# THE EFFICACY OF MATERNITY WAITING HOMES IN DECREASING MATERNAL AND PERINATAL MORTALITY IN LOW-INCOME COUNTRIES: A SYSTEMATIC REVIEW

## CHAPTER 1

A thesis submitted to the University of Arizona College of Medicine – Phoenix
in partial fulfillment of requirements for the Degree of Doctor of Medicine

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## Abstract

**Background:** Maternal and perinatal mortality remains significantly high in low-income countries with over 800 deaths per day of women around childbirth. Greater than 90% of such deaths occur in low-income countries. The concept of maternity waiting homes (MWH) was reintroduced to aid in decreasing maternal and perinatal mortality. Since the previous Cochrane Review in 2012 on maternity waiting homes, there have not been any published randomized controlled studies.

**Research Question:** Do observational studies on MWHs demonstrate decreased maternal and perinatal mortality in low-income countries when compared with the standard of care?

**Methods:** We searched for primary articles that reported maternal and perinatal deaths as major outcomes in studies who compared MWHs to other methods such as direct hospital admits, we also investigated cesarean delivery rates. Search engines used were: Cochrane Review, Medline and CINAHL. Meta-analyses and forests plots were formulated using MedCalc Software. Systematic review was drafted using MOOSE guidelines for meta-analysis and systematic reviews of observation.

**Results:** Seven articles met criteria for this study. The maternal mortality rate for MWH was 105/100,000 and 1,066/100,000 for non-MWH, Relative Risk (RR) 0.145 (95% Confidence Interval (CI) 0.062 to 0.204). Perinatal mortality rate was 60/1,000 in MWH compared to 65/1,000, RR 0.782 (CI 0.602 to 1.120) in non-MWH. Stillbirth rate was 18/1,000 in MWH and 184/1,000 in non-MWH, RR 0.204 (CI 63.88 to 94.08). Neonatal mortality rates were 16/1,000 in MWH and 15/1,000 in non-MWH, RR 0.862 (CI 0.392 to 1.628). Cesarean deliveries rate was 24/100 for MWH and 18/100 in non-MWH, RR 1.229 (CI 1.226-1.555).

**Conclusion:** MHWs statistically decreased maternal death, stillbirths and increased cesarean delivery rates. Overall, the observation nature of the study designs introduces selection biases that may have altered the results of the studies. No randomized trials have been done to date. We suggest cluster-randomized studies to further evaluate the effect of MWHs.

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## Introduction and Significance

### Background, Significance, Hypothesis, Research Question and Goals of Study

Maternal death is described by the World Health Organization as the "death of a mother while pregnant or within 42 days of delivery, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not form accidental or incidental causes." [1] Maternal mortality is calculated by the number of deaths divided by 100,000 live births. As many as 830 women die daily worldwide due to complications from child birth, with over 90% of this number occurring in low-income countries. [2] Most of these deaths are due to postpartum hemorrhage, infections, hypertensive disorders and unsafe abortions. [1] In the year 2000, eight goals were set by the United Nations to improve quality of health internationally and decrease health disparities in doing so. The eight goals were termed the Millennium Development Goals (MDG). Number five on this list was maternal health. The committee's ascribed to decrease maternal mortality by 75% between the years of 1990 and 2015. [3] Unfortunately, maternal mortality was only decreased by 45% at the end of 2015 according to the MDG Report 2015. The new report also highlighted that 71% of deliveries had skilled health personnel present as opposed to 59% in 1990 globally. [4] The report reiterates the importance of continuous attention, innovation, education and resource delegation to developing countries in order to continue to downward trend of maternal mortality.

One of such innovation is maternity waiting homes (MWH), which are institutions built in close proximity to a major hospital, intended to house women with high risk pregnancies towards the end of their pregnancy in order to have close monitoring and easier access to the main hospital. This concept dates back to the early 20$^{th}$ century where countries in Europe, Canada and the United States established MWH to improve maternal and child health. [5] MWH have resurfaced over the last four to five decades as a means to decreasing maternal and perinatal mortalities in developing countries.

Based on the possible prior success of MWH, and the United Nations emphasis on decreasing maternal mortality through MDG 5, we sought to synthesize the evidence on whether MWH can decrease maternal and perinatal mortality in low- world countries where

maternal mortality rates (MMR) remain high. Upon research on the literature, one systematic review published in 2012 in the Cochrane Review found insufficient evidence to recommend MWH due to limited availability of literature citing no randomized trials. [6] We wished to analyze if new literature could further highlight the benefit of MWH and meta-analyze observational studies to assess the possible magnitude of the effect of MWH.

## Materials and Methods

Prior to the systematic review, a prospectus was created to organize and outline the components of the future study. A comprehensive review, characterizing maternal mortality, trends, causes and interventions was also constructed before the systematic review in order to gain a deeper understanding on the topic. The review is included in chapter 2 of this thesis.

### Sources

The search for randomized controlled trials and observational studies was performed by myself (AM) and Dr. Coonrod with the help of the librarian at the University of Arizona, College of Medicine- Phoenix. The literature searches were performed between the years of 2012 and 2016. We primarily utilized Medline/PubMed, Cochrane Library, CINAHL and Embase search engines. The search terms used were "maternity waiting homes," "maternal mortality and maternity waiting homes," and "maternity waiting homes in decreasing maternal mortality."
We also looked through bibliographies for articles not found with the search engines. Once the search was complete, we narrowed down articles by reading the abstract, and determining if the selection criteria addressed below was met.

**Table 1: Literature search**

(reported as number of studies that met criteria/total studies)

| Search Term | MEDLINE | Cochrane | CINHAL | Embase |
|---|---|---|---|---|
| **"maternity waiting homes"** | 2/17 | 0/1 | 0/4 | 3/50 |
| **"maternity waiting area"** | 4/103 | 0/2 | 1/2 | 1/26 |
| **"maternal mortality and maternity waiting homes"** | 1/23 | 0/1 | 0/4 | 1/20 |
| **"maternity waiting homes and perinatal mortality"** | 1/6 | 0/1 | 0/1 | 1/7 |
| **"maternity homes"** | 1/311 | 0/7 | 1/125 | 2/311 |

**Study Selection:**

The following inclusion and exclusion criteria were used to select studies:

- Study had to be in English or translated into English
- Study had to be published
- Study could be a randomized controlled or observational
- Case reports were excluded
- Study must have utilized MWH as an intervention and compared it to some standard of care, whether direct hospital admits or home births
- Study must have compared maternal or perinatal mortality in MWH to that of the standard of care
- Study had to be based in a low-income country
- No limitation was placed on the year studies were published due to lack of available studies

Seven observational studies met criteria for this study. No randomized controlled trials were found during our search. There was some overlap in the studies found in the above table. Between the listed search engines, five studies met criteria for the systematic review. The remaining two studies were found in the bibliography of the previous systematic review. The studies were independently reviewed by myself (AM) and my mentor (DVC). We extracted outcomes on maternal deaths, perinatal deaths – which was further broken down to stillbirths and neonatal deaths, and cesarean deliveries. Maternal death was defined as death of a woman during pregnancy or within 42 days after delivery. Perinatal morality on the other hand is the combination of stillbirths and death of a newborn within seven days of life. Neonatal death occurs between the first 28 days of life. The outcomes were combined and MedCalc Meta-Analysis software was used to statistically analyze the data using both fixed and random effect models based on relative risks. Forests plots were created using the extracted data. The systematic review was drafted using the MOOSE guidelines for meta-analysis and systematic reviews of observation.

## Results

Seven observational studies met criteria for this study. There were no published randomized controlled or cluster- randomized controlled studies found on the topic. The previous Cochrane Review study published in 2012 did not find any randomized controlled studies and did not perform meta-analyses on the observational studies found. All the studies included in our study were excluded from the previous systematic review. There have not been any new studies since the last published Cochrane review in 2012.

### Summaries of Included Studies

**Lonkhuijzen et al. "Use of maternity waiting homes in rural Zambia." [7]**

This was a prospective study conducted in 1994 in Eastern Zambia. The study compared a MWH to the town's major hospital, Nyanje RCZ. The MWH was built next to the main hospital. The hospital caters to a population of about 60,000 people. The distance traveled by people in the town to the nearest hospital is about 80km. The MWH was recommended to women with high risk pregnancies by their local providers, but the home also accepted any pregnant woman who wished to stay. There was a fee to stay at the home with provision of food at no additional cost. Outcomes measured were parity, previous pregnancy risks, mode of delivery, maternal and perinatal mortality. The outcomes were compared between the MWH and direct hospital admits. The study recorded 218 births in the MWH and 292 in the direct admit group. The results revealed that 91% of the women who stayed at the MWH had a high risk pregnancy (examples include: prior cesarean delivery, pre-eclampsia, perinatal death, abnormal presentation) as opposed to 57% in the women who delivered at the hospital. The authors found no statistical difference in maternal and perinatal mortality.

**Tumwine et al. "Maternity waiting shelters and pregnancy outcome: experience from a rural area in Zimbabwe." [8]**

This was a prospective study based in Chimanimani, Zimbabwe, about 410km from the country's capital. There were 15 health clinics and 2 main hospitals that catered to this town of 100,000 people. The study compared outcomes in a local maternity waiting home, to direct admits at the main hospital Mutambara from May 1987 to April 1989. The home accommodated women who were deemed high risk by their local health centers, traditional

birth attendants and those from remote areas. They were advised to stay at the home during the last month of their pregnancy. Use of the home was free of charge, but patients brought their own food, utensils and they were allowed to have one guest accompany them. Outcomes measured were: education level, parity, mode of delivery (spontaneous vaginal delivery, vacuum extraction, cesarean section), blood pressure, birthweight and perinatal deaths (fresh stillbirths, macerated stillbirths and early neonatal deaths). There were 280 total births in the MWH as opposed to 773 in the direct admit group. It found no statistical difference in parity, pregnancy complications, education level, mode of delivery, perinatal and maternal mortality. It however concluded that only birthweight was statistically lower in non MWH.

**Millard et al. "Antenatal village stay and pregnancy outcome in rural Zimbabwe."** [9]

This study was also based in rural Zimbabwe in a town called Mt. Sclinda. The maternity waiting home, referred to as antenatal village in this study was within a two-minute walk from the main hospital (The Willis Pierce Hospital). The home housed a maximum of 30 women, and no referral was needed for stay. The study compared outcomes of stillbirth, perinatal deaths, mode of delivery, duration of labor, birth weight, hospital length of stay among women who stayed at the MWH to direct admits at the main hospital mentioned above. Secondary outcomes of the study included women's age, parity, antenatal risk factors and antenatal clinic attendance. There were 486 total births in the MWH group and 336 in the control group. The results indicated a perinatal mortality rate of 35 per 1,000 in the MWH and 71 per 1,000 in direct admits. The authors concluded that MWH could be associated with better perinatal outcome but there was no statistical difference in any of the outcomes compared between MWH and non MWH due to the observational nature of the study.

**Poovan et al. "A maternity waiting home reduces obstetric catastrophes."** [10]

This was an observational study based in Ethiopia that compared outcomes at a MWH, also known as tukul to one of the major hospitals, Attat. Attat is a 55-bed facility that serves a population of about 300,000. The MWH opened in 1976, and can house about 15 patients. The women were allowed to stay with one relative, and were expected to provide food by themselves. Women with high risk pregnancies were advised to stay at the home, but they also accepted anyone who wanted to stay. The women were charged a fee to stay at the home.

Outcomes measured were mode of delivery, stillbirths and maternal deaths in the year 1987. The outcomes compared women who were admitted through the MWH versus those directly admitted to Attat hospital. There were 142 births in the MWH and 635 in the control group. The results showed that the maternal mortality was 21.2 per 1,000 in the Attat hospital as opposed to 0 in the MWH, while stillbirth rate was ten times more in the direct hospital admits. The study suggested that proper utilization of MWH can be beneficial to studying its effects on perinatal mortality but proper research needs to be done prior to the establishment to ensure adequate use of the home.

**Chandramohan et al. "Effects of a maternity waiting home on adverse maternal outcomes and validity of antenatal risk screening." [11]**

This is a prospective study in Zimbabwe that compared a MWH to Chipinge Hospital, a facility that served 200,000 people. The MWH was built in 1988 to aid in reducing adverse outcomes during the peri-partum period. Pregnant women with risk factors such as parity of 0 of greater than 6, history of perinatal deaths, breech presentation, HTN or DM were advised to stay at the home starting at 36 weeks. Anyone else willing to stay was accepted. Exclusion criteria for stay included gestation age <37weeks, unknown gestation age and twin pregnancies. Outcomes measured were mode of delivery and maternal deaths between the MWH and Chipinge Hospital. There were 1573 births in the MWH and 2915 in Chipinge hospital within the study period. Maternal mortality rate was significantly decreased in the women who stayed at the home versus those directly admitted to the hospital.

**Andemichael et al. "Maternity Waiting Homes: A panacea for maternal/neonatal conundrums in Eritrea." [12]**

This was a retrospective study based in the Northern and Southern Red Sea Zones of Eritrea. It compared maternal mortality of eleven maternity homes built to accompany 11 different health facilities in the above regions to the previous year before the establishment of the MWHs. The study ranged between 2006 and 2009. The data from 2006 was collected before the MWH establishment. Data was also collected from 2007 and 2009 after the MWHs were built. The homes charged participants an admission fee that included food. Prior to the MWH, the study reported 5 maternal deaths out of 266 deliveries, as opposed to 0 out of 474

after the MWHs were established. The study concluded that MWH improves maternal outcomes.

**Kohls et al. "The role of maternity waiting area in reducing maternal mortality and stillbirths in high risk women in rural Ethiopia." [13]**

This was a retrospective cohort study in rural Ethiopia that analyzed data from 1987 to 2008. It compared a MWH to Attat Hospital. The MWH was built in 1973 and housed a maximum of 40 women. Women with high risk pregnancies were advised to stay, but the home also accepted any woman willing to stay. There was no fee associated the stay, but women were expected to provide their own food. The main outcomes measured were maternal deaths and stillbirths. Secondary outcomes included in the study included mode of delivery, age and literacy. There were 6805 births in the MHHs and 17343 in the hospital controls. The authors concluded that MWH substantially decreased those main outcomes.

**Study Results**

The main outcomes reported in our study are: maternal deaths, perinatal deaths, stillbirths, neonatal deaths and cesarean delivery rates. Six of the seven studies we analyzed reported on maternal deaths. The study by Millard et. al did not report on this outcome. The maternal mortality rate for MWH was calculated as 105/100,000 and 1,066/100,00 for non-MWH, RR 0.145 (95% CI 0.062 to 0.204) as shown in table 3 and figure 1. Perinatal mortality was reported by three studies (Lonkhuijzen et al., Tumwine et al. and Millard et al.). The pooled perinatal mortality rate was 60/1,000 in MWH compared to 65/1,000, RR 0.782, (95% CI 0.602 to 1.120) in non-MWH, shown in table 4 and figure 2. Four studies measured stillbirths, revealing a combined rate of 18/1,000 in MWH and 184/1,000 in non-MWH, RR 0.204, (95% CI 63.88 to 94.08) shown in table 5 and figure 3. Lonkhuijzen et al., Chandramohan et al. and Andemichael et al. did not report on stillbirth rates alone. Studies by Tumwine et al. and Millard et al. reported on neonatal deaths. The combined rate between the two studies was 16/1,000 in MWH and 15/1,000 in non-MWH, RR 0.862, (95% CI 0.392 to 1.628), table 6 and figure 4. Lastly, five studies reported on cesarean deliveries and combined results reveal a rate of 24/100 for MWH and 18/100 in non-MWH, RR 1.229, (95% CI 1.226-1.555), table 7 and figure 5. Chandramohan et al. and Andemichael et. al did not analyze cesarean delivery rates.

**Table 2**

**Characteristics of Studies**

| Articles | Type of Study | Study location | Study range | Comparison groups | Risk stratification for MWH | Fee |
|---|---|---|---|---|---|---|
| **Lonkhuijzen et al.** | Prospective cohort study | Zambia | 1994 | MWH vs hospital | Yes | Yes |
| **Tumwine et al.** | Prospective cohort study | Zimbabwe | 1987-1989 | MWH vs hospital | No | No |
| **Millard et al.** | Prospective cohort study | Zimbabwe | 1987 | MWH vs hospital | No | No |
| **Chandramohan et al.** | Prospective cohort study | Zimbabwe | 1989-1991 | MWH vs hospital | No | No |
| **Andemichael et al.** | Retrospective cohort study | Eritrea | 2006-2009 | Pre MWH vs MWH | No | Yes |
| **Kohls et al.** | Retrospective cohort study | Ethiopia | 1987-2008 | MWH vs hospital | Yes | Yes |
| **Poovan et al.** | Prospective cohort | Ethiopia | 1987 | MWH vs hospital | Yes | Yes |

**Table 3**

**Meta-Analysis: relative risk of Maternal Deaths**

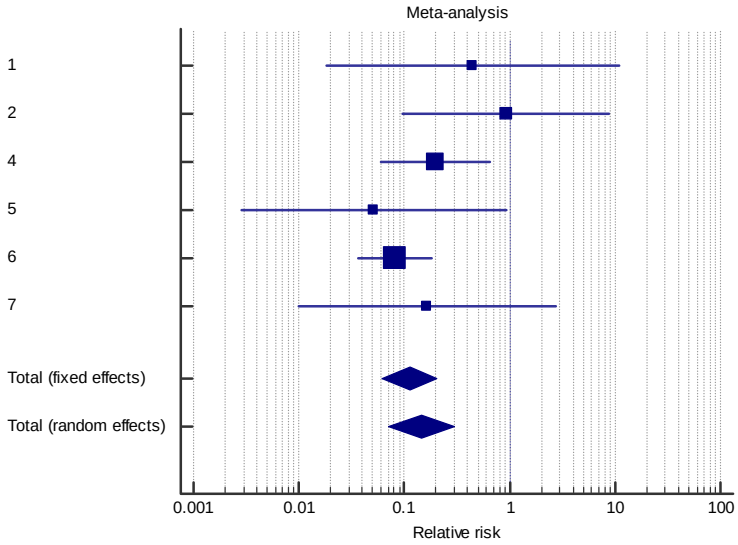
| Study | Intervention (rate per 100,000) | Controls (rate per 100,000) | Relative risk | 95% CI | z | P | Weight (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fixed | Random |
| **1. Lonkhuijzen et al.** | 0/218 (0) | 1/292 (342) | 0.446 | 0.0183 to 10.896 | | | 3.55 | 4.95 |
| **2. Tumwine et al.** | 1/280 (357) | 3/773 (388) | 0.920 | 0.0961 to 8.811 | | | 7.09 | 9.46 |
| **4. Chandramohan et al.** | 3/1573 (191) | 28/2915 (960) | 0.199 | 0.0605 to 0.652 | | | 25.61 | 27.68 |
| **5. Andemichael et al.** | 0/474 (0) | 5/266 (1,880) | 0.0511 | 0.00284 to 0.921 | | | 4.33 | 5.99 |
| **6. Kohls et al.** | 6/6805 (88) | 187/17343 (1,078) | 0.0818 | 0.0363 to 0.184 | | | 54.86 | 45.63 |
| **7. Poovan et al.** | 0/142 (0) | 13/635 (2,047) | 0.165 | 0.00985 to 2.755 | | | 4.56 | 6.29 |
| **Total (fixed effects)** | 10/9492 (105) | 237/22224 (1,066) | 0.112 | 0.0620 to 0.204 | -7.193 | <0.001 | 100.00 | 100.00 |
| **Total (random effects)** | 10/9492 (105) | 237/22224 (1,055) | 0.145 | 0.0701 to 0.301 | -5.191 | <0.001 | 100.00 | 100.00 |

**Test of Heterogeneity**

| | |
|---|---|
| Q | 5.8655 |
| DF | 5 |
| Significance level | P = 0.3195 |
| $I^2$ (inconsistency) | 14.76% |
| 95% CI for $I^2$ | 0.00 to 78.99 |

**Figure 1**

**Forest plot of maternal deaths in intervention group versus control**




Key

1. Lonkhuijzen et al.
2. Tumwine et al.
4. Chandramohan et al.
5. Andemichael et al.
6. Kohls et al.
7. Poovan et al.

**Table 4**

**Meta- analysis: relative risk of perinatal deaths**

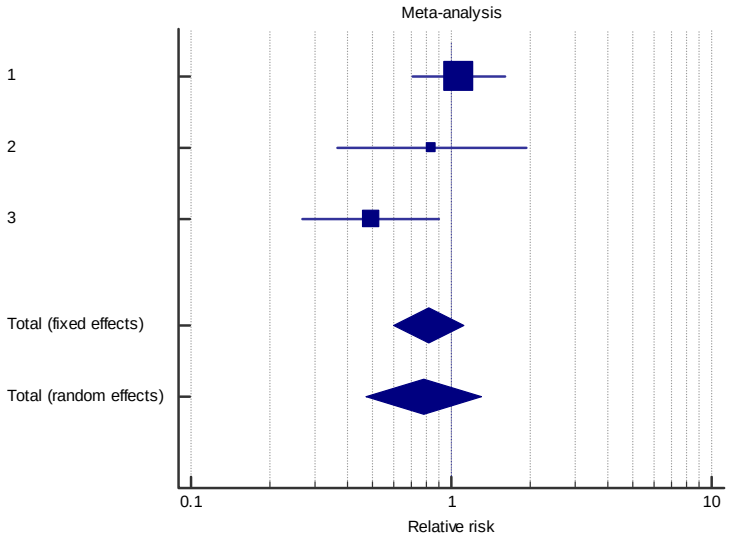
| Study | Intervention (rate per 1000) | Controls (rate per 1000) | Relative risk | 95% CI | z | P | Weight (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fixed | Random |
| **1.Lonkhuijzen et al.** | 35/218 (160) | 44/292 (151) | 1.065 | 0.709 to 1.602 | | | 59.10 | 44.10 |
| **2. Tumwine et al.** | 7/280 (25) | 23/773 (30) | 0.840 | 0.365 to 1.936 | | | 14.10 | 23.08 |
| **3. Millard et al.** | 17/486 (35) | 24/336 (71) | 0.490 | 0.267 to 0.897 | | | 26.80 | 32.82 |
| **Total (fixed effects)** | 59/984 (60) | 91/1401 (65) | 0.821 | 0.602 to 1.120 | - 1.244 | 0.213 | 100.00 | 100.00 |
| **Total (random effects)** | 59/984 (60) | 91/1401 (65) | 0.782 | 0.471 to 1.298 | - 0.953 | 0.341 | 100.00 | 100.00 |

**Test for Heterogeneity**

| | |
|---|---|
| **Q** | 4.3687 |
| **DF** | 2 |
| **Significance level** | P = 0.1126 |
| **$I^2$ (inconsistency)** | 54.22% |
| **95% CI for $I^2$** | 0.00 to 86.90 |

**Figure 2**

**Forest plot of perinatal deaths**




Key

1. Lonkhuijzen et al.
2. Tumwine et al.
3. Millard et al.

**Table 5**

**Meta-analysis: relative risk of Stillbirths**

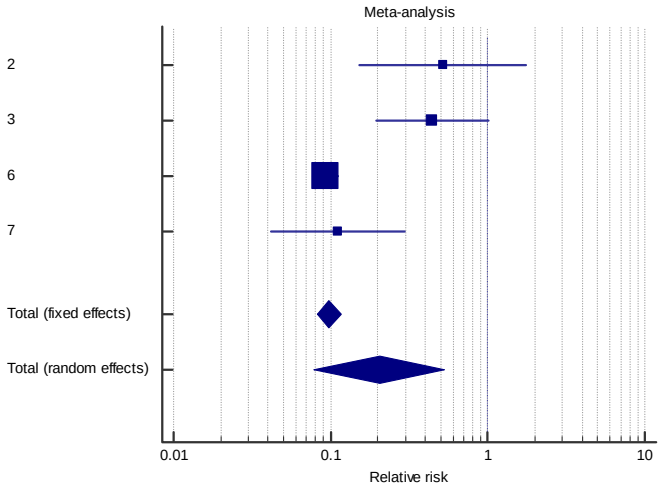
| Study | Intervention (rate per 1000) | Controls (rate per 1000) | Relative risk | 95% CI | z | P | Weight (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fixed | Random |
| 2. Tumwine et al. | 3/280 (11) | 16/773 (21) | 0.518 | 0.152 to 1.763 | | | 1.95 | 20.56 |
| 3. Millard et al. | 9/486 (19) | 14/336 (42) | 0.444 | 0.195 to 1.015 | | | 4.31 | 25.22 |
| 6. Kohls et al. | 120/6805 (18) | 3316/17343 (191) | 0.0922 | 0.0770 to 0.110 | | | 90.65 | 30.74 |
| 7. Poovan et al. | 4/142 (28) | 161/635 (254) | 0.111 | 0.0419 to 0.295 | | | 3.09 | 23.48 |
| Total (fixed effects) | 136/7,713 (18) | 3507/19,087 (184) | 0.0976 | 0.0823 to 0.116 | -26.605 | <0.001 | 100 | 100 |
| Total (random effects ) | 136/7,713 (18) | 3507/19,087 (184) | 0.204 | 0.0786 to 0.531 | -3.258 | 0.001 | 100 | 100 |

**Test for heterogeneity**

| | |
|---|---|
| Q | 20.5093 |
| DF | 3 |
| Significance level | P = 0.0001 |
| $I^2$ (inconsistency) | 85.37% |
| 95% CI for $I^2$ | 63.88 to 94.08 |

**Figure 3**

**Forest plot of stillbirths**




Key

2. Tumwine et al.
3. Millard et al.
6. Kohls et al.
7. Poovan et al.

**Table 6**

**Meta-analysis: relative risk of Neonatal Deaths**

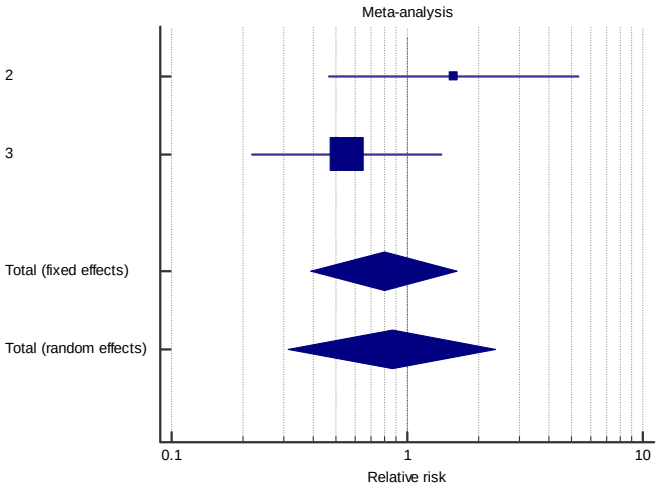
| Study | Intervention (rate per 1,000) | Control (rate per 1,000) | Relative risk | 95% CI | z | P | Weight (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fixed | Random |
| **2. Tumwine et al.** | 4/280 (14) | 7/773 (9) | 1.578 | 0.465 to 5.348 | | | 36.18 | 42.36 |
| **3. Millard et al.** | 8/486 (16) | 10/336 (30) | 0.553 | 0.221 to 1.387 | | | 63.82 | 57.64 |
| **Total (fixed effects)** | 12/766 (16) | 17/1,109 (15) | 0.798 | 0.392 to 1.628 | -0.62 | 0.536 | 100 | 100 |
| **Total (random effects)** | 12/766 (16) | 17/1,109 (15) | 0.862 | 0.312 to 2.380 | -0.286 | 0.775 | 100 | 100 |

**Test for heterogeneity**

| | |
|---|---|
| **Q** | 1.8080 |
| **DF** | 1 |
| **Significance level** | P = 0.1787 |
| **$I^2$ (inconsistency)** | 44.69% |
| **95% CI for $I^2$** | 0.00 to 0.00 |

**Figure 4**

**Forest plot of neonatal deaths**




Key

2. Tumwine et al.
3. Millard et al.

**Table 7**

**Meta- analysis: relative risk of Cesarean Delivery**

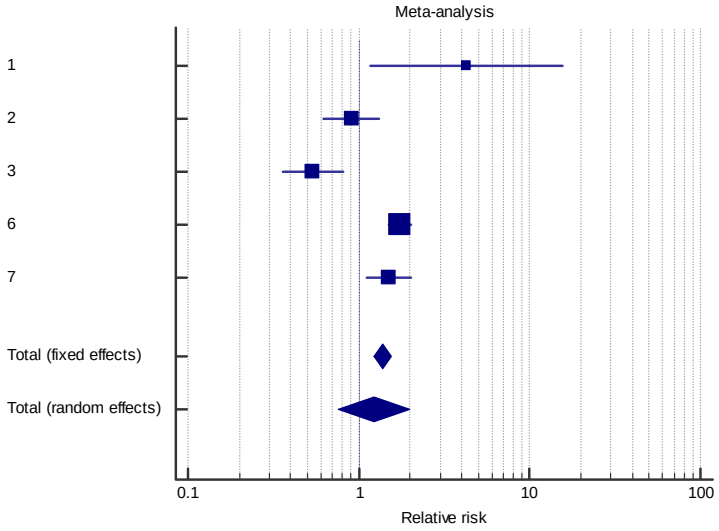
| Study | Intervention (rate per 100) | Control (rate per 100) | Relative risk | 95% CI | z | P | Weight (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fixed | Random |
| **1. Lonkhuijen et al.** | 9/196 (5) | 3/280 (1) | 4.286 | 1.175 to 15.629 | | | 0.86 | 8.89 |
| **2. Tumwine et al.** | 32/270 (12) | 96/733 (13) | 0.905 | 0.622 to 1.317 | | | 10.19 | 21.93 |
| **3. Millard et al.** | 37/454 (8) | 46/304 (15) | 0.539 | 0.358 to 0.810 | | | 8.62 | 21.4 |
| **6. Kohl's et al.** | 236/473 (50) | 195/683 (29) | 1.748 | 1.506 to 2.029 | | | 64.42 | 24.73 |
| **7. Poovan et al.** | 44/125 (35) | 88/375 (23) | 1.5 | 1.111 to 2.025 | | | 15.92 | 23.05 |
| **Total(fixed effects)** | 358/1,518 (24) | 428/2,375 (18) | 1.381 | 1.226 to 1.555 | 5.322 | <0.001 | 100 | 100 |
| **Total(random effects)** | 358/1,518 (24) | 428/2,375 (18) | 1.229 | 0.762 to 1.984 | 0.846 | 0.398 | 100 | 100 |

**Test for heterogeneity**

| | |
|---|---|
| **Q** | 38.1892 |
| **DF** | 4 |
| **Significance level** | P < 0.0001 |
| **$I^2$ (inconsistency)** | 89.53% |
| **95% CI for $I^2$** | 78.36 to 94.93 |

**Figure 5**

**Forest plot of Cesarean Delivery**




Key

1. Lonkhuijzen et al.
2. Tumwine et al.
3. Millard et al.
6. Kohls et al.
7. Poovan et al.

## Discussion

The results as stated above demonstrate a statistical decrease in maternal deaths and stillbirths for MWH when compared to the control. Cesarean delivery was statistically increased in the MWH. Perinatal and neonatal deaths were not statistically decreased, although both relative risks were reduced. The meta-analysis was reported for both fixed and random effect modeling. The statistical significance was relatively consistent between the two except for the p-values in cesarean delivery meta-analysis, where the random effects modeling showed no statistical significance. The results of maternal deaths and stillbirths support our hypothesis, but there are many limitations to the study that raise concerns about the validity of the results.

Higher cesarean delivery rates in MWH is likely explained by the success of risk stratification of the individual MWH. Even though most of the homes included in our study accepted any pregnant woman who wished to stay, the goal of all the homes was to house women with high risk pregnancies (prior cesarean deliveries, pre-eclampsia etc.). In that context, high cesarean rates in the MWH is not surprising and actually reflects appropriate risk stratification.

A major limitation to our study is the lack of inclusion of subjects who chose to deliver at home. In rural areas of Africa, most women deliver with midwives or experienced elderly women in their homes. There has been a global increase from 59% in 1990 to 71% in 2014 in the number of births that are now attended by trained healthcare personnel. [4] Although this is a trend in the right direction, about one third of the population in developing countries still deliver without standard monitoring by a qualified healthcare provider. Understandably so, maternal and perinatal deaths from this one -third population was not included in the control calculations. The exclusion was likely due to difficulty of data collection in rural area and inability to identify patients delivering within the timeframe of the studies. It is safe to assume that many of the home births were uncomplicated and could have altered the results of our study in favor of the standard of care.

Studies discovered that participation in MWH for the target communities were lower than anticipated. Suggested factors that could explain the lack of participation are finances and time spent away from family. Four of the seven studies we analyzed charged patients to stay at

the home and all the homes allowed an additional person to stay with the patient. Some of the patients complained that they did not utilize MWHs because they worried about the family they left behind in the village during their stay. An avenue to enable full optimization of MWHs is to provide it free accommodation if possible and allow more family to stay with the patients. Equally as important is continuous education of the importance of proper care during pregnancy and delivery. If more women are aware of the risks of maternal and perinatal mortality during the peri-partum stages, the short term sacrifices could be potentially outweighed.

In analyzing statistical significance, it is imperative to consider biases and study designs that can influence the results. The studies that met criteria were observational and not the gold standard of randomized controlled trials. Systematic reviews of observational studies introduce confounding and selection biases due to the lack of randomization. To illustrate, women in an obstetric emergency will likely report to the main hospitals, be directly admitted, as opposed to first presenting to a MWH and ultimately being transferred to the hospital. As it stands, the hospitals tend to attract sicker patients to begin with. This possibly explains the increase in maternal deaths in direct hospital admits in comparison to MWH. To mitigate selection bias, we suggest cluster randomized trials. Prior to these trials, several towns in various low-income countries with similar characteristics need to be identified. Such characteristics can include: population, current rates of maternal and perinatal mortality, socioeconomic status of residents, number of hospitals and education level. These towns would be randomly assigned to have a MWH. Requirements to stay at the home and medical monitoring during the stay would be standardized across the MWHs. Results on maternal and perinatal deaths can then be compared between the towns with MWHs and the standard of care among the control groups. Not all complications can be predicted, and having easier access to hospital and a trained birth attendant should be the standard of care. The variability of the presence of a skilled birth attendant between communities could be a potential confounder in the suggested experimental design, but randomization of towns could address that to an extent, depending on the power of the study.

## Future Directions

As mentioned earlier, there have not been new published studies on use of MWH to decrease maternal and perinatal mortality since 2012. It makes one wonder whether they are falling out of favor or other means of decreasing the rates are being explored. With studies concluding the need for further research including randomization, we would like to remain current on new studies that address this topic. If funding and opportunity allow, it would be ideal to perform one of these studies.

## Conclusion

With the development of health care over the years, a wide disparity remains between low-income countries and developed countries in the context of maternal and perinatal mortality. One of the proposed ways to bridge this disparity was the established of MWHs. Very few studies have addressed these homes, making it difficult to assess its efficacy. In this study, we ascribed to compare maternal and perinatal deaths (neonatal and stillbirths), and cesarean delivery rates in observation studies that compared MWH to the standard of care. The results indicate that MWH significantly reduce maternal deaths and stillbirths, and statistically increases cesarean deliveries. Perinatal and neonatal deaths were not statistically different between the two groups. As there were no randomized controlled trials, the results may be influenced by selection biases.

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# COMPREHENSIVE REVIEW ON MATERNAL MORTALITY AND MATERNITY WAITING HOMES

## CHAPTER 2

## Table of Contents

## List of Figures and Tables

## Introduction

The World Health Organization (WHO) describes maternal mortality 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" [1]. Maternal mortality has been a constant issue that is still unfortunately prevalent in developing countries. In 1990, it was estimated that 546,000 women were dying each year from maternity related problems [2]. The issue was emphasized at the Safe Motherhood Conference in 1987 when attention was drawn to the high maternal mortality rates in developing countries [3]. This conference, along with many others that occurred afterwards stressed the importance of reducing the mortality rate in an effort to improve lives in developing countries. In 2001, the United Nations established eight Millennium Development Goals, commonly known as MDGs. Goal number five on this list is to reduce maternal mortality rate by 75% between the years 1990 and 2015 [4].

As of 2012, about 800 women still die every day from pregnancy or delivery related obstacles [5]. This accounts for about 287,000 deaths annually [5]. Although 287,000 is an improvement from 546,000, it is still unacceptable given that avenues to decrease the maternal mortality are available and implemented in developed countries. 99% of the maternal deaths occur in developing countries and half of this 99% are concentrated in sub-Saharan Africa [5]. The disparities between countries are profound when the maternal mortality rate of 240 per 100,000 in developing countries is compared to that of 16 per 100,000 in developed countries [6].

This article will elaborate on the decreasing trend, measurement, causes, interventions and projection of maternal mortality rate, with a focus on developing countries.

## Measuring Maternal Mortality

The maternal mortality rate or ratio is calculated by dividing the amount of maternal deaths, using WHO's definition of maternal mortality, by the number of live births within the same period of time. This number is then multiplied by 100,000 to get the maternal mortality rate [7] . Late maternal death is the death of a woman, after 42 days, but less than one year after termination of pregnancy. This includes deaths from direct obstetric complications, and other health issues that are exacerbated by pregnancy, but excludes deaths from accidents. Pregnancy associated death occurs while the woman is pregnant, or within 42 days of termination, regardless of the cause of death [7].

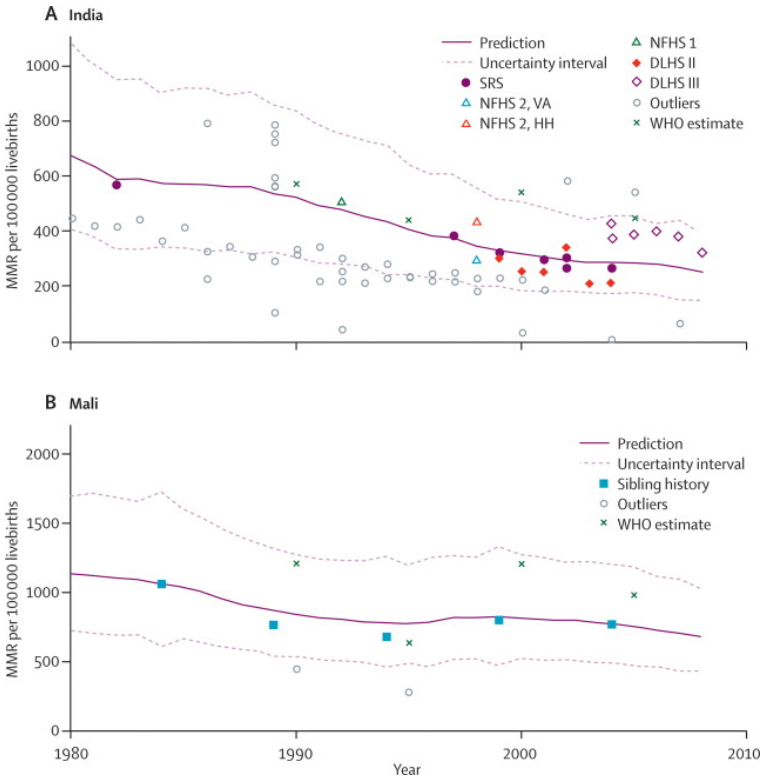
Accounting properly for the maternal mortality rate (MMR) proves to be difficult and often indirect, as many countries do not have a systematic way of recording the numbers. Recording maternal mortality can be done through: civil registration, household surveys, census, reproductive age mortality studies (RAMOS) and verbal autopsies [5]. Civil registration is the gold standard as it relies on hospital-acquired information concerning births and deaths. Even though this is the ideal method, errors can arise from misclassification and underreporting of deaths; moreover, many countries do not have established protocols that can aid in using the civil registration. For instance, WHO reports that out of the 181 countries it evaluated concerning maternal mortality, 65 had adequate civil registration that can be relied on, 89 had some foundation and 27 were without any national form of reporting maternal deaths [8] . With household surveys and census, families are interrogated on the age, number and any deaths of in order to ascertain if any of the deaths can be attributed to maternal mortality. RAMOS are utilized to determine the cause of death for all women in the reproductive age, while verbal autopsy is used in the absence of a death certificate. Measuring maternal mortality in countries where civil registration is not common can be done with a combination of the other four criteria.

Underreporting of MMR poses to be a major problem in developed countries. For instance, Italy in 2010 had a MMR of 4 as reported by WHO. Through an investigation, it appears that only 37% of the actual maternal deaths were accounted for [9]. Additionally, 38% of Maryland's maternal deaths were not recorded as such on death certificates [9]. While the actual

MMR was calculated as 22.2 upon revision, previous accounts reported 13.8 [9]. Experts attribute some of these discrepancies to the International and Statistical Classification of Diseases and Health Problems, ICD-10 complexity and sole reliance on death certificates in reporting maternal deaths [9]. In an effort to decrease underreporting of maternal mortality, an additional category has been recently added to birth certificates to capture any recent pregnancies and mishaps that might have been overlooked.

The difficulty in tracking MMR is evident when a comparison is made between WHO and the Institute of Health Metrics and Evaluation (IHME). These two entities follow the trends in MMR. To illustrate, in 2008, WHO stated that MMR for Kuwait and North Korea were 9 and 250; however, IHME claims that MMR for those same countries were 26 and 64 respectively [10]. Looking at those two cases, North Korea appears to be improving by IHME standards but when analyzed by WHO, the country needs intervention to decrease their MMR. Additionally, figure 1 below presents another situation where different sources report variations of MMR for India and Mali. The difference between estimates from DLHSII and WHO can be as high as 200 when the MMR for India in 2010 is analyzed [11]. This can pose a problem when efforts are being made to decrease MMR and researchers have difficulty determining the baseline rate. While maternal mortality is an issue of its own, it tends to present with many other layers that need to be addressed before the main problem can be targeted.

**Figure 1 [11].**
**Predicted maternal mortality ratio for India and Mali**




*Predicted maternal mortality ratio (MMR) per 100 000 livebirths for India (A) and Mali (B) SRS=sample registration system. NFHS=National Family Health Surveys. VA=verbal autopsy. HH=household. DLHS=District Level Household Surveys.*

## Trends in Maternal Mortality

MMR has decreased worldwide between 1990 and 2010. Much of this change occurred in Eastern Asia and Northern Africa. Other parts of the world also improved, but the disparity between the represented regions in Table 1 is nevertheless clear. Although MMR in Sub-Saharan Africa decreased by 47%, approximately 284,000 women were dying of maternal related causes every year [5]. As of 2010, about 10 countries have already achieved MDG 5. These countries are: Estonia, Maldives, Belarus, Romania, Bhutan, Equatorial Guinea, Iran, Lithuania, Nepal and Vietnam [5]. On the other hand, the HIV epidemic caused an increase in MMR in countries such as: Botswana, Lesotho, Namibia, South Africa and Swaziland. Countries that are on track to reach a 75% decline are estimated to show an annual reduction of at least 5.5% [5]. Nine countries that will most likely achieve MDG 5 by 2015 are: Eritrea, Oman, Egypt, Timor-Leste, Bangladesh, China, Lao People's Democratic Republic, Syrian Arab Republic and Cambodia. Most of the countries in Sub-Saharan Africa are not projected to reach this goal, suggesting that aggressive and innovative methods need to be established to facilitate the process [5].The decrease in MMR is attributed to improvements in sanitation, public health and proper training of healthcare workers. In the actual clinic, improvements have been made with blood transfusions, antibiotic administration and safe abortions [10].

**Table 1 [5].**

**Maternal mortality comparisons in 1990 and 2010**

| Region | 1990 MMR | 1990 Maternal Deaths | 2010 MMR | 2010 Maternal Deaths | % change in MMR between 1990 and 2010 | Average annual % change in MMR between 1990 and 2010 |
|---|---|---|---|---|---|---|
| World | 400 | 543,000 | 210 | 287,000 | -47 | -3.1 |
| Developed Regions | 26 | 4,000 | 16 | 2,200 | -39 | -2.5 |
| Developing Regions | 440 | 539,000 | 240 | 284,000 | -47 | -3.1 |
| Northern Africa | 230 | 8,500 | 78 | 2,800 | -66 | -5.3 |
| Sub-Saharan Africa | 850 | 192,000 | 500 | 162,000 | -41 | -2.6 |
| Eastern Asia | 120 | 30,000 | 37 | 6,400 | -69 | -5.7 |
| Eastern Asia excluding China | 53 | 610 | 45 | 400 | -15 | -0.8 |
| Southern Asia | 590 | 233,000 | 220 | 83,000 | -64 | -4.9 |
| Southern Asia excluding India | 590 | 70,000 | 240 | 28,000 | -59 | -4.4 |
| Western Asia | 170 | 7,000 | 71 | 3500 | -57 | -4.2 |
| Caucasus and Central Asia | 71 | 1400 | 46 | 750 | -35 | -2.1 |
| Latin America and the Caribbean | 140 | 16,000 | 80 | 8,800 | -41 | -2.6 |
| Latin America | 130 | 14,000 | 72 | 7,400 | -43 | -2.8 |
| Caribbean | 280 | 2,300 | 190 | 1,400 | -30 | -1.8 |
| Oceania | 320 | 630 | 200 | 520 | -38 | -2.4 |
| South-Eastern Asia | 410 | 50,000 | 150 | 17,000 | -63 | -4.9 |

## Causes of Maternal Mortality

The causes of maternal mortality can be divided into two main categories: direct and indirect. A direct cause of death is one that happens solely because of the pregnancy; as opposed to indirect that arises from preexisting complications that are exacerbated by pregnancy [10]. Some direct causes of maternal mortality are: postpartum hemorrhage, infection, hypertension, unsafe abortions and obstructed labor [12]. These are also the major causes of maternal mortality. Indirect causes of deaths include: heart disease, preexisting anemia, asthma and malaria [13].

Post-partum hemorrhage accounts for most of maternal mortality. It most often occurs when the uterus fails to contract post-placental delivery, predisposing the woman to excessive bleeding. Long term the hemorrhage can cause severe anemia and hypopituitarism if not addressed. To avoid post-partum hemorrhage, oxytocin or other agents are administered to aid in uterine contraction. Prophylactic antibiotics and vaccines are given to women who are at a higher risk for developing infections. Family planning and contraception options have also been introduced to help keep the rate of unwanted pregnancies low.

As shown in figure 2, the causes of maternal deaths vary by region. In Africa and Asia, hemorrhage proves to be the leading cause, accounting for 33.9% and 30.8%, respectively [14]. In Latin American and the Caribbean, hypertensive disorders leads the other causes. However, in developed countries, the leading cause is referred to as “other direct cause of death” which includes complications from anesthesia and cesarean sections to name a few [14]. Sorting out the major causes as done by WHO enables researchers to develop targeted solutions for specific regions. For instance, focusing on anesthesia complications and cesarean sections, although great causes, may not yield striking results when practiced in Africa.

**Figure 2 [14].**

**Causes of maternal deaths in various regions**

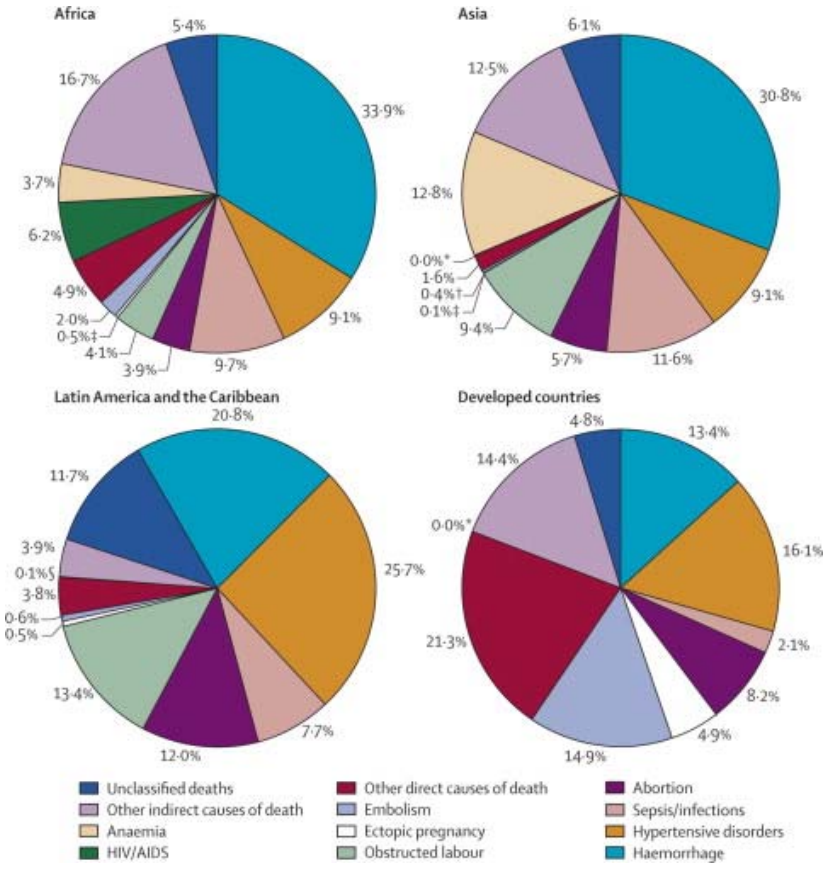


**Table 2 [14].**

**Causes of maternal deaths in developed vs developing countries**

| | **Developed countries** | **Africa** | **Asia** | **Latin America and the Caribbean** |
|---|---|---|---|---|
| Number of datasets | 5 | 8 | 11 | 10 |
| Number of maternal deaths | 2823 | 4508 | 16089 | 11777 |
| Hemorrhage | 13.4% (4.7-34.6) | 33.9% (13.3-43.6) | 30.8% (5.9-48.5) | 20.8% (1.1-46.9) |
| Hypertensive disorders | 16.1% (6.7-24.3) | 9·1% (3·9–21·9) | 9·1% (2·0–34·3) | 25·7% (7·9–52·4) |
| Sepsis/infections | 2·1% (0·0–5·9) | 9·7% (6·3–12·6) | 11·6% (0·0–13·0) | 7·7% (0·0–15·1) |
| Abortions | 8·2% (0·0–48·6) | 3·9% (0·0–23·8) | 5·7% (0·0–13·0) | 12·0% (0·0–32·9) |
| Obstructed labor | 0·0%* (0·0–0·0) | 4·1% (0·0–10·3) | 9·4% (0·0–12·0) | 13·4% (0·0–38·9) |
| Anemia | 0·0%* (0·0–0·0) | 3·7% (0·0–13·2) | 12·8% (0·0–17·3) | 0·1% (0·0–3·9) |
| HIV/AIDS | 0·0%* (0·0–0·0) | 6·2% (0·0–13·3) | 0·0%* (0·0–0·0) | 0·0%* (0·0–0·0) |
| Ectopic pregnancy | 4·9% (0·4–7·4) | 0·5% (0·0–3·3) | 0·1% (0·0–3·9) | 0·5% (0·0–4·5) |
| Embolism | 14·9% (0·0–21·2) | 2·0% (0·0–5·6) | 0·4% (0·0–51·0) | 0·6% (0·0–8·4) |
| Other direct causes | 21·3% (0·0–33·9) | 4·9% (0·0–10·3) | 1·6% (0·0–25·9) | 3·8% (0·0–27·9) |
| Other indirect causes | 14·4% (0·0–51·2) | 16·7% (9·1–29·3) | 12·5% (0·0–29·2) | 3·9% (0·0–25·3) |
| Unclassified deaths | 4·8% (0·0–22·9) | 5·4% (0·0–21·8) | 6·1% (0·0–16·2) | 11·7% (0·0–20·4) |

Zero indicates that the condition is not reported as a cause of death. Deaths from that cause could have occurred but listed under other or unclassified deaths.

## Interventions to Decrease Maternal Mortality

Developed countries have been successful in maintaining low maternal mortality rates because of easier access to hospitals, increased prenatal visits and screening for potential complications such as preeclampsia and infections. Citizens of such countries have access to facilities that are capable of handling obstetric complications. They have a greater chance of attaining prenatal care and critical screenings that aid in decreasing the risk of complications. In a 2011 report on 36 states, 73.7% of women in those areas received prenatal care in their first trimester, while 6% didn't until their last trimester [15]. During a typical prenatal visit, women are screened for hypertensive disorders that can predispose them to preeclampsia and blood disorders that can contribute to post-partum hemorrhage. They are also vaccinated against diseases such as influenza, tetanus, diphtheria and pertussis. An ultrasound is done to assess for normal presentation and anatomy of the fetus and maternal structures. Finally, these women are encouraged to control any underlying health issues such as diabetes and hypertension while pregnant. The average pregnant woman in a developed country has options that are not readily available to other women in developing countries. Recently, the focus on prenatal care in the US has spread just beyond prenatal care to preconception care. The expansion will help women prime their bodies before conceiving.

The UK identified some recommendations necessary to address maternal health in their tri annual maternal health report for the years 2006, 2007 and 2008. They stress the need of healthcare facilities to:

1. Provide pre-pregnancy counseling. This is particularly tailored to women with existing illnesses and current medications that can potentially harm a pregnancy. They should be constantly reminded of the risk and managed properly should they wish to conceive.
2. Professional interpretation for women who do not speak English will limit the language barrier and strengthen communication.
3. Prioritized referrals to specialists for all pregnant women because some specialties can take up to months to schedule appointments
4. Maintenance of healthcare workers' clinical skills necessary in treating obstetric complications.

5. Appropriate triaging of sick pregnant women or women who have just delivered. This will ensure that healthcare providers do not delay treatment of serious problems.
6. Treatment of all pregnant women with preeclampsia and systolic pressure of 150 -160 mmHg.
7. Education of women about the signs and systems of infection and sepsis.

These are some steps that have been taken and continue to be refined by developed countries to keep maternal mortality low [16].

In order for developing countries to achieve MDG 5, countries have promoted prenatal care, safe abortions, family planning, skilled birth attendants and maternity waiting homes. For example, Ghana now provides free prenatal care for its citizens. This helps eliminate the cost barrier that once prevented some people from achieving prenatal care.

Interventions aimed at reducing maternal mortality focus on the concept of the three delays. The three delays refer to:

1. Delay in attaining the proper obstetrics help due to the inability of the staff to recognize emergency situations or cost barriers that prevent women from seeking help in the first place [17].
2. Delay in getting to the appropriate hospital because of transportation issues or cost barriers [17].
3. Delay in the right care once they arrive at the hospital because of technical difficulties, electric outage or shortage of staff In an effort to decrease the amount of deaths caused by delays in attaining the proper obstetric care, many countries such as China, Tunisia and Egypt have successfully instituted the presence of skilled birth attendants at delivery facilities. Skilled birth attendants "refer exclusively to people with midwifery skills (for example, doctors, midwives, and nurses) who have been trained to proficiency in the skills necessary to manage normal deliveries and diagnose, manage, or refer obstetric complications" [18].

It is difficult to predict pregnancies that will become complicated because most complications arise during or after labor. According to a report by UNFPA in 2006, about 40% of all deliveries happened in the presence of a skilled birth attendant [18]. In contrast, up to 90% of all deliveries

in high income countries have skilled healthcare workers present [18]. The same publication reported that Nepal and Bhutan have an average of 20% of deliveries that take place with a skilled professional [18]. A third of the 3.3 million stillbirths per year occur during childbirth and can be intervened by trained healthcare workers [18]. It is therefore crucial to have qualified people stationed at every facility to recognize these complications.

Once these complications have been identified, the healthcare worker is responsible for determining whether the procedure can be performed at the same facility or the patient needs to be transferred to another hospital. The idea of maternity waiting home is significant here as it encompasses the first and second delays of treatment. A systematic review of the efficacy of maternity waiting homes in developing countries will shortly follow this article.

Maternity waiting home (MWH) is an old concept that is gradually resurfacing as an approach to reduce maternal mortality. MWH bridges rural and city lives by creating an environment where women who live in remote areas await delivery within close proximity to a major hospital if they are identified as having factors that could predispose them to complications. Such criteria that grant access to a MWH can include: age (between 16 and 40), more than 6 births, anemia, preeclampsia, history of antepartum hemorrhage, 3rd degree tear, and stillbirths [19]. The concept dates back to the 20th century where these homes were used in Europe, Canada and the United States in remote areas where obstetric facilities were distant [2]. In 1950's, Nigeria established a MWH close to a district hospital. In these homes, they housed women two to three weeks before estimated delivery in order to alleviate the stress of walking to the nearest hospital, which was tens of miles from their homes. After this establishment, Eastern Nigeria reported a decrease of maternal deaths from 116 per 1000, to 20 per 1000 [2].

From previous establishments, four requirements that have been recognized as necessary for a successful MWH are:

1. definition of risk factors and selection of women;
2. viable community level health service necessary for referral to occur and women's compliance with the referral;
3. skilled obstetric services (including capacity to handle obstetric emergencies); and
4. community and cultural support [24].

The above criteria illustrate that MWHs require community involvement and the medical knowledge and acuity of healthcare workers to be successful. A deficiency in any area prevents the MWH for operating in an optimal manner.

Table 3 illustrates two MWHs located in two districts of Timor-Leste, a small country in Southeast Asia. The MWHs were evaluated to see if women who lived in rural areas would be more likely to utilize the facility. The presence of midwives and physicians assures the recognition of peri-partum complications. Secondly, ambulances are available to transport women to other hospitals when a case is too advanced for a MWH. The above examples of MWHs adequately address significant facets of a MWH. The article on the MWH in Timor-Leste concludes that there wasn't a significant increase in MWH accommodation of women who lived greater than 5km from the MWH. It was expected that more women who live over 10km away from hospitals would utilize MWH. The next step in addressing the underutilization could be proving space and kitchen use for family of the pregnant woman. If these women are to have family support while they stay at the MWH, they could be more prone to using the facility. This is a prime example of how culture and community can interfere with healthcare. From acknowledging the amenities and resources MWHs have to aid in healthy deliveries, it is intuitive to assume that they would be used to their full capacity. When a different culture and environment are included, people tend to shun from the unknown and embrace what has been practiced for centuries within their communities.

**Table 3** [19]

**Comparison of two maternity waiting homes**

| Population or health service | Lautem | Manufahi |
|---|---|---|
| District population | 67465 | 43949 |
| Annual expected birth | 3070 | 2000 |
| Health centers in the district | 5 | 4 |
| Health centers equipped for births | 1 | 1 |
| Midwives at health center | 7 | 7 |
| Physician at health center | 6 | 3 |
| Travel time to the nearest referral hospital | 2 hours | 4-6 hours |
| Electricity | Generator (not 24/7) | Generator (not 24/7) |
| Radio | Not functioning | Yes |
| Ambulance | 1 | 2 |
| Date MWH started functioning | January 2005 | February 2007 |
| Cost of building | $41000 | $60000 |
| Monthly cost to run MWH | $2745 | N/A |
| MWH project funded by | Medicos do Mundo, Portugal | Red Cross, Monaco |
| Beds at MWH | 8 | 5 |
| Space for family to sleep | No | No |
| Kitchen for family | No | No |
| Food provided at MWH | Yes | Yes |
| Health education at MWH | Yes | Yes |
| User fees at MWH | Free | Free |

Additionally, education on family planning is also essential in reducing maternal mortality simply because if there is no pregnancy, there is no mortality to reduce. Teaching women on the appropriate interval between children, birth control methods and importance of prenatal care are all significant as well. Many studies done by UNFPA show an inverse relationship between literacy and education level of females. This is especially prevalent in sub-Saharan Africa where the education of males is sometimes prioritized over women. Culture is one of the many reasons of prioritizing male education. In Ghana, when a woman is married, she is taken from her family and viewed as part of her husband's family. Some families fail to educate their daughters because they anticipate they will someday get married and not be able to directly provide for them, making it a "waste" of hard earned resources. As it relates to maternal mortality, studies indicate that educated females are more likely to know about contraception, safe abortion and right spacing between children [20.]

## Conclusion

According to the Millennium Development Goals Report of 2014 by United Nations Development Program, there has been a decrease in maternal mortality worldwide, but this decrease is not close to the target of 75%. 300,000 maternal deaths were accounted for in 2013 [21]. Although this is a decrease from 500,000, most organizations and the UN believe that there is more to be done even though a step has been taken in the right direction. It is vital to note that decreasing maternal mortality is not accomplished by providing transportation to hospitals, or housing pregnant women until they deliver. The burden of high maternal mortality is multifaceted, so the approach that will yield the greatest results has to be multifaceted as well. The approach will have to address areas such as poverty, illiteracy, lack of adequate facilities and workers, culture and proper utilization of available resources like MWHs. Focusing on each of the contributors alone will not yield the necessary results. A strategic approach on all aspects will help drive the numbers closer to the goal. What if the 75% reduction is not attained by 2015? It is satisfying that efforts are being made towards the goal. Maybe there can be a 10-year extension of the date deadline to ensure that no matter where somewhere lives, the basic human right of life is not jeopardized.

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