</td>
<td>9.7%</td>
<td>13.2%</td>
<td>0%</td>
<td>22.9%</td>
</tr>
<tr>
<td>7</td>
<td>9.7%</td>
<td>13.2%</td>
<td>0%</td>
<td>22.9%</td>
</tr>
<tr>
<td>Group Risk</td>
<td></td>
<td></td>
<td></td>
<td>87%</td>
</tr>
</tbody>
</table>

\(^2\) Births: Preliminary data for 2012. National vital statistics reports

\(^3\) Higgens et al., 2010
8.3 Newborn Outcome

*Table 15* contains a summary of newborn outcomes and birth weights (in grams) from the community and the participants in 2011-2012. All 7 women in the program delivered newborns with a healthy birth weight. Six of the newborns were considered to be healthy but the one newborn had a cardiac murmur. The 7 newborns had an average birth weight of 3331 grams. The program newborns outweighed the low birth weight newborns by 1100 grams and the healthy, normal birth weight newborns by 10 grams.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBW Problems</td>
<td>21</td>
<td>1276 ± 777</td>
<td>1149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>46</td>
<td>2230 ± 211</td>
<td>2250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW Problems</td>
<td>34</td>
<td>2316 ± 138</td>
<td>2343</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>19</td>
<td>3241 ± 539</td>
<td>3105</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW Problems</td>
<td>171</td>
<td>3241 ± 458</td>
<td>3228</td>
<td>1</td>
<td>3350</td>
<td>3350</td>
</tr>
<tr>
<td>Normal</td>
<td>892</td>
<td>3321 ± 405</td>
<td>3293</td>
<td>6</td>
<td>3328 ± 375</td>
<td>3383</td>
</tr>
<tr>
<td>Macrosomic</td>
<td>0</td>
<td>4809 ± 95</td>
<td>4803</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>4</td>
<td>4731 ± 186</td>
<td>4820</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.3.1 Newborn Outcome By Medicaid HMO Plan

*Table 16* contains a summary of newborn outcomes and birth weights (in grams) from the control group and the participants in 2011-2012 that were enrolled in a Medicaid HMO Plan. The program newborns outweigh LBW newborns with problems in the community by 2114 grams and outweighed healthy, normal birth weight newborns by 20 grams.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal BW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>12</td>
<td>1667 ± 751</td>
<td>1758</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Problems</td>
<td>38</td>
<td>2226 ± 220</td>
<td>2260</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>31</td>
<td>3313 ± 139</td>
<td>2330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>10</td>
<td>3142 ± 460</td>
<td>2988</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>139</td>
<td>3242 ± 458</td>
<td>3230</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>737</td>
<td>3320 ± 405</td>
<td>3295</td>
<td>5</td>
<td>3340 ± 418</td>
<td>3460</td>
</tr>
<tr>
<td>Macrosomic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>3</td>
<td>4787 ± 103</td>
<td>4730</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>7</td>
<td>4731 ± 186</td>
<td>4820</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.3.2 Newborn Outcome By Medicaid Fee-For-Service

*Table 17* is a summary of newborn outcomes and birth weights (in grams) from the control group and the participants in 2011-2012 that were under the Medicaid Fee-For-Service plan. Both program newborns outweighed LBW newborn in the community. The program newborn that is considered to be healthy weighed approximately 50 grams less compared to healthy, normal birth weight newborns. The program newborn with issues outweighed the healthy, normal birth weight newborns in the community by 421 grams.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBW Died</td>
<td>8</td>
<td>802 ± 454</td>
<td>667</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Problems</td>
<td>8</td>
<td>2249 ± 175</td>
<td>2228</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>3</td>
<td>2353 ± 162</td>
<td>2395</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Died</td>
<td>9</td>
<td>3352 ± 624</td>
<td>3345</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Problems</td>
<td>31</td>
<td>3235 ± 463</td>
<td>3210</td>
<td>1</td>
<td>3755 ± 624</td>
<td>3755</td>
</tr>
<tr>
<td>Normal</td>
<td>151</td>
<td>3324 ± 408</td>
<td>3270</td>
<td>1</td>
<td>3270 ± 624</td>
<td>3270</td>
</tr>
<tr>
<td>Macrosomic</td>
<td>0</td>
<td>4875</td>
<td>4875</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.4 Muskegon County Abortion Data

Table 18 contains a summary of abortions in Muskegon from 2011-2012. There were a total of 25 missed abortions and 84 spontaneous abortions. Costs were higher for women who experienced missed abortions and for women on a Medicaid Fee-For-Service plan.

<table>
<thead>
<tr>
<th>Type of Abortion</th>
<th>Medicaid Payer Type</th>
<th>Number of Individuals</th>
<th>Average Costs</th>
<th>Median Costs</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missed Abortion</td>
<td>HMO</td>
<td>14</td>
<td>$891</td>
<td>$368</td>
<td>$12,469</td>
</tr>
<tr>
<td></td>
<td>FFS</td>
<td>10</td>
<td>$2,046</td>
<td>$431</td>
<td>$20,462</td>
</tr>
<tr>
<td></td>
<td>Self</td>
<td>1</td>
<td>$197</td>
<td>$197</td>
<td>$197</td>
</tr>
<tr>
<td>Spontaneous Abortion</td>
<td>HMO</td>
<td>38</td>
<td>$224</td>
<td>$92</td>
<td>$9,284</td>
</tr>
<tr>
<td></td>
<td>FFS</td>
<td>37</td>
<td>$321</td>
<td>$159</td>
<td>$11,866</td>
</tr>
<tr>
<td></td>
<td>Self</td>
<td>9</td>
<td>$250</td>
<td>$23</td>
<td>$2,254</td>
</tr>
<tr>
<td>Legal Abortion</td>
<td>HMO</td>
<td>5</td>
<td>$1,398</td>
<td>$455</td>
<td>$6,992</td>
</tr>
<tr>
<td></td>
<td>FFS</td>
<td>2</td>
<td>$3,410</td>
<td>$3,410</td>
<td>$6,820</td>
</tr>
<tr>
<td></td>
<td>Self</td>
<td>4</td>
<td>$592</td>
<td>$116</td>
<td>$2,369</td>
</tr>
<tr>
<td>Unspecified</td>
<td>HMO</td>
<td>1</td>
<td>$21</td>
<td>$21</td>
<td>$21</td>
</tr>
<tr>
<td></td>
<td>FFS</td>
<td>2</td>
<td>$836</td>
<td>$836</td>
<td>$1,672</td>
</tr>
<tr>
<td></td>
<td>Self</td>
<td>1</td>
<td>$22</td>
<td>$22</td>
<td>$22</td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.5 Program Costs

The costs in *Table 19* contains a summary associated in the operations of the Pregnancy Pathways Pilot Program. The total costs were recorded from April 1, 2011 to March 31, 2012. The data came from the expense records maintained by the Muskegon Community Health Project. There were in-kind services, provided by Dr. Sylvia Mupepi and Dr. Cynthia Coviak from Grand Valley State University’s College of Nursing, which provided the program concept, approach, strategies, and procedures for the program. The costs associated with the in-kind services was excluded for the cost-benefit analysis.

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent</td>
<td>$1,050.48</td>
</tr>
<tr>
<td>Cleaning/Security/Document Storage/Utilities</td>
<td>$1,484.59</td>
</tr>
<tr>
<td>Operating</td>
<td>$278.05</td>
</tr>
<tr>
<td>Program</td>
<td>$214.41</td>
</tr>
<tr>
<td>Travel/Training/Meetings</td>
<td>$937.19</td>
</tr>
<tr>
<td>Professional Fees</td>
<td>$1,241.05</td>
</tr>
<tr>
<td>CHW Salary</td>
<td>$17,710.94</td>
</tr>
<tr>
<td>Benefits</td>
<td>$5,313.22</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$73.42</td>
</tr>
<tr>
<td>In-Kind Services</td>
<td>-$1,000.00</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td><strong>$26,252.87</strong></td>
</tr>
</tbody>
</table>

-Source: Muskegon Community Health Project, 2012
8.6 Newborn Care At Birth Costs

*Table 20* contains a summary of newborn outcomes and costs (in United States dollars) from the control group and the participants in 2011-2012. All 7 program newborns, on average, cost $1,438 to care for. The program newborns cost $2,190 less to care for compared to LBW newborns in the community. Program newborns cost $149 more when compared to healthy, normal birth weight newborns.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>21</td>
<td>749 ± 292</td>
<td>673</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Died</td>
<td>21</td>
<td>749 ± 292</td>
<td>673</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Problems</td>
<td>46</td>
<td>3628 ± 2773</td>
<td>2627</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>34</td>
<td>1495 ± 360</td>
<td>1324</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Died</td>
<td>19</td>
<td>941 ± 462</td>
<td>820</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW Problems</td>
<td>171</td>
<td>2056 ± 2008</td>
<td>1433</td>
<td>1</td>
<td>2174 ± 166</td>
<td>2174</td>
</tr>
<tr>
<td>Normal</td>
<td>892</td>
<td>1289 ± 381</td>
<td>1225</td>
<td>6</td>
<td>1315 ± 166</td>
<td>1302</td>
</tr>
<tr>
<td>Macrosomic Problems</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrosomic Diet</td>
<td>4</td>
<td>2183 ± 686</td>
<td>2215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrosomic Normal</td>
<td>7</td>
<td>1477 ± 424</td>
<td>1384</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.6.1 Newborn Costs By Medicaid HMO Plan

*Table 21* is a summary of newborn outcomes and costs (in United States Dollars) from the control group and the participants in 2011-2012 for those enrolled in a Medicaid HMO Plan. The 5 program newborns cost $214 less when compared LBW newborns with problems in the community. When compared to healthy, normal birth weight newborns in the community, the program newborns cost $26 less, on average.

<table>
<thead>
<tr>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died LBW Problems</td>
<td>12</td>
<td>815 ± 293</td>
<td>720</td>
<td>38</td>
<td>3724 ± 2979</td>
</tr>
<tr>
<td>Died Normal</td>
<td>31</td>
<td>1488 ± 366</td>
<td>1323</td>
<td>10</td>
<td>1058 ± 618</td>
</tr>
<tr>
<td>Died Normal BW Problems</td>
<td>139</td>
<td>2035 ± 2096</td>
<td>1433</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died Normal Macrosomic</td>
<td>737</td>
<td>1299 ± 369</td>
<td>1235</td>
<td>5</td>
<td>1274 ± 149</td>
</tr>
<tr>
<td>Died Macrosomic Problems</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died Macrosomic Normal</td>
<td>3</td>
<td>1973 ± 664</td>
<td>1701</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died Macrosomic Normal</td>
<td>7</td>
<td>1477 ± 424</td>
<td>1384</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
### 8.6.2 Newborn Costs By Medicaid Fee-For-Service

*Table 22* contains a summary of newborn outcomes and costs (in United States dollars) from the control group and the participants in 2011-2012 under the Medicaid Fee-For-Service plan. Both program newborns, when compared LBW newborns with problems, cost less to care for. The healthy program newborn cost $263 more when compared to healthy, normal birth weight newborns. The program newborn with issues cost $920 more when compared to healthy, normal birth weight newborns in the community.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LBW Problems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>8</td>
<td>682 ± 296</td>
<td>609</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>3</td>
<td>1569 ± 338</td>
<td>1674</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Normal BW Problems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>9</td>
<td>811 ± 113</td>
<td>847</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>31</td>
<td>2154 ± 1580</td>
<td>1452</td>
<td>1</td>
<td>2174</td>
<td>2174</td>
</tr>
<tr>
<td><strong>Normal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>151</td>
<td>1254 ± 429</td>
<td>1190</td>
<td>1</td>
<td>1517</td>
<td>1517</td>
</tr>
<tr>
<td>Macrosomic Problems</td>
<td></td>
<td>2814</td>
<td>2814</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.7 Delivery Costs

*Table 23* contains a summary of maternal delivery costs (in United States dollars), separated by newborn condition, from the control group and the participants in 2011-2012. Maternal delivery costs were higher for the program participants when compared to mothers who delivered a LBW newborn with issues and those who delivered a healthy, normal birth weight newborn in the community.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>19</td>
<td>5291 ± 2074</td>
<td>5305</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Problems</td>
<td>44</td>
<td>6195 ± 1703</td>
<td>5931</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>34</td>
<td>6249 ± 2058</td>
<td>5730</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>19</td>
<td>6668 ± 3493</td>
<td>5800</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW</td>
<td>170</td>
<td>5949 ± 2154</td>
<td>5635</td>
<td>1</td>
<td>7887</td>
<td>7887</td>
</tr>
<tr>
<td>Problems</td>
<td>170</td>
<td>5949 ± 2154</td>
<td>5635</td>
<td>1</td>
<td>7887</td>
<td>7887</td>
</tr>
<tr>
<td>Normal</td>
<td>881</td>
<td>5677 ± 1850</td>
<td>5582</td>
<td>6</td>
<td>6838 ± 1035</td>
<td>6560</td>
</tr>
<tr>
<td>Macrosomic</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>4</td>
<td>8698 ± 1265</td>
<td>8564</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>7</td>
<td>6214 ± 2080</td>
<td>6977</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.7.1 Delivery Costs By Medicaid HMO Plan

*Table 24* contains a summary of maternal delivery costs (in United States dollars), separated by newborn condition, from the control group and the participants in 2011-2012 for those enrolled in a Medicaid HMO Plan. The 5 program mothers created a higher cost compared to mothers who delivered LBW newborns with problems and healthy, normal birth weight newborns.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LBW Problems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>16</td>
<td>5454 ± 2179</td>
<td>5638</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>40</td>
<td>6213 ± 1711</td>
<td>5931</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Normal BW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>15</td>
<td>7047 ± 3797</td>
<td>5800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>145</td>
<td>5953 ± 1980</td>
<td>5654</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>742</td>
<td>5673 ± 1834</td>
<td>5582</td>
<td>5</td>
<td>6159 ± 759</td>
<td>6518</td>
</tr>
<tr>
<td><strong>Macrosomic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>3</td>
<td>8247 ± 1085</td>
<td>7627</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>7</td>
<td>6214 ± 2080</td>
<td>6977</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.7.2 Delivery Costs By Medicaid Fee-For-Service

Table 25 contains a summary of maternal delivery costs (in United States dollars), separated by newborn condition, from the control group and the participants in 2011-2012 for those under the Medicaid Fee-For-Service plan. The mother who delivered the healthy newborn had a higher cost for care compared to the mother who delivered the newborn with issues. Both program mothers had a higher delivery cost compared to mothers who delivered LBW newborns with problems and healthy, normal birth weight newborns in the community.

<table>
<thead>
<tr>
<th></th>
<th>Community Count</th>
<th>Community Mean ± Standard Deviation</th>
<th>Community Median</th>
<th>Participant Count</th>
<th>Participant Mean ± Standard Deviation</th>
<th>Participant Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBW Died</td>
<td>3</td>
<td>4425 ± 1329</td>
<td>4951</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW Problems</td>
<td>4</td>
<td>6012 ± 1862</td>
<td>6195</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>4</td>
<td>6817 ± 2054</td>
<td>6389</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW Died</td>
<td>4</td>
<td>5248 ± 1592</td>
<td>5400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal BW Problems</td>
<td>24</td>
<td>5953 ± 3085</td>
<td>5111</td>
<td>1</td>
<td>7887</td>
<td>7887</td>
</tr>
<tr>
<td>Macrosomic Died</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrosomic Problems</td>
<td>1</td>
<td>10,053</td>
<td>10,053</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrosomic Normal</td>
<td>0</td>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011-2012 Mercy Health Partners Electronic Medical Records Claim Data
8.8 Cost-Benefit Analysis per Individual

Table 28 contains a summary of cost-savings adjusted for risk factor probability. Findings indicate an overall savings of $2,364.23 (excluding program costs) when CHWs interact with pregnant women on Medicaid who are at risk of delivering an unhealthy, low weight newborn. Savings from costs of participants’ newborns were on average $493.50 (including the newborn with issues) or $516.99 (excluding the newborn with health issues). Costs from participant deliveries were higher on average, $155.75 (including the newborn with issues) or $119.43 (excluding the newborn with issues). The average savings per participant in this study was $337.75.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Newborn Condition</th>
<th>Medicaid Payer Type</th>
<th>Maternal</th>
<th>Newborn</th>
<th>Total Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Healthy</td>
<td>HMO</td>
<td>-$33.84</td>
<td>$527.31</td>
<td>$493.47</td>
</tr>
<tr>
<td>2</td>
<td>Healthy</td>
<td>FFS</td>
<td>-$373.68</td>
<td>$352.55</td>
<td>-$21.13</td>
</tr>
<tr>
<td>3</td>
<td>Healthy</td>
<td>HMO</td>
<td>-$377.32</td>
<td>$563.30</td>
<td>$185.98</td>
</tr>
<tr>
<td>4</td>
<td>Healthy</td>
<td>HMO</td>
<td>-$91.39</td>
<td>$703.03</td>
<td>$611.64</td>
</tr>
<tr>
<td>5</td>
<td>With Issues</td>
<td>FFS</td>
<td>-$280.98</td>
<td>$242.82</td>
<td>-$38.16</td>
</tr>
<tr>
<td>6</td>
<td>Healthy</td>
<td>HMO</td>
<td>-$93.16</td>
<td>$529.03</td>
<td>$435.87</td>
</tr>
<tr>
<td>7</td>
<td>Healthy</td>
<td>HMO</td>
<td>$160.09</td>
<td>$536.47</td>
<td>$696.56</td>
</tr>
<tr>
<td><strong>Total Savings</strong></td>
<td><strong>N/A</strong></td>
<td><strong>N/A</strong></td>
<td>-$1,090.28</td>
<td>$3,454.51</td>
<td><strong>$2,364.23</strong></td>
</tr>
</tbody>
</table>


8.9 Cost-Benefit Analysis of Overall Program

When the total cost of the program ($26,252.87) was spread equally amongst the seven study participants, the cost was $3,750.41 per participant. The average program loss per participant (including the newborn with issues) was -$3,959.81 and -$3,919.57 (excluding the newborn with issues). This total was calculated after subtracting the adjusted cost-savings from the program costs per mother. From a social perspective, the program was successful in helping at-risk pregnant women avoid a low birth weight newborn with issues. For every dollar spent in program costs, there was 9 cents recovered in savings. From a business perspective, the pilot program did not provide a positive return.

8.10 Answering Research Questions

1. How much of an improvement, if any, occurred in the birth outcomes of newborns from at-risk pregnant women in the program compared to < 2,500 gram newborns with issues from women on a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County.

On Medicaid Overall

All 7 newborns were born with a healthy birth weight. The 6 healthy newborns from the program weighed an average of 3,331 grams. When excluding the newborn with a health issue, the healthy newborns weighed 3,328 grams, on average. The 46 low birth weight newborns with health concerns on Medicaid who were not in the program weighed on average 2,230 grams.

Overall, participants’ newborns had weighed more on average by 1,101 grams per child compared to low birth weight newborns with issues. If excluding the program
newborn with issues, the healthy newborns weighed more than 1,098 grams on average compared to low birth weight newborns with issues.

Medicaid HMO Plan Only

All 5 newborns under a Medicaid HMO plan were born with a healthy birth weight. On average, these newborns weighed 3,340 grams. For low birth weight newborns with issues in the community (38 children), they weighed 2,226 grams on average. For the program, the participants’ newborns weighed more on average by 1,114 grams.

Medicaid Fee-For-Service Only

Both newborns under the Medicaid Fee-For-Service plan were born with a healthy birth weight. The healthy newborn weighed 3,270 grams and the newborn with issues weighed 3,755 grams. Non-program low birth weight newborns with issues (8 children) weighed 2,249 grams on average. When compared to the low birth weight newborns with problems, the healthy newborn 1,021 grams more and the newborn with issues weighed 1,506 grams more.

2. How much of an improvement, if any, occurred in the birth outcomes of the newborns from the at-risk pregnant women in the program compared to 2,500 – 4,500 gram healthy newborns from women on a Medicaid HMO plan or Medicaid Fee-For-Service plan in Muskegon County.

On Medicaid Overall

On average, the six healthy newborns from the program weighed 3,331 grams. When excluding the newborn with issues, the healthy newborns weighed 3,328 grams on average. The 46 low birth weight newborns with issues from the community weighed on average 2,230 grams.
Overall, participants’ newborns had weighed 1,101 grams more per child compared to non-program low birth weight newborns with issues. If excluding the program newborn with issues, the healthy newborns weighed more than 1,098 grams on average.

Medicaid HMO Plan Only

Five of the healthy newborns were covered under a Medicaid HMO plan. On average, these newborns weighed 3,340 grams. For low birth weight newborns with issues in the community (38 children), they weighed 2,226 grams on average. The program newborns weighed more on average by 1,114 grams.

Medicaid Fee-For-Service Only

Two of the newborns, one healthy and one with a cardiac murmur, were covered under a Medicaid Fee-For-Service plan. The healthy newborn weighed 3,270 grams and the newborn with issues weighed 3,755 grams. Low birth weight newborns with issues in the community (eight children) weighed 2,249 grams on average. When compared to the low birth weight newborns with problems, the healthy newborn and the newborn with issues weighed 1,021 and 1,506 grams more.
3. **How much of an improvement, if any, in costs of newborns delivered from the at-risk pregnant women in the program compared to <2,500 gram neonates with problems from women on Medicaid in Muskegon County.**

**On Medicaid Overall**

Money was saved on the initial care of newborns in the program. On average, it cost $1,315.00 to care the 6 healthy newborns from the program. For the program newborn with issues, it cost $2,174.00 for care. For the 46 low birth weight newborns in the community, it cost an average of $3,628.00 to care for them.

After adjusting the cost-savings to reflect the probability of being a LBW newborn based the identified maternal risk factors, participants’ newborns had saved on average $493.50 (median of $529.03) per child compared to non-program low birth weight newborns with issues. If excluding the program newborn with issues, the healthy newborns saved on average $516.99 (median of $532.75) per child.

**Medicaid HMO Plan Only**

Money was saved on the initial care of the five newborns in the program under a Medicaid HMO plan. On average, the cost to care for these newborns was $1,274.00 (median of $1,285.00). For low birth weight newborns with issues in the community (38 children), it cost on average $3,724.00 (median of $2,611.00) for care.

After adjusting the cost-savings to reflect the joint probability that the newborn would have been of a low birth weight, the newborns saved on average $595.18 with a median savings of $588.45. The overall savings for the 5 newborns was a total of $2975.89.
Medicaid Fee-For-Service Only

Money was saved on the initial care of both newborns under a Medicaid Fee-For-Service plan in the program. For the healthy newborn, it cost $1,517.00 to care for them compared to $2,174.00 for the newborn with issues. For a low birth weight child with issues in the community (8 children), it cost $3,170.00 on average (median of $2,888.00).

After adjusting the cost-savings to reflect the probability of being a LBW newborn based the identified maternal risk factors, the cost-savings to care for the healthy newborn was compared to cost of care for non-program low birth weight newborns with issues was calculated to be $276.07. When the program newborn with issues was compared to low birth weight newborns with issues in the community, the cost-savings was calculated to be $166.32. The total savings from the two program newborns was $442.40.

4. *How much of an improvement, if any, in costs of newborns delivered from the at-risk pregnant women in the program compared to 2,500-4,500 gram healthy newborns from women on Medicaid in Muskegon County.*

On Medicaid Overall

Money was not saved on the initial care of newborns in the program. The care for the 6 healthy newborns from the program cost an average of $1,315.00. Care for the newborn with issues, cost $2,174.00. For the 892 healthy normal birth weight newborns in the community, it cost an average of $1,289.00 for care.

After adjusting the cost-savings to reflect the probability of being a LBW newborn based on the identified maternal risk factors, participants’ newborns had cost more. On average the newborn care was $24.42, compared to non-program healthy
normal birth weight newborns. Excluding the newborn with issues, participants who delivered healthy newborns cost on average $3.86 more per child when being compared to healthy normal birth weight newborns.

*Medicaid HMO Plan Only*

Money was saved on the initial care of the 5 newborns in the program under a Medicaid HMO plan. On average, the cost to care for these newborns was $1,274.00 (median of $1,285.00). For healthy normal birth weight newborns in the community (737 children), it cost on average $1,299.00 (median of $1,235.00) for care. Program newborns saved on average $5.42 with a median of $3.13 after adjusting the savings based on the probabilities of being a LBW newborn based on the identified maternal risk factors. As a result, a total of $27.08 was saved.

*Medicaid Fee-For-Service Only*

Money was not saved on the initial care of the 2 newborns covered under a Medicaid Fee-For-Service plan. For the healthy newborn, care cost $1,517.00 and $2,174.00 for the newborn with issues. For non-program related healthy normal birth weight children (151 children), it cost $1,254.00 on average (median of $1190.00) to care for.

When the healthy newborn from the program was compared to healthy newborns in the community, there was a calculated loss of $43.91. When the newborn with issues was compared to healthy, normal birth weight newborns in the community, the loss was calculated to be $153.64. Overall, there was a loss of $197.55.
5. How much of an improvement, if any, in cost-savings for the at-risk women whom were pregnant in the program compared to women on Medicaid who delivered less than 2,500 gram neonates with problems in Muskegon County.

On Medicaid Overall

Money was not saved on delivery costs of participants in the program. The mothers of the 6 healthy newborns cost an average of $6,838.00 (median of $6,560.00) to care for. For the mother of the newborn with issues, care cost $7,887.00. The 44 mothers of low birth weight newborns with issues in the community cost an average of $6,195.00 for care.

After adjusting the cost-savings to reflect the probability of delivering a LBW newborn based on the identified maternal risk factors, participants cost on average $155.75 more, compared to mothers in the community who delivered low birth weight newborns with issues. If excluding the newborn with issues, participants cost on average $134.88 more.

Medicaid HMO Plan Only

Money was not saved on delivery costs of participants in the program. Five of the mothers who delivered a healthy newborn were covered under a Medicaid HMO plan. On average, the cost to care for these mothers was $6,159.00 (median of $6,518.00). For mothers of low birth weight newborns with issues in the community (40 mothers), it cost on average $6,213.00 (median of $5,931.00). After adjusting the cost-savings to reflect the probability of delivering a LBW newborn based on the identified maternal risk factors, participants cost more, on average $82.75 (median of $86.29).
**Medicaid Fee-For-Service Only**

Money was not saved on delivery costs of participants in the program. Two mothers were covered under a Medicaid Fee-For-Service plan. For the mother with a healthy newborn, it cost $8,433.00 to care for them and $7,887.00 for the mother with the newborn with issues. For mothers with a low birth weight child with issues in the community (24 mothers), it cost $6,012.00 on average (median of $6,195.00).

After adjusting the cost-savings to reflect the probability of delivering a LBW newborn based on the identified maternal risk factors, was a calculated loss of $404.24 when the mother of healthy newborn was compared to mothers of low birth weight newborns with problems in the community. When the mother of the newborn with issues was compared to mothers’ of low birth weight newborns in the community, there was a calculated loss of $311.54.

6. **How much of an improvement, if any, in cost-savings for the at-risk women whom were pregnant in the program compared to women who delivered 2,500 – 4,500 gram healthy newborns and were on Medicaid in Muskegon County.**

**On Medicaid Overall**

Money was not saved on delivery costs of participants in the program. The mothers of the 6 healthy newborns from the programs cost an average of $6,838.00 (median of $6,560.00) to care for. The mother with the newborn with issues cost $7,887.00 to care for. For the 881 mothers to healthy normal birth weight newborns in the community, it cost an average of $5,677.00.
After adjusting the cost-savings to reflect the probability of delivering a LBW newborn based on the identified maternal risk factors, participants had cost on average $270.45 more, compared to mothers of healthy normal birth weight newborns in the community. If excluding the newborn with issues, participants who delivered healthy newborns cost on average $254.28 more, as compared to mothers in the community who delivered healthy normal birth weight newborns.

*Medicaid HMO Plan Only*

Money was not saved on delivery costs of participants in the program. Five of the mothers who delivered healthy newborns were covered under a Medicaid HMO plan. On average, the cost to care for these mothers was $6,159.00 (median of $6,518.00). Cost Mothers of healthy normal birth weight newborns in the community (742 mothers), it cost on average $5,673.00 (median of $5,582.00). Program participants, on average, were more expensive by $214.07.

*Medicaid Fee-For-Service Only*

Money was not saved on delivery costs of participants in the program. Two mothers were covered under a Medicaid Fee-For-Service plan. For the mother with a healthy newborn, it cost $8,433.00 to care for them and $7,887.00 for the newborn with issues. For mothers with a healthy normal birth weight newborn in the community (136 mothers), it cost $5,716.00 on average (median of $5,571.00).

After adjusting the cost-savings to reflect the probability of delivering a LBW newborn based on the identified maternal risk factors, the participant that delivered the healthy newborn was compared to mothers in the community who delivered a healthy normal birth weight infant. The cost was calculated to be a loss of $453.67. When the
participant who delivered the newborn with issues was compared to mothers who delivered healthy normal birth weight newborns, there was calculated loss of $360.97.
Chapter Nine: Conclusions

The study was designed to explore the health outcome benefits and potential cost-savings generated by CHWs who interacted with at-risk pregnant women on Medicaid in Muskegon County. By improving the health outcomes for the participants and their newborns, through maternal risk factor intervention and by increasing access to prenatal care, the extent of the potential cost-savings were examined. Literature was available that provides insight in the positive health outcomes that CHWs can affect, but was limited in viewing the outcomes provided in a cost-benefit context. This study answered two general questions:

1. Can CHWs that target at-risk pregnant women improve upon the birth outcomes for the participants and the newborns?
2. How much cost-savings is being generated by the program?

The program was able to obtain healthy birth weights for all 7 newborns. The joint probability of all 7 women delivered a newborn with a healthy birth weight was 13 percent. Six of the newborns were considered to be healthy at the time of birth while one had a cardiac murmur issue with an unidentified cause. All 7 mothers delivery without complications and were considered to be healthy. This can be interpreted as a win for the program from a social perspective.

The program was able to generate a cost-saving on a per individual basis, albeit rather a small one. There were significant cost-savings generated in newborn care costs. It was found that the program mothers had a higher cost of care compared to other mothers in
the community. From an overall program perspective, the program was not able to break even on its investment. This can be interpreted as a loss from a business perspective.

9.1 Answering Study Proposition

Proposition #1: Community Health Worker engagement using the Pathways Model produces a better overall health outcome for newborns and at-risk pregnant women in the program, which will result in cost-savings.

Unit of Analysis: Newborn Outcomes

It was proposed that CHWs, through case management, would have the ability to influence the positive health outcome of the newborn. The CHW would be able to identify maternal risk factors and to create Pathways to resolve those issues. The CHW was able to connect women to pre- and post-natal care, ancillary health, and social service support to solve the various pathways.

The CHW was able to start the case management of all 7 women during their first trimester. The early interaction allowed the CHW to identify any risks and barriers earlier and it allowed ample time to resolve these issues. All of the women were eligible for Medicaid and were able to enroll for the program, allowing them to have access to healthcare for most of their pregnancy.

The 7 women had a probability ranging from 16 to 28 percent chance of delivering a low birth weight newborn. There was a 13 percent chance that all seven women would have delivered a healthy birth weight newborn without the aid of the CHW. Against the probability, all seven women were able to deliver a newborn whose weight fell within the accepted standard of a healthy birth weight. The assistance from the CHW may have helped influence the positive health outcomes for the newborn.
The women under the Medicaid Fee-For-Service plan cost more compared to women under a Medicaid HMO plan. For women to be under the FFS plan, they would have to be considered to be non-residents of the United States and/or Michigan. Because of the eligibility of the two women, this may have resulted in higher costs.

9.2 Limitations

All of the startup costs were accounted for during the one year program study. In a multiyear program, the costs would have been spread over the time that the program is in operation and would be able to reduce the cost per participant significantly as the number of participants increase. As costs are spread out and reduced on a per participant basis, the hope would be that the savings generated would negate the startup costs. However, this study was limited due to its short timeframe and the entire startup costs had to be placed on the seven study participants.

The purpose of the pilot program was to aid women in the community and to develop the delivery of services that would be provided for following years to come. During this one year time, it was important to develop connections and relationships to local organizations and services that can aid pregnant women. Also, the community health worker would have gained a year’s worth of experience in aiding at-risk pregnant women. Lessons learned from the pilot program could help increase the efficiency of the program.

The potential for increased cost-savings to break even on program costs can occur through increased efficiency in dropped participants. As part of this study, all program costs were shifted from the dropped participants onto the active participants since claim costs were not found for the missing individuals. Increasing the number of participants,
especially those who complete the program and have viable claims data, can help the program to break even and potentially become a business viable solution in addition to the positive social returns that it can create.

There is a potential for increase efficiency in service of delivery for all participants. Being able to identify maternal risk factors and have a plan to solve or treat these issues earlier can help mitigate negative outcomes and reduce costs. Increased access to social and community outreach resources in the community that focuses on specific maternal needs can help aid at-risk women and their issues and prenatal care could potentially enhance positive health outcomes and further reduce costs at the time of delivery for both the mother and newborn.

In this study, there was a small cost-saving provided on a per individual basis, mostly due to reduced newborn care costs. It is possible that with more participants in the larger three year study, the delivery costs can be reduced and result in cost-savings, resulting in further savings. There is a potential for increased efficiency of the program by maximizing the volume of participants who are managed by the CHW. If the CHW could handle a maximum of 35 women in the program and 18 of those women dropped, as to mirror this study, the cost of the program would be spread among 17 women. If all 17 cases saved $337.75 in newborn and delivery costs, it would have resulted in a total saving of $5,741.15. If the program maintained its $26,252.87 budget, there would be a reduced loss of $20,511.72. Also, a normal term pregnancy is for a relative short period of time. Unlike the previous ROIs done about the work of CHWs intervention on diabetes and asthma, pregnancies are not treatable on a daily basis and may result in a smaller cost-savings and would need more participants to generate larger savings.
Another limitation of this study may have been present in the maternal delivery costs. The women in the program were educated during the program and may have known and requested available services during their delivery such as lactation counseling and additional monitoring services. The additional services that were requested would have increased the cost for care. The claims data retrieved from Mercy Health Partners did not individualize costs, therefore, it is unknown whether the costs of the additional services are included.

The participants did not have their age standardized. As age increases, the women are more susceptible to chronic illnesses. These chronic diseases will increase the overall risk for pregnant women of delivering a LBW newborn.

The study did not track the gestational age of the newborn. It was unknown whether the newborn was premature or small for its gestational age. This information would have provided further data that would have been useful in accounting for the delivery and newborn costs.

Diaz states that “many of the benefits of the work of CHWs do not materialize immediately. In fact, the biggest returns will occur in the future with every year of life not lost generates a stream of benefits in the future” (Diaz, 2012). Post-birth and delivery data was not tracked due to the short time frame of the study. It would have been valuable to track the women and newborns to see if there were any avoided negative outcome and costs as a result of the program. The information would have provided a much more realistic cost-benefit analysis.
9.3 Implications

The outcome of this study remains positive when looking at the health outcome of the mother and newborn. The healthy delivery and birth outcome, in most cases, will likely result in a lower cost of treatment compared to a newborn with issues over time. To help at-risk women to avoid delivering a LBW newborn with issues will result in positive returns for years to come.

The positive net gain per person show health care organizations that this is a potentially worthwhile program for community benefit dollars. It is clear that this program has the potential of positive social returns through the use of CHWs targeting at-risk populations at relatively low cost. With program refinement cost-savings could be generated.

9.4 Additional Research Needed

The generalizability of this study was limited by the lack of sample for a robust evaluation. Further research is needed in the areas in perinatal and pediatric health to determine: 1) costs in the lifespan of an individual to treat diseases and conditions relating to newborn low birth weight; 2) the impact of multiple risk factors have towards the mother delivering a low birth weight child; 3) identification and role of having no transportation, homelessness, and the need of translation services on health; 4) numbers of mothers who are enrolled in Medicaid (including which trimester); and 5) the long term retention of health seeking behaviors from mothers that are acquired in programs such as the Pregnancy Pathways Pilot Program. Since this study was part of a pilot for a larger three year study, it is expected that the follow on research can provide a much robust cost-benefit analysis.
9.5 Final Thoughts

Much like the available literature, CHWs are able to improve the health outcomes of their clients. Their positive impact they are able to provide for their communities is a social win. This study has shown that CHWs are able to provide cost-savings through avoided costs to treat low birth weight newborns. The Pregnancy Pathways Pilot Program not able to break even on program costs, and can be considered a “loss” on a business perspective. However, the potential for the program to succeed on a business perspective is there but can only be done by increasing the number of participants in the program and to achieve the same positive health outcomes.
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