**THE IMPACT OF COMMUNITY HEALTH WORKERS ON MATERNAL MORTALITY IN THE UNITED STATES**

by

**BeLinda Berry**

BS in Human Development and Family Studies, Kent State University, 2013

Submitted to the Graduate Faculty of

Behavioral and Community Health Sciences

Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Master of Public Health

University of Pittsburgh

2018

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

This essay is submitted

by

**BeLinda Berry**

on

May 16, 2018

and approved by

Essay Advisor:

Martha Ann Terry, PhD \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Associate Professor

Behavioral and Community Health Sciences

School of Public Health

University of Pittsburgh

Essay Reader:

William Dunn, PhD \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Professor

Public Policy and Management

Graduate School of Public and International Affairs

University of Pittsburgh

Copyright © by BeLinda Berry

2018

Martha Ann Terry, PhD

**THE IMPACT OF COMMUNITY HEALTH WORKERS ON MATERNAL MORTALITY IN THE UNITED STATES**

BeLinda N. Berry, MPH

University of Pittsburgh, 2018

**ABSTRACT**

In the United States, maternal mortality has been increasing, especially in rural and minority populations while it has been generally decreasing in both other developed and developing nations. There is some evidence that using community health workers (CHWs) can improve maternal mortality be significant in improving and impacting the public health of communities, especially in areas that are resource-poor. This literature review looks at the use of various types of CHWs, health extension worker (HEW), lay health worker (LHW), community health extension worker (CHEW), and peer counselling interventions that were designed to reduce health disparities in various communities. As maternal mortality continues to increase, the burden on communities will increase as well. It is imperative to the health of women and children to begin eliminating the gaps in health care and health education. The purpose of this literature review was to see if there is potential to implement similar CHW programs and interventions in the United States, and specifically in Allegheny County as a method to improve maternal mortality. The literature suggests that the use of CHWs and other lay health persons could be beneficial to the health of mothers and their infants.

TABLE OF CONTENTS

1.0 Introduction 1

2.0 Background 4

2.1 Community Health Workers 8

3.0 Methods 10

4.0 Literature review 11

4.1 CHWs and HIV 11

4.1.1 Counseling on Adherence and Community Health 11

4.1.2 Home-Based AIDS Care project 14

4.2 HEWs and Birth registry 15

4.3 Self-care and CHWS 16

4.4 HEWs and the prevention of bacterial Infections 17

4.5 Breastfeeding and peer counselors 18

4.6 Tuberculosis treatment and LWs/CHWs 19

4.6.1 Lay health worker intervention with choice of DOT 19

4.6.2 Control of tuberculosis by community health workers in Bangladesh 20

4.7 Cardiovascular management and CHWs 21

4.8 Diabetes management and CHWs 22

4.8.1 CHWs and Diabetes in LA 22

4.8.2 CHWs and diabetes in East Harlem 24

4.9 Emergency Deparments and CHWs 25

5.0 Discussion 26

6.0 CONCLUSION 29

bibliography 31

# Introduction

Maternal mortality (MM) in the United States (US) continues to increase as trends in both developed and developing nations have declined. The Millennium Development Goals (MDGs) were developed in 1990 to help improve health outcomes, and MDG 5 was written to improve maternal health. The Millenium Development Goal 5 was created to help improve MM around the world. As MM continues to negatively impact minorities and rural communities, this review looks at the use of Community Health Workers (CHWs), this includes Lay Health Workers (LHWs), Health Extension Workers (HEWs), Community Health Extension Workers (CHEWs), and Peer Counselors.

Community health workers are being used as a means to address some pervasive health issues, especially the negative health outcomes that impact rural communities. CHWs are community members who help bridge language and cultural barriers by expanding access and coverage to care to improve health outcomes. This essay explores the use of CHWs and their impact on health outcomes and how they could be used to improve maternal health and reduce maternal mortality.

There were 189 abstracts reviewed for this review. Twelve articles that look at CHWs and similar programs throughout the world including LHWs, HEWs, CHEWs, and Peer Counsellors. The first section of this chapter looks how these programs can impact HIV. This chapter discusses the use of CHWs in Miami, Florida. The CHWs completed assessments, met with participants, referred participants to resources, and helped review medication practices. This section also includes a home-based antiretroviral design which used counsellors to improve social outcomes for participants. HEWs to register births in three rural Ethiopian villages. HEWs were used to increase MM reporting through the presence of HEWs, the Health Extension Program (HEP) was able to conduct a cost benefit analysis to show that using this intervention could save money.

 The Latina community used promotoras (similar to CHWs), they intended to help improve caregiver self-care for mothers of children with intellectual or developmental disabilities (IDD). Health extension workers were used in hopes of preventing possible bacterial infections in newborns. HEWs were given tools and resources to provide care to the community. Latina mothers from Mexico City received education and assessment from peer counsellors on their breastfeeding practices.

There are two interventions that were implemented to treat and reduce TB infections. It looks at the evaluation of lay health workers (LHW) to reduce TB in farm dwellers in rural south Africa and the use of CHWs in Bangladesh .The literature review includes analysis of programs focused on improving outcomes for those who have cardiovascular disease. CHWs were implemented in Baltimore where they conducted Community Outreach and Cardiovascular Health (COACH) and community-based participatory research (CBPR).

CHWs to improve health outcomes for those with diabetes. Both sections used CHWs in minority populations, one on the east coast and one on the west coast. The final section, section nine, used CHWs in emergency departments (EDs) to help physicians with high blood pressure (HBP) detection, treatment, and follow-up among high-risk black men.

Chapter five is the discussion and the final chapter of this literature review. This chapter reviews what was found in the literature review and what it means for Allegheny County or minority health. It also discusses the limitations of this review.

# Background

MM in the US has been increasing while the MM in both developing and developed countries has been decreasing (MacDorman, Declercq, Cabral, & Morton, 2016). Maternal mortality, also known as maternal death, is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (World Health Organization [WHO], 2004).

In 1990, to help combat MM, world leaders joined forces at the United Nations (UN) to develop a vision for the future. The MDGs were created to help reduce the repercussions of poverty by 2015. Eight goals were established:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria, and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development.

The target for MDG 5a was to reduce global MM by three quarters, between 1990 and 2015 (UN, 2010). While not achieving the MDG goal, the maternal mortality ratio (MMR) was reduced by half in that period of time, most of which occurred after 2000 (UN, 2015).

One difficulty when dealing with MM is that many deaths happen in settings where reporting is difficult. It was not until the ICD-10, the tenth revision of the International Statistical Classification of Diseases, that pregnancy status was added to death certificates. Though the ICD-10 was finished in 1992, the compliance date for the ICD-10 was not set until 2015, a year later than originally planned (Dimick, 2014). It is not always easy for medical certifiers to accurately label deaths linked to direct or indirect maternal causes, especially in some parts of the world where many deliveries happen in the home (WHO, 2015). Direct causes of maternal death are obstetric hemorrhage, eclampsia pregnancy, embolism, and anesthesia-related complications (Nour, 2008). Indirect causes are chronic health issues that are exacerbated by pregnancy and childbirth such as cardiac disease and psychiatric illness. Causes of death such as car accidents or violent deaths are not linked to maternal mortality and are classified as incidental deaths (Nour, 2008). As a result, there are gaps and discrepancies in reporting, which can make it difficult to get accurate, well-informed data that paint a full picture of the disparities that exist in maternal death.

Despite the limitation reporting presents, some things that remain clear. For example, countries that are developing, third world, or in conflict have higher levels of maternal mortality. Maternal mortality is higher in countries deemed as fragile or in conflict. The WHO defines a fragile country as whether it is eligible for assistance, such as grants, from the International Development Association (IDA), has had a UN peacekeeping mission in the last three years, and has received a ‘governance’ score of less than 3.2.2 (World Bank, 2011).

The risk of death for a 15-year-old in a fragile or conflict-affected country due to a maternal cause is one in 54whereas 15 year olds in developing countries have a one in 180 chance and those in developed countries have a risk of one in 4900. Resources play a major role in the health outcomes of mothers (World Health Organization, 2016). Most complications that result in maternal death are preventable; complications include severe bleeding, infections, pre-eclampsia and eclampsia, complications from delivery, or unsafe abortion. Pregnancy and birth can also exacerbate already existing conditions. With access to care these complications could be avoided (World Health Organization, 2016).

Despite global trends of declining maternal mortality, the MM in the US has been moving in the opposite direction. In 2015 MM in the US was 26.5 per 100,000 deaths, compared to 12 deaths per 100,000 in 1990 (Agrawal, 2015). While the US saw increasing MMR, the global maternal mortality rate dropped by  2.3% over 15 years while the US saw its MMR double (Agrawal, 2015).

In the US and globally differences in health outcomes differ between rural and urban areas exist. The Centers for Disease Control and Prevention (CDC) (2017) found that those who live in rural areas are more likely to have negative health outcomes. Women who give birth in a rural area experience 30 deaths per 100,000 compared to those who live in more urban areas, 18 deaths per 100,000, live births. The disparities between urban and rural maternal mortality have been linked to dwindling obstetric services provided. For example, many women who live in the rural US must travel 90 minutes to a facility with a maternity ward (Maron, 2017).

Geographic disparities are not the only ones to exist in the US. A report by the CDC (2017) shows that black women are 243 times more likely to die in childbirth than white women. In addition, Tucker, Berg, Callaghan, and Hsia (2007) report that black women are more likely to have comorbidities like hypertension, diabetes, or obesity. Another factor that contributes to poor health outcomes for black women is that they are more likely to delay prenatal care until after the first trimester.

In Pennsylvania (PA) MM declined between 2006 and 2014 (Pennsylvania Department of Health, 2016a). It is important to note that despite the downward trend in PA, MM among black women remains high (Pennsylvania Department of Health, 2016a). Black women in 2014 continue to experience maternal death at a rate of 23.1 compared to white women at a rate of 9.5; the rate at which Hispanic women die is not reported as it is considered data statistically unreliable (DSU) (Pennsylvania Department of Health, 2016b). Philadelphia minority women experience disproportionately high MDs (Philadelphia Department of Public Health Medical Examiner's Office, 2015). Since the development of the city focused MM review in 2012, the results show a discrepancy and under reporting that occurred through the state (Hamill, 2018). However, it is difficult to get a clear picture of the MMR for all of Pennsylvania, and more specifically Allegheny County, as MD is only reported 42 days after days after the end of a pregnancy despite other states measuring and recording MD up until a year after the end of pregnancy (Hamill, 2017). It can be assumed, that due to the high rates of health disparities of minorities in Allegheny County the MMR for minority women would be higher than the state average and Community Health Workers could be used to help reduce MD (Sims, Bangs, & Thompson, 2002).

## Community Health Workers

The use of Community Health Workers has been recognized globally as a tool to successfully reduce negative health outcomes. CHWs are defined by WHO (1989) as any health worker who performs a functions related to health care delivery, was trained in some way in the context of the intervention but has received no formal professional or paraprofessional or tertiary education, should be members of the communities where they work, be selected by the communities, be answerable to the communities for their activities and should be supported by the health system. However, throughout the years, the definition of CHWs has shifted and changed. CHWs are more likely to receive more training than before (Maes & Kalofonos, 2013).

 CHWs are often employed as a way to offer care in communities where access and services are already lacking. While CHWs are not the answer to inadequate health care, they do provide support within the gaps (Tran, Portela, de Bernis, & Beek, 2014). Their ultimate goal is to extend services into communities where facilities do not exist. CHWs were integrated into the MDGs as necessary for their success (Singh & Sachs, 2013).

While CHWs have been used to help bridge the gap in care and health outcomes, not all implementation is successful and sometimes faces barriers. For example, barriers in implementation were an issue and had an impact on the reimbursement CHWs received (Giuglani et al., 2014). Through a literature review conducted by USAID (2015) on the effectiveness of CHWs, identified barriers include insufficient training, can be unsalaried and informal, weak internal systems, high work load, lack of necessary supplies and resources, remuneration, the influence of community contexts, motivation, and stigma.

Despite the use of CHWs as a method to improve health outcomes in some health care settings, CHWs are often underutilized. Most of the research regarding CHWs is based in other countries, especially low to mid income countries. However, the US has been using CHWs for years, though less frequently (Feudtner, Schreiner, & Lantos, 2013). In 2010 the Affordable Care Act, more specifically the Patient Protection and Affordable Care Act, placed an emphasis on CHWs to incentivize the use and evaluation of those programs (Islam et al., 2015). However, despite its success, the use of CHWs has some weaknesses as well. Barriers in implementation were an issue and had an impact on the reimbursement CHWs received (Giuglani et al., 2014).

# Methods

This paper is based on a systematic literature search to identify articles discussing the role of Community Health Workers in changing health outcomes. The search terms for this literature review were community health workers (CHWs), lay health workers (LHWs), community health extension workers (CHEWs), peer counselling, or home based care. PubMed, JSTOR, Google Scholar, PsychINFO, Wiley Online Library, and SAGE journals online were used to search for articles. Articles were included if they were a report or analysis of an intervention or program. Both quantitative and qualitative studies were included. Bibliographies of included articles were also used to identify additional articles. One hundred eighty nine abstracts were reviewed for this literature search between January 18, 2018, and March 19, 2018. Of those 189 articles, 12 articles fit the criteria. Literature reviews, systematic reviews, and overviews were excluded.

# Literature review

The literature yielded 12 articles that fit the inclusion criteria. They fall into nine categories. These categories include CHWS and HIV, HEWs and Registering Births, Self-care and CHWs, HEWs and the Prevention of Bacterial Infections, Breastfeeding and Peer Counselors, Tuberculosis Treatment and LSWs/CHWs, Cardiovascular Management and CHWs, Diabetes Management and CHWs, and Emergency Departments and CHWs.

## CHWs and HIV

### Counseling on Adherence and Community Health

Kenya et al. (2013) look at the Counseling on Adherence and Community Health (COACH) study to determine the success of whether CHWs were successful in increasing medication adherence for those who were HIV+. This study was a randomized control trial in Miami, Florida, that investigated AIDS-related mortality and how it has declined in many populations, yet many African-Americans and Latinos continue to be disproportionately impacted by HIV (Kenya et al., 2013). The study recruited 91 participants who had a history of non-adherence to taking their highly active antiretroviral medications (HAART) and were patients of the Special Immunology Clinics of Jackson Memorial Hospital, which is Miami-Dade’s only public hospital (Kenya et al., 2013).

Partners in Health (PIH) Prevention, Access, Care, and Treatment (PACT) programs in Haiti and in Boston were used as the basis of this program design. PIH and PACT utilize CHWs to address barriers to HIV care and HAART adherence among people living with HIV (Kenya et al., 2013). Participants who had a viral load below ≤1000 were recruited over a 13-month period (March 2008–June 2009) (Kenya et al., 2013). They were then randomized by a block scheme and number generator. The intervention group participants were assigned to one of four CHWs who had received training: online institutional training on patient protections in social/behavioral research and patient confidentiality, and a four-week long specialized training on HIV, barriers to medication adherence, and behavioral strategies to improve clinical HIV outcomes (Kenya et al., 2013).

The intervention participants received an initial assessment of social and system barriers to obtaining health care from CHWs (Kenya et al., 2013). This assessment included insurance status, stability of housing, food availability, medication adherence, social service needs, social support, transportation resources, and mental health of each participant to better create individualized plans services. CHWs conducted face to face interviews once a week for the first three months. These meetings, which lasted between one to two hours, focused on peer HIV health education, maximizing health-seeking behaviors, and the importance of medication adherence (Kenya et al., 2013).

After the first three months, CHWs connected with participants over the phone, phones were provided for those who did not have them (Kenya et al., 2013). CHWs contacted participants by telephone six to ten times per month to offer support and additional counseling. CHWs were also present to attend medical appointments and ensured the participant understood advice or recommendations. During the last 60 to 90 days of the program CHWs began referring participants to support groups, and reviewing HAART adherence strategies and how to maintain their health insurance and other social service benefits (Kenya et al., 2013).

The patients in the control group continued to receive care at the Special Immunology Clinics of Jackson Memorial Hospital; this group received assistance in medical follow-up, assessing medical, financial, educational, psychosocial, and referral needs for each client, and developing an individualized care plan with a case manager through the hospital (Kenya et al., 2013). The case manager was also responsible for providing one-on-one education and group education sessions on HIV and AIDS, transportation assistance, and help acquiring food vouchers. Not all participants used the case manager, and the study found the success of these services was dependent on the relationship between the case manager and the participant. CHWs were used to collect information for the study every three months but did not offer support to patients (Kenya et al., 2013).

Both the control group and intervention group showed decreases in viral loads; however, the decrease in the intervention group was significant (Kenya et al., 2013). Kenya et al. (2013) note that CD4 counts were not impacted by the intervention enough to be statistically significant; they suggest it could be because of the presence of other comorbidities. Even though CD4 counts did not show much improvement, the intervention group did show a decrease in the number of total inpatient days by 35%; the median length of stay decreased by 50% and accounted for a savings of $10,000 per participant per year; the intervention cost approximately $2,700 per participant (Kenya et al., 2013).

### Home-Based AIDS Care project

In most of Africa, home-based antiretroviral therapy (ART) has been expanded; however, the impact on social outcomes was still unknown so the Home-Based AIDS Care project (HBAC) was used in home visits to measure the impact of home-based ART on social outcomes (Apondi et al., 2007). These social outcomes include community support, family support, and relationship strengthening. According to Apondi et al. (2007), HBAC recruited 1,000 participants and 654 completed the study. HBAC is based in Tororo and Busia Districts, which are in rural Uganda. Participants were identified, screened, and enrolled between May 2003 and May 2004. Field officers, similar to peer counsellors, completed weekly home visits to all participants for drug delivery and monitoring. Questionnaires were provided at baseline and three months after ART initiation. The baseline interviews were included if they were collected between two weeks and 150 days after the initiation of ART (Apondi et al., 2007).

The participants received weekly home visits for three months (Apondi et al., 2007). Social outcomes measured and reported in this study include community support, family support, and relationship strengthening. Three methods were used to monitor the outcome of ART: clinical monitoring by trained lay persons only, clinical monitoring plus quarterly measuring of CD4 cell counts, and clinical monitoring plus quarterly CD4 cell counts and viral loads.

Not only did the intervention provide ART, it also gave medication for tuberculosis (TB) (Apondi et al., 2007). At follow-up after the intervention participants were more likely to report community, family support, and relationship strengthening, thus supporting the hypothesis that home-based ART care can improve social outcomes (Apondi et al., 2007).

## HEWs and Birth registry

Yaya et al. (2015) evaluated the use of health extension workers (HEWs) in Ethiopia to help register births and maternal deaths. Most births happen at home in rural south Ethiopia, making it difficult to track MMR or birth rates. In Ethiopia health extension programs (HEP) have been used in rural villages to improve health outcomes (Yaya et al., 2015).

In 2010, HEWs registered births and maternal deaths among 421,639 people in Derashe, Bonke, and Arba Minch Zuria. Yaya et al. (2015) used data from 2008, which reported an MMR in Ethiopia of 590 per 100,000 live births (LBs) (Hogan et al., 2010). They estimated MMR could decline by 10% in two years resulting in an MMR of 531 per 100,000 LBs (Yaya et al., 2015). In turn they anticipated 70 maternal deaths in a year out of an estimated 13,492 births and 13,223 LBs in a population of 421,639 people (Yaya et al., 2015).

The HEP program is a community-based healthcare system with two female HEWs (Yaya et al., 2015). The HEWs and their supervisors, who were experienced nurses, and the district health authorities completed a one week training. They helped the HEWs in reviewing and classifying deaths, monitoring the quality of data, and transferring the information from HEWs to the central data clerk. HEWs visited homes within hours or days after a pregnancy ended, registered birth conditions, and continued with follow-up until maternal death occurred or until the six-week mark occurred (Yaya et al., 2015). By using HEWs, the intervention registered more births and achieved more accurate reporting of MMR (Yaya et al., 2015). While the intervention had some limitations, overall it improved the ability to record and measure MMR (Yaya et al., 2015).

## Self-care and CHWS

Magana et al. (2015) conducted a randomized control study to investigate the efficacy of promotor/as in the Latina community. A promotor/a is a culturally sensitive health educator who receives training and understands the values of those with whom they work; these facilitators, who are similar to CHWs, conducted a manualized health intervention called “By Caring for Myself, I can Care Better for My Family,” which is designed to help Latina mothers of children with intellectual and developmental disabilities (IDD). The manual was designed to assist promotoras in the education of mothers/caregivers and increase their confidence in engaging in healthy behaviors, and in activities designed to improve health and reduce stress. This eight-week intervention focused on mothers of youths and adults with IDD (Magana et al., 2015).

The project worked with a well-established community-based organization that served people with development disabilities and their families to recruit 100 mothers over the age of 40 with children over the age of eight years old (Magana et al., 2015). The intervention was introduced due to evidence that shows that most services offered are aimed at people with IDD, not their caregivers or family (Magana et al., 2015). The intervention was eight-weeks in total for participants who were recruited between 2011 and 2014. The study was completed over a three-month span (Magana et al., 2015). The intervention focused on taking care of oneself, healthcare for oneself, well-being activities, nutrition, exercise, reducing stress and depression, and personal growth; promotoras visited homes for one to two hours each week (Magana et al., 2015). The intervention group received a participant version of the manual, a folder containing information about local resources, and eight in-home visits while the control group received participant manuals with the intervention content, but did not receive home visits with promotoras (Magana et al., 2015).

 According to Magana et al. (2015), both the control group and intervention group experienced a decrease in depressive symptoms but the intervention group showed significant increases in self-efficacy, self-care, nutrition, and overall health behaviors; this intervention was conducted in a smaller Latina community, which could benefit from additional research to measure its long-term effects and documents the positive impact of CHWs or promotoras within a community (Magana et al., 2015).

## HEWs and the prevention of bacterial Infections

Ethiopia has the second highest population in Africa, with a slow reduction in neonatal deaths (Mathewos et al., 2017). In 2012, approximately 6.9 million neonatal deaths world wide were caused by bacterial infections like meningitis, sepsis, and pneumonia (Wang et al. 2016). A multi-country standardized economic evaluation was conducted to look at the benefits and costs of using HEWs to help manage possible serious bacterial infections in newborns (PSBI) (Mathewos et al., 2017). The intervention took place in 2012. The intervention used the government and several community organizations to host a cluster randomized trial.

In the intervention group arm, oral and injectable antibiotics were provided at health posts when referral was not possible or acceptable due to circumstances, as compared to the control group that had no access to health posts (Mathewos et al., 2017). The intervention arm received more equipment that was equipment usable for more than one year and included motorbikes for Project Officers (POs) and HEW kits. Both intervention groups received training, but the intervention arm received one extra day of training on infection management which included PSBI training. Both groups also received in-home visits (Mathewos et al., 2017).

The intervention was analyzed for its ability to save money. The cost for the intervention arm was $37 and $30 for the control arm (Mathewos et al., 2017). While HEWs spent only 9% of their time on the project, the intervention reduced neonatal mortality by 17%, which translates to $223 saved per Disability-Adjusted Life Year. The cost-benefit analysis showed that the intervention was cost-effective and avoids costly transfers to health centers and hospitals. In the future, Mathewos et al. (2017) recommend that a platform-wide approach for HEWs should improve supervision and include a budget dedicated to transportation; these changes would help with sustainability.

## Breastfeeding and peer counselors

Breastfeeding newborns is recommended worldwide, but is not commonly practiced in Mexico City, so Morrow et al. (1999) introduced an intervention that focused on increasing education and breastfeeding incidence. One hundred thirty mothers participated in the study; all were residents of periurban Mexico City (Morrow et al., 1999).

 The mothers were split into three groups: one group received six counselling visits, the second group received three counseling visits, and the control group had no intervention (Morrow et al., 1999). Mothers in the first group were visited in mid- and late pregnancy, and in weeks one and two, four, and eight postpartum. In the three-visit intervention group, mothers were visited in late pregnancy, and in the first and second weeks postpartum (Morrow et al., 1999).

For both groups peer counsellors were permitted to respond to additional requests initiated by mothers for more support. The control group mothers were referred to their physicians for help regarding lactation difficulties and no other resources were available in the community (Morrow et al., 1999).

The interventions took place between March 1995 and September 1996 with 130 mothers (Morrow et al., 1999). When Morrow et al. (1999) assessed the mothers breastfeeding habits at three month postpartum, they found that 67% of mothers who received six visits and 50% of mothers who received three visits compared to 12% of control mothers reported exclusively breastfeeding. The results show home-based peer counselling significantly increased the likelihood of mothers exclusively and partially breastfeeding their babies. The mothers in the intervention groups, who had more visits with peer counsellors, were more likely to breastfeed their babies than those the control group (Morrow et al., 1999).

## Tuberculosis treatment and LWs/CHWs

### Lay health worker intervention with choice of DOT

Clarke et al. (2005) evaluated lay health workers (LHW) and their impact on TB in South Africa, which in 2002 had the 9th highest incidence of TB. Implementation in 1996 of the WHO’s DOT (Directly Observed Treatment) strategy to reduce TB incidence, did not have the anticipated impact. The intervention took place on several farms in the Boland health district, Western Cape Province, South Africa, with permanent farm workers and farm dwellers (Clarke et al., 2005). One hundred and sixty-four participants were recruited for this intervention.

The farms selected for the intervention used farm-dwelling peers for training as LHWs. If LHWs did not already exist on the farms, they were requested to incentivize the participation as a LHW. The selected farm dwellers were invited to information sessions to discuss the local TB situation and the intended intervention.

During the intervention LHWs weighed participants and screened them monthly for TB, referring participants for additional tests at a treatment clinic when appropriate (Clarke et al., 2005). Clarke et al. (2005) found that the intervention groups on some farms were 18% more likely to complete treatment than those without the intervention, which shows that LWHs were able to improve the rate of successful treatment of TB in individuals who were new smear-positive.

### Control of tuberculosis by community health workers in Bangladesh

In Bangladesh, TB was a major public health issue in the 1970’s and 1980’s despite efforts to improve diagnosis and treatment (Chowdhury et al., 1997). In 1984, CHWs were introduced to a sub-district of Bangladesh through the Bangladesh Rural Advancement Committee (BRAC) as a way to screen villagers for chronic cough and collect sputum samples for acid-fast bacillus (AFB) microscopy (phase one) (Chowdhury et al., 1997). The analysis looks at data from 1992 to 1995. The authors analyzed phase two (12-month therapy) and phase three (eight-month therapy) of the intervention separately to measure proportion cured, died, treatment failed, defaulted, migrated, and referred. During this time 9,000 homes were randomly selected and 3,886 were identified as eligible. Of those 3,886, (90%) 3,497 accepted 12-month treatment. All 1,741 of phase three identified cases accepted the eight-month regimen.

Following diagnosis, participants were directly observed by CHWs for one year. In phases two and three more sub-districts were added (Chowdhury et al., 1997). Treatment and adherence to medication was high during the intervention, 81% in phase one and 85.5% in phases two and three with a cure rate of 85%. While the program showed improvement in adherence to TB treatment, for unknown reasons, once the intervention ended the relapse rate was accelerated; however, the program is responsible for at least half of the TB diagnoses, suggesting success during the program (Chowdhury et al., 1997).

## Cardiovascular management and CHWs

Even though information has been provided on the necessary steps and importance of managing cardiovascular disease and type-2 diabetes, their incidence rates still remain high (Allen et al., 2011). Allen et al. (2011) looked at the results of a randomized controlled clinical trial evaluating the effectiveness of a comprehensive program of cardiovascular disease risk reduction through the use of nurse practitioners (NP) as well as CHWs from two community health centers in Baltimore, MD, which are part of the federally qualified community Baltimore Medical Systems Incorporated. The intervention was intended to improve lipids, blood pressure, glycated hemoglobin and patients’ perceptions of the quality of their chronic illness care in patients in urban community health centers (Allen et al., 2011). Community Outreach and Cardiovascular Health (COACH) and community-based participatory research (CBPR) were used for this intervention.

 Participants were recruited between July 2006 and July 2009.  Patients were enrolled in the trial if they were 21 years of age or older and had at least one of the following criteria within the past six months: (1) an LDL-C ≥ 100 mg/dl or LDL-C ≥ 130 mg/dl if no diagnosed CVD or diabetes, (2) a blood pressure > BP 140/90 mm Hg or > 130/80 mm Hg if diabetic or renal insufficiency, or (3) if diabetic, a HbA1c 7% or greater or glucose ≥ 125 mg (Allen et al., 2011).

The intervention group received enhanced usual care plus management by the NP/CHW team. Enhanced usual care includes aggressive pharmacologic management, tailored educational and behavioral counseling for lifestyle modification, identification of barriers to adherence and control, phone follow-ups between visits and pre-appointment reminders (Allen et al., 2011). Participants in the control group received usual care from their primary provider which was enhanced by feedback regarding CVD risk factors provided to the patient and their providers.

Patients were followed for a year by NPs and CHWs who were trained in motivational interviewing and were responsible for tracking adherence to protocols (Allen et al., 2011). CHWs worked to reiterate the information participants received from NPs. After a year of the intervention, participants in the intervention group significantly greater overall improvement in total cholesterol, LDL cholesterol, triglycerides, systolic and diastolic BP, HbA1c, and perceptions of the quality of their chronic illness care compared to patients receiving enhanced usual care (Allen el al., 2011).

## Diabetes management and CHWs

### CHWs and Diabetes in LA

Hispanics are disproportionately impacted by many health issues (Babamoto et al., 2009), including diabetes. Babamoto et al. (2009) conducted a prospective randomized pre–post measurement design randomized control trial that looked at CHW, case management, or standard provider care. One hundred and eighty-nine eligible patients were recruited and enrolled during routine clinic visits at three inner-city family health centers in Los Angeles. The inclusion criteria are as follows: Hispanic/Latino by self-report, 18 years of age or older, and diagnosis of type-2 diabetes within six months of study enrollment; patients with gestational diabetes or previous diabetes case management were excluded (Babamoto et al., 2009).

Each participant, regardless of group assignment, received standard provider care from a physician and/or nurse practitioner. Standard provider care included routine clinic appointments, laboratory tests, medications, and referrals. CHWs looked at the impact that bilingual CHWs could have on improving health status, emergency department utilization, dietary habits, physical activity, and medication adherence for Hispanics newly diagnosed with type-2 diabetes (Babamoto et al., 2009). Through the use of three full-time bilingual CHWs, the diabetes education and monitoring services incorporated individual participant preferences. Routine follow-up telephone calls were made to participants in order to monitor self-management progress, identify barriers and issues, and assist in problem solving. The intervention period was six months and CHWs conducted individual educational sessions based on American Diabetes Association (ADA) standards with participants and their family members (Babamoto et al., 2009). The education sessions were 10 weeks long and tailored to the participants’ needs such as their knowledge level, identified problems, goals, and level of progress. CHWs used the study materials to provide education, positive reinforcement, and tips on achieving health behavior goals.

Those who were assigned to the case management group received care in a more clinical setting from two culturally competent nurses who were considered linguistically competent. They worked directly with patients one-on-one, following standardized clinic protocols for diabetes education, and monitoring based on ADA clinical recommendations (Babamoto et al., 2009). On average patients were seen once a month and follow-up calls were made as deemed necessary by the case manager. The third and final group received standard care as defined above without the use of CHWs or case managers. Those in the intervention groups were more likely to experience improved health behaviors, including increased intake in fruits and vegetables, reliable medication adherence, increased exercise (28%-62%), and a decrease in fatty food intake compared to those who were not in the intervention group (Babamoto et al., 2009).

### CHWs and diabetes in East Harlem

Corkery et al. (1997) evaluated the effect of bicultural CHWs on the completion of diabetes education and the impact of the education program on patient knowledge, self-care behaviors, and glycemic control. The patients were recruited through the diabetes management clinic in New York City, serving East Harlem, which has a large minority population including Hispanics. The participants were randomized into two groups: one with CHWs and one without (Corkery et al., 1997). Sixty four patients were enrolled, but only 40 completed the study.

All participants met with a certified diabetes nurse educator and received individualized, comprehensive diabetes education after the initial assessment, which collected demographic information, diabetes knowledge, diabetes self-care practices, and glycohemoglobin levels (Corkery et al., 1997). This information was collected at the completion of the intervention and again at a post-program medical appointment follow-up. The CHW was a bicultural, bilingual Hispanic-American of Puerto Rican heritage who was a resident of East Harlem and had previous volunteer experience in a diabetes clinic. The CHW acted as a liaison between patients, their families, and health care providers. CHWs attended clinic sessions with selected patients and a Spanish interpreter, reinforced self-care instructions, reminded patients of upcoming appointments, and rescheduled missed appointments. The control group did not use the CHW, meaning interactions occurred between a nurse and the patient, and sometimes the family member. Corkery et al. (1997) found that the intervention group with bicultural CHWs improved rates of completion of a diabetes education program (80%) compared to the control group (47%), and glycemic control improved as Glycohemoglobin levels improved from mean baseline values of 11.7  ± 3.7% to 9.9 ± 2.2% (Corkery et al., 1997).

## Emergency Deparments and CHWs

In Baltimore, CHWs were introduced to an emergency department to help physicians detect and treat high blood pressure (HBP) in high-risk black men and follow up with them. The intervention continued over a two-year span with a total of 256 participants (Bone et al., 1989). Participants were recruited through the Adult Emergency Department at John Hopkins in Baltimore. During that time CHWs took BP and pulse measurements, provided and educational counseling regarding HBP and cardiovascular risk factors, made telephone calls to patients before appointments to improve ED follow-up visit rates, and contacted patients who did not go to follow-up visits. The goal was to improve return rates even after a missed BP appointment. This intervention showed that the use of CHWs to provide pre-appointment reminders improved appointment follow-through by 19%. and an overall improvement of 7% for appointment keeping (Bone et al., 1989).

# Discussion

Community health workers and other lay health workers have been used to improve health outcomes around the world. This review looked at studies reporting the use of CHWs to address several different public health issues including HIV, registering births, IDD and caregiver self-care, PSBI in newborns, breastfeeding, tuberculosis, cardiovascular disease, diabetes, and high blood pressure detection in EDs. CHWs have been increasing in number and this review looked at their use in programs in India, Bangladesh, South Africa, Ethiopia, and the US. Most of the articles reviewed showed that CHWs were effective, especially when mandated and supported by local government. CHWs or similar programs showed a positive impact on improving health outcomes.

As MM continues to increase in the US so does the urgency for addressing the gaps in care for women in rural areas and minority women. The literature shows that the presence of CHWs or other lay people can have a positive impact on improving health outcomes. When appropriately trained, CHWs offer support and services where physicians might not be able to reach.

CHW programs could do several things to help reduce maternal mortality in Allegheny Country. In PA, black women are more likely than white women to experience complications during hospitalized delivery and labor (Department of Health, 2016). As black women are known to have more complications due to pre-existing conditions during labor, CHWs could be used to help get black women into treatment sooner, and help increase participation in prenatal care. For example, eclampsia, which is the result or pre-eclampsia, which shows up after the 20th week of pregnancy is the result of high blood pressure and is more common in women who have high blood pressure before pregnancy according to the (American College of Obstetricians and Gynecologists [ACOG], 2014). Access of CHWs in communities, not just during pregnancy, but before pregnancy could help improve overall health. In Allegheny County, Pennsylvania, though programs to support black families exist, they do not focus on health disparities, not specifically addressing mortality among black residents (Ajang, 2007). By helping black and minority women focus on their health, it will ultimately increase their own health and the health of their babies.

As mentioned in Magana et al. (2015), promotaras were successful in minority populations to increase self-care among mothers who were caregivers of children with IDD. In Pennsylvania, measuring maternal mortality has been limited, and for minority women, especially Hispanic women, it has been even less so. When looking at Hispanic mothers, they are 44.9 percent more likely to not receive prenatal care during the first trimester (Pennsylvania Department of Health, 2012). However, these numbers could be much higher due to those who do not trust using the formal health system (Documet, 2001). According to Documet (2001), Hispanics and Latino/as in Southwestern Pennsylvania (SWPA) are more likely to use informal sources when meeting their health needs. When dealing with these minority populations, it is important to remember that financial access is not the only barrier faced, but also includes language and cultural barriers (Documet, 2001). CHWs can help bridge these gaps. Educating community members would help increase trust and cultural and language barriers.

CHWs will help not only minority women, but women in rural areas who often do not have easy access to health care services. Only 6% of the nation’s obstetrician-gynecologists work in rural areas (Maron, 2017). By using CHWs as a module for health care, basic education could be provided to communities. Between Pittsburgh’s large hospital systems, community health centers, and through organizations like the Latino Family Center Pittsburgh and Allegheny County are well posed to implement a CHW model to help bridge the gaps to care. Programs should remain small and manageable in order to make sure they are tailored to the needs of each community. The most effective healthcare programs and interventions exist when they meet people where they are. As discussed in Yaya et al. (2015), CHWs are cost-effective, so it would prove be beneficial for insurance companies to invest and allow for CHWs to be billed for and receive reimbursement for services offered.

# CONCLUSION

The purpose of this paper was to look at the utilization of CHWs and similar lay health persons to improve various health outcomes. As MM rates decline in some part of the world but continue to rise in the US, CHWs could be part of the answer. CHWs have different titles and different duties making data collection difficult to collect and compare effectiveness. In addition to diversity in CHWs, a limitation included that articles were only read in English. Despite the diversity in CHWs and their titles, CHW programs have the ability to offer support to communities and improve health outcomes.

 In many cases, programs that used CHWs saw improved outcomes that benefited the health of participants.

This review looked at the benefit of CHW programs on rural and minority population health, often in hard to reach populations like those with HIV to improve medication adherence. In other parts of the world HEWs were used to help register births; this intervention not only achieved its increase in birth registrants, but also improved some outcomes for mothers and infants after birth.

 Not only did HEWs improve health, but CHW promotoras focused on self-care among mothers who were caregivers of IDD. The manualized intervention is an intervention that used manuals on a specific health education subject and then used promotoras to implement the education to improve basic self-care like eating well, less depressive symptoms, and improving overall health behaviors. CHWs were also used to help prevent PSBI in newborns successfully. They have also been used successfully in improving breastfeeding incidence, tuberculosis treatment adherence, managing cardiovascular issues, diabetes, and helping EDs.

 African American and minority women deserve to have a high quality of life and survive childbirth to raise their children and those who live in rural areas of the US. CHWs could help improve health outcomes not only for pregnant women, but all women. By investing in the health of women in these sometimes hard to reach communities, we can improve health for entire families. No one deserves to be left behind merely because of where they live, the color of their skin, or the language they speak.

bibliography

American College of Obstetric Gynocology (2014). Preeclampsia and High Blood Pressure During Pregnancy. Retrieved from <https://www.acog.org/Patients/FAQs/Preeclampsia-and-High-Blood-Pressure-During-Pregnancy>

Agrawal, P. (2015). *Maternal mortality and morbidity in the United States of America*. Retrieved from <http://www.who.int/bulletin/volumes/93/3/14-148627/en/>

Ajang, G. D. (2007). *Health Disparities: Education, Race and Mortality*. Retrieved from <http://www.achd.net/biostats/pubs/Gabe/disparities.html>

Allen, J. K., Himmelfarb, C. R. D., Szanton, S. L., Bone, L., Hill, M. N., Levine, D. M., . . . Anderson, K. (2011). COACH Trial: A Randomized Controlled Trial of Nurse Practitioner/Community Health Worker Cardiovascular Disease

Risk Reduction in Urban Community Health Centers. *Circ Cardiocasc Qual Outcomes, 4*(6), 595-602. doi:10.1161/CIRCOUTCOMES

Apondi, R., Bunnell, R., Awor, A., Wamai, N., Bikaako-Kajura, W., Solberg, P., . . . Mermin, J. (2007). Home-Based Antiretroviral CareIs Associated With Positive Social Outcomes in a Prospective Cohort in Uganda. *J Acquir Immune Defic Syndr, 44*(1).

Babamoto, K. S., Sey, K. A., Camiller, A. J., Karlan, V. J., Catalasan, J., & Morisky, D. E. (2009). Improving Diabetes Care and Health Measures Among Hispanics Using Community Health Workers. *Health Educ Behav., 36*(1).

Bone, L. R., Mamon, J., Levine, D. M., Walrath, J. M., Nanda, J., Gurley, H. T., . . . Ward, E. (1989). Emergency department detection and follow-up of high blood pressure: Use and effectiveness of community health workers. *The American Journal of Medicine, 7*(`), 16-20.

Chowdhury, A. M. R., Chowdhury, S., Islam, N., Islam, A., & Vaughan, J. P. (1997). Control of tuberculosis by community health workers in Bangladesh. *The Lancet, 350*(9072), 169-172.

Clarke, M., Dick, J., Zwarenstein, M., Lombard, C. J., & Diwan, V. K. (2005). Lay health worker intervention with choice of DOT superior to standard TB care for farm dwellers in South Africa: a cluster randomised control trial. *INT J Tuberc Lung Dis, 9*(6), 673-679.

Corkery, E., Palmer, C., Foley, M. E., Schechter, C. B., Frisher, L., & Roman, S. H. (1997). Effect of a bicultural community health worker on completion of diabetes education in a Hispanic population. *Diabetes Care, 20*, 254-257.

Dimick, C. (2014). CMS Announces October 2015 as New ICD-10 Compliance Date. Retrieved from <http://journal.ahima.org/2014/05/01/cms-proposes-october-2015-as-new-icd-10-compliance-date/>

Documet, P. (2001). *Latinos’ health care access in southwestern Pennsylvania.* University of Pittsburgh, Retrieved from [http://www.healthequity.pitt.edu/sites/default/files/Documet dissertation 2001.pdf](http://www.healthequity.pitt.edu/sites/default/files/Documet%20dissertation%202001.pdf)

Feudtner, C., Schreiner, M., & Lantos, J. D. (2013). Risks (and benefits) in comparative effectiveness research trials. *N Engl J Med, 369*(10), 892-894. doi:10.1056/NEJMp1309322

Giuglani, C., Bartholow, B., Harzheim, E., Lavor, A. C. H., Lavor, M. C., Machado, M. M. T., . . . Knauth, D. R. (2014). Community health workers programme in Luanda, Angola: an evaluation of the implementation process. *Human Resources for Health, 12*(68).

Hamill, S. D. (2017). State committee would study rising maternal mortality rate in Pennsylvania. *Pittsburgh Post-Gazette* Retrieved from <http://www.post-gazette.com/news/health/2017/12/12/State-committee-would-study-rising-maternal-mortality-rate-in-Pennsylvania/stories/201712120181>

Hamill, S. D. (2018). State could speed up maternal mortality review impact by looking at past cases, expert says. *Pittsburgh Post-Gazette*. Retrieved from <http://www.post-gazette.com/news/health/2018/01/02/Pennsylvania-maternal-mortality-pregnancy-womens-health-review-impact-house-committee/stories/201712290176>

Hogan, M. C., Foreman, K. J., Naghavi, M., Ahn, S. Y., Wang, M., Makela, S. M., . . . Murray, C. J. (2010). Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5. *The Lancet, 375*, 1609-1623.

Islam, N., Nadkarni, S. K., Zahn, D., Skillman, M., Kwon, S. C., & Trinh-Shevrin, C. (2015). Integrating community health workers within Patient Protection and Affordable Care Act implementation. *J Public Health Manag Pract, 21*(1), 42-50. doi:10.1097/PHH.0000000000000084

Kenya, S., Jones, J., Arheart, K., Kobetz, E., Chida, N., Baer, S., . . . Carrasquillo, O. (2013). Using community health workers to improve clinical outcomes among people living with HIV: a randomized controlled trial. *AIDS Behav, 17*(9), 2927-2934. doi:10.1007/s10461-013-0440-1

MacDorman, M. F., Declercq, E., Cabral, H., & Morton, C. (2016). Recent Increases in the U.S. Maternal Mortality Rate: Disentangling Trends From Measurement Issues. *Obstet Gynecol, 128*(3), 447-455. doi:10.1097/AOG.0000000000001556

Maes, K., & Kalofonos, I. (2013). Becoming and remaining community health workers: perspectives from Ethiopia and Mozambique. *Soc Sci Med, 87*, 52-59. doi:10.1016/j.socscimed.2013.03.026

Magana, S., Li, H., Miranda, E., & Paradiso de Sayu, R. (2015). Improving health behaviours of Latina mothers of youths and adults with intellectual and developmental disabilities. *J Intellect Disabil Res, 59*(5), 397-410. doi:10.1111/jir.12139

Maron, D. F. (2017). Maternal Health Care Is Disappearing in Rural America. *Scientific American*. Retrieved from <https://www.scientificamerican.com/article/maternal-health-care-is-disappearing-in-rural-america/>

Mathewos, B., Owen, H., Sitrin, D., Cousens, S., Degefie, T., Wall, S., . . . Daviaud, E. (2017). Community-Based Interventions for Newborns in Ethiopia (COMBINE): Cost-effectiveness analysis. *Health Policy Plan, 32*(suppl\_1), i21-i32. doi:10.1093/heapol/czx054

Morrow, A. L., Guerrero, M. L., Shults, J., Calva, J. J., Lutter, C., Bravo, J., . . . Butterfoss, F. D. (1999). Efficacy of home-based peer counselling to promote exclusive breastfeeding: a randomised controlled trial. *The Lancet, 353*(9160), 1226-1231. doi:10.1016/s0140-6736(98)08037-4

Nour, N. M. (2008). An Introduction to Maternal Mortality. *Reviews in Obstetrics & Gynecology, 1*(2), 77-81.

Pennsylvania Department of Health (2012). *Pennsylvania Health Disparities Report 2012*. Retrieved from [http://www.health.pa.gov/Your-Department-of-Health/Offices and Bureaus/Health Equity/Documents/2012 Health Disparities Report(2)Final.pdf](http://www.health.pa.gov/Your-Department-of-Health/Offices%20and%20Bureaus/Health%20Equity/Documents/2012%20Health%20Disparities%20Report%282%29Final.pdf)

Pennsylvania Department of Health (2016a). *Tracking Healthy People 2020 Objectives Family Health Statisticsfor Pennsylvania and Counties* Retrieved from <http://www.statistics.health.pa.gov/HealthStatistics/VitalStatistics/FamilyHealthStatistics/Documents/Family_Health_Statistics_FullReport.pdf>

Pennsylvania Department of Health (2016b). *Family Health Statistics for Pennsylvania and Ccounties 2010-2014*. Retrieved from <http://www.statistics.health.pa.gov/HealthStatistics/VitalStatistics/FamilyHealthStatistics/Documents/Family_Health_Statistics_FullReport.pdf>

 Philadelphia Department of Public Health Medical Examiner’s Office (2015). *Maternal Mortality in Philadephia* *2010-2012*. Retrieved from [http://www.phila.gov/health/pdfs/MMR 2010-12 Report - final 060115.pdf](http://www.phila.gov/health/pdfs/MMR%202010-12%20Report%20-%20final%20060115.pdf)

Sims, T. N., Bangs, R., & Thompson, K. (2002). *Health problems among african american women age 35-64 in allegheny county: a black paper for the urban league of pittsburgh*. Retrieved from <https://ucsur.pitt.edu/files/center/>WomensHealthBlackPaper.pdf

Singh, P., & Sachs, J. D. (2013). 1 million community health workers in sub-Saharan Africa by 2015. *The Lancet, 382*(9889), 363-365. doi:10.1016/s0140-6736(12)62002-9

Tran, N. T., Portela, A., de Bernis, L., & Beek, K. (2014). Developing capacities of community health workers in sexual and reproductive, maternal, newborn, child, and adolescent health: a mapping and review of training resources. *PLoS One, 9*(4), e94948. doi:10.1371/journal.pone.0094948

Tucker, M. J., Berg, C. J., Callaghan, W. M., & Hsia, J. (2007). The Black-White disparity in pregnancy-related mortality from 5 conditions: differences in prevalence and case-fatality rates. *Am J Public Health, 97*(2), 247-251. doi:10.2105/AJPH.2005.072975

United Nations (2010). The World's Women 2010: Trends and Statistics. Retrieved from [https://unstats.un.org/unsd/demographic/products/worldswomen/executive summary.htm](https://unstats.un.org/unsd/demographic/products/worldswomen/executive%20summary.htm)

U.S. Department of Health and Human Services, Center for Disease Control. (2017). Pregnancy Mortality Surveillance System. Retrieved from <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html>

United States Agency International Development USAID. (2015). *Factors impacting the effectiveness of community health worker behavior change: A literature review.* Retrieved from <http://healthcommcapacity.org/wp-content/uploads/2015/06/Barriers-to-CHW-Svc-Provision-Lit-Review-June2015.pdf>

Wang, M. E., Patel, A. B., Hansen, N. I., Arlington, L., Prakash, A., & Hibberd, P. L. (2016). Risk factors for possible serious bacterial infection in a rural cohort of young infants in central India. BMC Public Health, 16, 1097.

World Bank, W. B. (2011). *Conflict, Security, and Development*. Retrieved from <https://siteresources.worldbank.org/INTWDRS/Resources/WDR2011_Full_Text.pdf>

World Health Organziation (1989). *Strengthening the performance of community health workers in primary care*. Retrieved from <http://apps.who.int/iris/bitstream/10665/39568/1/WHO_TRS_780.pdf>

World Health Organization (2015). *Trends in maternal mortality: 1990 to 2015:estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.* Retrieved from

World Health Organization. (2016). *Maternal Mortality Fact Sheet*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs348/en/>

Yaya, Y., Data, T., & Lindtjorn, B. (2015). Maternal mortality in rural south Ethiopia: outcomes of community-based birth registration by health extension workers. *PLoS One, 10*(3), e0119321. doi:10.1371/journal.pone.0119321