A Review of the Literature on Factors Contributing to the Reductions of Maternal and Child Mortality in Low-Income and Middle-Income Countries: An Evidence Synthesis for the Success Factors Study Series

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1. Introduction

Both maternal and child mortality have dropped dramatically since 1990. Maternal deaths have declined from 543,000 deaths in 1990 to 289,000 in 2013 and child deaths have decreased from 12.6 million deaths in 1990 to 6.6 million in 2012 [1, 2]. Countdown for 2015—which tracks progress in the 75 "high burden" countries that together account for more then 95% of maternal, newborn, and child deaths—reports that 30 Countdown countries achieved maternal mortality reductions of 50 percent or more between 1990 and 2010 [3]. Furthermore, eight Countdown countries reduced the under-five mortality rate by at least two-thirds and 22 others reduced the rate by at least half [3]. Some countries, however, have seen less success and maternal and child deaths remain unacceptably high. Furthermore, as global under-five mortality rates have declined, the proportion of deaths that occur in the neonatal period have increased, calling for greater attention to strategies that prevent neonatal deaths.

Some high burden low- and middle-income countries (LMICs) have therefore made greater progress in reducing maternal and child mortality than others. We conducted a literature review to assess why some high burden LMICs realized significant reductions in maternal and child mortality over time while others have not. What lessons can be learned from a close examination of LMICs' progress, or lack thereof, towards Millennium Development Goals 4 (reducing child mortality) and 5a (reducing maternal deaths)? What is the context of countries' successes or struggles? This narrative review of the literature, part of the Partnership for Maternal, Newborn, and Child Health (PMNCH) Success Factors study series,[1] examines these questions and identifies socioeconomic, political, and health-related factors that explain why some high-burden LMICs have been more effective than others in reducing maternal and child mortality.

2. Literature Review Approach

This narrative review utilized a structured literature review strategy. It drew from English-language articles, reports, and other literature focused on the reduction of maternal and child mortality at the country-level in the 139 countries that the World Bank designated as low- and middle-income countries (LMICs) in 2014.[2] The cut-off date for all literature included in the analysis was March 1, 2014. No specific start date was selected for the literature in order to look at as broad a timeframe as possible. Databases searched were PubMed, World Bank e-library, SSRN, JStor, EconLit, Lilacs, and the Google Scholar search engine. As Annex I demonstrates, several search

[1] For more information on the PMNCH Success Factors study series, see: http://www.who.int/pmnch/knowledge/publications/successfactors/en/

[2] The list of 139 countries can be found at http://data.worldbank.org/income-level/LMY

strategies were employed using key words, combinations and medical subject headings (MeSH) including "infant mortality," "child mortality," "maternal mortality," "millennium development goal," "on track," "success," "progress," "factors," and the names of each of the 139 LMICs. The search strategy did not include study design filters in order to capture all information of potential interest in the review. Additional published and grey literature was identified through a PMNCH Endnote Web database for the Success Factors study series and a purposeful search of Google and bibliographies of papers retrieved.

In two phases, we reviewed the abstracts and full text of the papers and assessed them for inclusion based on six exclusion criteria.[3]

> 1) The document does not focus on at least one of the 139 LMICs (cross-country comparisons must include at least one LMIC);
>
> 2) The document does not study the factors that explain how reductions were achieved for at least one of the following study outcomes: a) change in rates of under-five mortality (birth to 59 months); b) change in rates of neonatal or newborn mortality (birth to 1 month); c) change in rates of infant mortality (1 month – 12 months); d) change in rates of postneonatal mortality (1 month-59 months); e) change in rates of maternal mortality (death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management).
>
> 3) The document solely attributes the country's progress to a single factor—for example, female education or immunization—instead of analyzing a range of factors and the broader country context. The focus in the literature review on papers that analyze multiple factors, instead of single factors, allows a broader understanding of country context and *how* countries were able to reduce maternal and child mortality.
>
> 4) The document has a subnational (i.e. district level) focus, rather than a national-level or comparative national focus (the exception would be documents with a state-level focus in large, federally-administered countries such as India, China, and Brazil).
>
> 5) The document is a duplicate version of another report or study that is published elsewhere (for example, a working paper that then gets published in a peer-reviewed journal).
>
> 6) The document is conceptual, an advocacy piece, a commentary, or a textbook that does not include national-level empirical data.

[3] These criteria were drawn from other similar literature reviews, such as in Mays N, Erwin J, De Lay PR, Beck EJ. Understanding Country Responses to their HIV Epidemics: An Exploratory Qualitative Comparative Analysis. Manuscript in preparation.

Given these exclusion criteria, a number of important papers related to maternal and child mortality have been left out of this review since these papers focus predominantly on either the causes of mortality or "what works" in terms of key interventions, instead of the steps or investments particular countries have taken to achieve results.[4]

We conducted thematic analysis of all included papers, using both deductive and inductive coding, to identify factors that explained why some LMICs are more effective than others in reducing maternal and child mortality. For deductive coding, we coded themes drawn from the analytical framework of the Success Factors study series (see Table 1 in Annex IV) which is adapted from the UN Millennium Project's "clusters of public investment and policies" and WHO's "health systems building blocks" [4, 5]. Inductive coding involved identifying additional themes in the studies that were not found in the analytical framework of the Success Factors study series.

In reporting our findings, we have highlighted the experiences of the set of "fast track" countries shown in Table 2 in Annex IV. This set includes ten of the 75 Countdown to 2015 countries that were identified as being on the "fast track" to both MDGs 4 and 5a in 2012. These ten countries are the focus of in-depth policy reviews in the Success Factors study series. The set of countries in Table 2 also includes those LMICs identified by the John Hopkins analysis for the Success Factors study series that are on track for MDGs 4 and 5a and are superseding regional best performance measures in certain policy areas in health and other sectors.[5] In our findings we have also occasionally highlighted neonatal mortality separately from that of under-five mortality since countries that have made the largest under-five mortality reductions between 2000 and 2010 are not always the same countries that have made the most progress on neonatal mortality.

[4] For example, articles such as Kassebaum NJ, Bertozzi-Villa A, Coggeshall MS, Shackelford KA, Steiner C et al (2014). Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* S0140-6736 (14): 60696-6; Dickson KE, Simen-Kapeu A, Kinney MV, Huicho L, Vesel L, et al (2014). Health-systems bottlenecks and strategies to accelerate scale-up in countries. *Lancet* S0140-6736 (14)60582-1; Bhutta ZA, Chopra M, Axelson H, Berman P, Boerma T et. al. (2010). Countdown to 2015 decade report (2000-10): taking stock of maternal, newborn, and child survival. *Lancet* 375 (9730): 2032-44; Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, et al. (2008) What works? Interventions for maternal and child undernutrition and survival. *Lancet* 371 (9610): 417-40; Boerma JT, Bryce J, Kinfu Y, Axelson H, Victora CG (2008). Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries. *Lancet* 371 (9620): 1259-67; McGuire J. (2006). Basic health care provision and under-5 mortality: A cross-national study of developing countries. *World Development* 34:405-425.; Stuckler D, Basu S, McKee M (2010). Drivers of inequality in Millennium Development Goal progress: a statistical analysis. *PLoS medicine* 7:e1000241; Gakidou E, Cowling K, Lozano R, Murray CJ (2010). Increased educational attainment and its effect on child mortality in 175 countries between 1970 and 2009: a systematic analysis. *Lancet* 376:959-974.

[5] Cohen et al. Country progress towards MDGs: Adjusting for socioeconomic factors reveals greater progress and new challenges. Manuscript in preparation.

3. Findings

The search generated a total of 1,497 documents. After removing duplicates, 901 remained (see Annex II for the literature review flow chart). After applying the exclusion criteria, a total of 82 papers were identified for inclusion in the review (see Annex III). These papers are based on both qualitative and quantitative methodologies and include case studies, time trend analyses, implementation research studies, and policy analyses. These papers consist of 69 single country studies of progress on maternal and child mortality and 12 multi-country studies. A total of 27 papers focused on maternal mortality, 41 on child mortality, and 14 on both. Of the papers on child mortality, seven were all or in part on infant mortality and 14 on newborn health.

These papers identified factors for why some LMICs have been more effective than others in reducing maternal and child mortality. We present these factors in three categories: 1) health systems factors; 2) investments and policies outside the health sector; and 3) cross-sectoral enabling factors for health.

3.1 Health Systems Factors

The papers included in the review highlighted factors across six health systems pillars as being important to maternal and child mortality reductions.

3.1.1 Health Service Delivery

Summary of key findings:

- Scaling up minimal essential packages of evidence-based maternal and child health interventions[6] situated along the continuum of care can rapidly improve mortality outcomes even in the context of political and economic instability.
- Success is often attributed to both improving coverage of community and primary health services and facilities and carrying out mass campaigns of targeted interventions.

Between 1998 and 2009, Niger (a fast track country) saw its mortality drop from 226 to 128 child deaths per 1,000 live births (an average of -5.1% per year) in spite of being ranked 186 out of 187 on UNDP's Human Development Index. Amouzou et al. (2012) describe how Niger improved coverage of key child health services such as single dose vitamin A supplementation, insecticide-treated bednet (ITN) distribution, improved immunization coverage (measles, tetanus, DPT3), promotion of improved care-seeking behavior for fever and cough, and targeted programming for nutrition [6]. In total, the combined increase in ITNs and vitamin A coverage contributed to half of the total lives saved (44%), with ITNs alone attributed to saving one in four deaths. Additionally, more

[6] A summary table of these essential interventions can be found at http://www.who.int/pmnch/topics/part_publications/201112_essential_interventions/en/index.html.

than 400 integrated health centers and 1,900 health posts were built in remote, rural communities between 2000-2009, along with 39 inpatient and 671 outpatient nutritional rehabilitation centers. Together these intervention-based strategies led to a major reduction in under-five mortality rates in Niger.

In Bangladesh (a fast track country), Adams et al (2013) describe how scaled up demand creation campaigns for targeted child health interventions —involving a joint effort by NGOs, donors, and government health and family planning field workers—led to more equitable distribution of infant and child survival across wealth quintiles by rapidly improving access to critical services [7]. The authors highlight the example of National Immunization Day in 2012, where health workers and family planning staff worked in partnership with 600,000 volunteers to deliver polio vaccines and vitamin A capsules to 24 million children at 140,000 sites across the country. This was followed up by a 4-day house-to-house campaign by mobile immunization teams.

In other fast track countries—such as Brazil [8], Mongolia [9, 10], Rwanda [11], Nepal [12], Bangladesh [13-15], Egypt [16], Ethiopia [17], and China [18]—the implementation of cost-effective, intervention-based strategies have likewise contributed to large reductions in under-five mortality, often in the context of stagnating economic circumstances, political instability, and stalled progress on other social and demographic indicators typically linked to mortality decline (for example, female education). Authors have attributed countries' progress on mortality to the following health service delivery factors: coverage of health facilities and reproductive health services; scale up of antenatal care, skilled birth attendance, and facility based deliveries; and improved referral from communities to primary health clinics to secondary hospitals. Even for LMICs that are not presently classified as fast track countries—such as India [19], Malawi [20], Tanzania [21], Uganda [22], and Ghana [23]—the papers highlight maternity wards and newborn care centers as factors contributing to reductions in maternal and child mortality.

Expansion of service coverage, however, does not exist in a vacuum. The literature also emphasizes a number of other important health systems factors that support and sustain the delivery of maternal and child health services and interventions.

3.1.2 Health Workforce

Summary of key findings:

- In many countries, progress on maternal and child mortality declines has resulted from increasing coverage of key maternal and child health cadres—community health workers, midwives, nurses, obstetricians, pediatricians—at community, primary, and secondary facility levels.
- Improved health worker coverage, however, is not enough. A number of papers point to quality improvements—such as scale up of training, mentoring, and supervision of health workers in Integrated Management of Childhood Illnesses (IMCI) and Emergency Obstetric and Newborn Care (EmONC), and increased

investment in health worker training institutions—as important factors in countries' successes.

Central to the decline of maternal mortality in many fast track countries were efforts to increase and strengthen human resources. Among high burden countries, such factors include the increased availability of skilled birth attendants and community health workers. In Egypt, a high-burden country that has seen a 52% drop in maternal mortality from 174 to 84 per 100,000 live births between 1992/93 and 2000, a safe motherhood project focused on improved care during pregnancy and delivery for the population with the highest risk. A competency-based program trained 1,300 doctors and nurses in essential obstetric care protocols in Upper Egypt to improve skills of providers in both the public and private sectors. In addition, 25 hospitals were renovated and equipped with required supplies [24, 25].

Amouzou et al (2012) also describe how Niger supported its rollout of maternal and child health interventions by rapidly increasing its cadre of rural health workers in order to support its scale up of facilities in rural areas [6]. Over 2,300 community health workers were trained in Community IMCI and were added to the government payroll in 2007. An additional 1,400 IMCI-trained health workers were placed in community health posts. They provided the community with an integrated minimum package of promotion, prevention, and treatment services focused on malaria, diarrhoea, respiratory infection, and nutrition. Over this period, the number of people living within five kilometers from health facilities almost doubled, from 48% to 80%, with a resulting rise in utilization of services.

Elsewhere, Mongolia achieved a 43% reduction in its under-five mortality rate between 1990 and 2007, along with a more than 90% increase in rates of hospital-based deliveries. Its high performance is partially attributed to achieving a high density of health care workers [10]. In addition, the country's commitment to appropriate staffing is emphasized, including sufficient staffing of doctors and nurses at the primary level, and the placement of specialists (pediatricians and obstetricians) at secondary and tertiary levels [9]. Mongolia also strengthened its health training institutions in order to ensure a sustainable supply of health workers. China and Vietnam are also highlighted as countries that have prioritized the improved quality of health worker training institutions in order to improve service delivery and therefore reduce maternal and child mortality [10].

Even in countries that are not classified as fast track, the literature attributes modest successes to the expansion of health worker cadres. For example, Malawi is a country that has seen an under-five mortality decline of 227 to 89.6 per 1,000 live births between 1990 and 2010. Service agreements with the Christian Health Association of Malawi to deliver free services to the poorest families and an investment in paid community health workers increased use of public health service delivery for maternal and child health in some settings [20]. Malawi has struggled with a rise in newborn mortality (subsequent to decreases in under-five mortality), but nevertheless has seen its expansion of services lead to positive overall child health outcomes. In another

example, Tamil Nadu is a state in India that has experienced progress with infant and child mortality reductions, as well as reductions in mortality differences between regions, wealth strata, genders, and rural-urban areas. These achievements have been made in the context of stagnating national-level mortality rates in India. In Tamil Nadu, health authorities deployed qualified Auxiliary Nurse Midwives/Village Health Nurses at the rate of one for 5,000 rural people and one for 3,000 people in tribal areas for antenatal care and other services. The government also attracted medical officers to rural areas through incentives such as reserved places for post-graduate study [19, 26].

The expansion, training, mentoring, quality control, and retention of the health workforce has, therefore, been a vital strategy in the effective delivery of interventions and services by many countries.

3.1.3 Health Information Systems and Tools and Methodologies for Evidence-Based Decision Making

Summary of key findings:

- National efforts to reduce maternal and child mortality often rely on strengthened information systems and data for decision making via investments in locally-generated formative research, LiST modeling, national Health Management Information Systems (HMIS), and other mechanisms for monitoring and evaluation.
- A number of successful countries have prioritized roll out of national birth and death registries and maternal death reporting systems.

A number of papers emphasize the importance of both information systems and evidence in countries' formulation of advocacy, policy, and planning for maternal and child mortality reductions. From the most basic reliance on Demographic and Health Survey (DHS) data for information on mortality and the factors influencing it, to the utilization of LiST modeling, policy and program timelines, and implementation research, our review illuminates various ways in which information has helped countries target their responses towards measurable outcomes.

The role that tools and methodologies have played in country responses is highlighted in the papers analyzing the experiences of Bangladesh and Nepal (both fast track countries) with Save the Children's Saving Newborn Lives (SNL) program [12, 13]. Global-level research (such as The Lancet 2003 Series on neonatal mortality), locally-generated research (such as icddr,b's formative research on community-based packages for neonatal health in Bangladesh), and LiST analyses have helped countries create national-level political priority for neonatal mortality and lay the groundwork for a longer-term, health systems approach to newborn health. While other focal countries in the SNL program have not seen as much progress in maternal and child mortality reductions, the papers suggest that many of these countries are currently reforming their health information systems and establishing an outcome-oriented approach that will serve them well beyond 2015.

Similarly, Egypt (a fast track country) utilized evidence from a National Maternal Mortality Survey (NMMS) conducted in 1992-93 to help formulate policy and direct planning. The survey found that metropolitan areas and Upper Egypt had a higher maternal mortality rate than Lower Egypt. The Ministry of Health and Population targeted its safe motherhood program to this area and by 2000, a second national survey showed dramatic reductions in maternal mortality in these targeted areas [24].

A number of other countries are also upgrading their information systems and improving the evidence base. Ethiopia (a fast track country), for example, is strengthening its Health Management Information System and is improving its data collection of information on maternal, newborn, and child health indicators [17]. China (a fast track country) has developed a strong maternal death reporting system, including investigation by Prenatal Health Committees and counseling and education of practitioners to address the causes of maternal mortality [27, 28]. Additional examples of places that have prioritized maternal and child death registries and audits, and have seen reductions in maternal and child mortality, are Tamil Nadu, India [19], Sri Lanka, and Malaysia [29].

3.1.4 Medical Commodities

Summary of key findings:

- Large reductions in maternal and child mortality are linked to improved delivery and uptake of key reproductive, maternal, and child health commodities.

Many papers highlight the key role of vaccination, contraception, vitamin A, and ORS in mass campaigns or in primary-level maternal and child health service delivery. Scale up of immunization coverage is cited as a key factor in the improvement of child mortality rates in fast track countries such as Brazil [8, 30], Niger [6, 31], and Mongolia [10], Nepal [12], Bangladesh [7, 32], and Ethiopia [17]. Countries that have not made as much progress also attribute improved immunization coverage as a contributing factor to gains in under-five mortality (e.g. Malawi [20], India [33], Philippines [10]).

Likewise, papers highlight improved delivery and uptake of ITNs in Niger [6] and Rwanda [11]; oral rehydration salts (ORS) in Brazil [30], Bangladesh [7], and Vietnam [10]; contraception in Mongolia [9], Nepal [34], Romania [35], Bangladesh [7], and Egypt [25]; and vitamin A and other micronutrient supplementation in Mongolia [10], Nepal [34], Bangladesh [14], and China [10].

The importance of health commodities is mentioned even in countries that have experienced stagnating mortality rates. For example, Kenya is struggling to meet its MDG 4 targets on child mortality. However, Demombynes and Trommlerová (2012) describe how, through a combination of public health interventions and economic growth, Kenya's infant mortality rate fell by 7.6%/year between 2003 and 2009, the fastest rate of decline among 20 countries in the region [36]. Postneonatal mortality fell from 47 deaths to 22 deaths per 1,000 live births while infant mortality dropped from 81 to 60 deaths per 1,000 live births, corresponding to a decline of 53% and 26%,

respectively [36]. The authors attribute these gains to a rapid scale-up of ITN ownership in malaria endemic areas, an intervention that benefits infants and under-fives, but not necessarily newborns. Other factors were increased supplementation during pregnancy, immunization rates, and expansion of intermittent preventive therapy for malaria, along with broader environmental and economic change.

3.1.5 Health Financing

Summary of key findings:

- Countries' progress on mortality is sometimes attributed in part to increased external support for targeted maternal and child health interventions, or for interventions in non-health sectors that free up domestic resources for health.
- The establishment of domestic financing mechanisms to facilitate women and children's access to care—such as cash transfers, performance-based financing, or universal health coverage schemes—can be a critical factor in reducing mortality.

The positive role of external financing was cited as a factor in a number of studies on fast track countries. For example, Barker et al (2007) argue that continued financial support from donors allowed the Nepalese government to provide uninterrupted, high quality health services toward maternal mortality reduction [37]. In an analysis of four countries, including Bangladesh and Egypt, Croghan et al (2006) state that targeted health interventions and foreign aid were key factors in these countries' successful reduction of under-five mortality, even in the absence of significant economic development, good governance, poverty reduction, and economic equity. These countries "formed more effective relationships with donors than less successful countries" while ODA "mitigated weak economy and low levels of internal and public/private health spending" [15]. The authors also believe that non-health sector ODA helped free up and redirect domestic resources for health. Studies focusing on the Saving Newborn Lives Program (Bangladesh and Nepal, as well as Malawi, Pakistan, and Uganda) cite financing from the Bill and Melinda Gates Foundation to Save the Children-US as instrumental in redirecting political priority toward newborn survival [12, 13, 20, 22, 38].

Many fast track countries in the literature review highlighted financing mechanisms in countries that ensured poor women did not face financial barriers in accessing services as important in reducing maternal mortality. These mechanisms include cash transfer programs in Brazil, Niger, and Nepal. In Brazil and Nepal, cash transfers helped pregnant women access public health facilities for antenatal care or facility-assisted births [8, 34]. In Niger, cash transfers and food for work programs helped support improved nutrition initiatives—a factor cited by the Niger Countdown Team as one of the primary strategies leading to large reductions in Niger's absolute rate of under-five mortality [6]. Other financing mechanisms utilized by fast track countries include health equity funds and partner organizations' voucher programs for pregnant women in Cambodia [41], national health insurance and elimination of user fees in Mongolia [10], performance-

based financing to improve quality of care in Rwanda [42], and increased governance subsidies for hospital-based deliveries in China [43].

Elimination of user fees, either specifically for women and children or more generally for the entire population, have been credited with influencing maternal and child mortality decline in many countries, including Niger [6], Uganda [22], Nepal [12], Thailand [44], Brazil [8], Yunnan Province of China [18], and a number of countries in the Western Pacific Region, including Mongolia [10]. For countries that have already achieved their targets, such as Thailand [14, 44], Malaysia and Sri Lanka [29], and Jordan [45], removing financial barriers to health care has been cited as a key factor in achieving maternal and child mortality goals. For countries struggling to reduce maternal and child mortality, universal health coverage schemes have proven to be a vital initiative for making inroads in the reduction of mortality. For example, in Haiti, the expansion of the free Soins Obstétricaux Gratuits and Soins Infantiles Gratuits schemes helped to double the number of institutional deliveries from what it was prior to the devastating earthquake of 2010 [46]. Although post-earthquake maternal and child mortality rates have not been assessed, Haiti had the highest maternal and infant mortality rate in the Western Hemisphere before 2010, and women and children in Haiti still face unimaginable odds. Nevertheless, the literature highlights free maternal and child health services as one of the most important steps toward addressing mortality rates in the country [46].

3.1.6 Health Systems Governance

Summary of key findings:

- A number of fast track countries have prioritized maternal and child health in national health plans and policies and created targeted national strategies on reproductive, maternal, neonatal, or child health.
- The creation of national stakeholder institutions – such as working groups and committees – focused on planning, financing, and results dissemination – can be an important means of creating stakeholder buy-in and mobilizing resources towards maternal and child survival.
- While success is often attributed to the creation of national governance structures to improve accountability, efficiency, and harmonization, a clear link between these structures and mortality reductions is not evident in the literature.

Leadership, governance, and implementation structures are not sufficient in themselves to put a country on a fast track to achieving their MDGs, but the review found a number of countries in which these factors have proven critical to their progress. For example, studies from Nepal (a fast track country) highlight the creation of favorable policy environments for maternal and neonatal mortality reduction [12, 34]. Among other developments, these studies mention the inclusion of reproductive health as a citizen's right in the Interim Constitution of 2007, the development of the National Neonatal

Health Strategy in 2004, the Safe Motherhood and Neonatal Long Term Plan 2006-2017 in 2006, and the National Policy for Skilled Birth Attendants in 2006, as providing a critical mandate for the Family Health and Child Health divisions of the Ministry of Health and Population.

Shiffman and Sultana (2013) similarly trace the prioritization of newborn survival in Bangladesh, a process which developed over the course of a decade, and which involved the creation of various national institutions, strategies, and partnerships [47]. For example, Save the Children's Saving Newborn Lives (SNL) Program selected Bangladesh as a focal country in 2000, providing programmatic infrastructure to mobilize government and its partners to act on newborn health. SNL was supported in its efforts by a global level alliance, the Healthy Newborn Partnership. In 2001, SNL brought stakeholders in Bangladesh together within a Newborn Survival Working Group. In 2002, this group created a newborn care module that was eventually integrated into Bangladesh's IMCI strategy in 2006. A national task force for the maternal and child survival MDGs was established in 2007 and a National Neonatal Health Strategy in 2009. These efforts paid off, helping the government of Bangladesh set goals, create costed work plans, and attract the interest of donors such as USAID, the Bill & Melinda Gates Foundation, Australia, the United Kingdom, and the European Community in financing maternal and child health programs. At present, the government's 2011-2016 health strategy includes an operational plan solely dedicated to maternal and child health, and indicators suggest a number of positive outcomes. For example, the percentage of women initiating breastfeeding within one hour of birth climbed from 17.0% to 43.0% between 2000 and the mid- to late 2000s, while the percentages of women making at least four antenatal visits, delivering with a skilled birth attendant, delivering within a facility, or receiving a postnatal check up within two days of delivery more than doubled during that time. Tetanus toxoid uptake among mothers also rose from 64% to 83%. Estimates suggest that neonatal mortality has declined 31.0% since 2000, from 42.7 per 1000 live births to 29.5 in 2009 [47].

Studies of other fast track countries also mention critical health governance structures, including legislation on abortion in Nepal [34] and Cambodia [41], the development of a national policies on nutrition and IMCI in Niger [6], the adoption of results-based management and community accountability structures in Rwanda [42], and the alignment and harmonization of government and development partners in Ethiopia [17].

3.2 Investments and Policies outside the Health Sector

Many of the papers included in this review emphasized investments and policies outside the health sector as factors in the reduction of maternal and child mortality.

3.2.1 Education

Summary of key findings:

- Investing in and promoting female education is one of the most commonly cited

non-health sector activities contributing to reductions in maternal and child mortality.

- However, the specific mechanisms that countries have utilized to eliminate barriers to female education (e.g. cash transfers for improved attendance among girls) are not described in detail in the literature.

Education—especially of women—has been shown to be an important factor for the improvement of maternal and child survival. In a study of 175 countries, Gakidou et al. (2010) found that of 8.2 million fewer deaths of under-fives between 1970 and 2009, 51% could be attributed to increased educational attainment in women of reproductive age [48].

Of the papers included in the review that addressed female education, all found it to be a critical determinant of maternal and child mortality rates. For example, Campbell notes that women's education improved during the 1990s in Egypt, especially in terms of higher education, and this led to better socioeconomic status with a subsequent effect on health [24]. Papers of fast track countries that cite the link between female education and maternal and child mortality decline include studies of Brazil [8, 30, 49, 50], Mongolia [9, 10], Nepal [12, 34, 51], Bangladesh [7, 13, 32], Cambodia [10], Rwanda [11], Peru [52], Egypt [24], and China [43]. These factors were also identified as key to reductions in maternal and child mortality in countries that did not have a high burden in 1990, such as Sri Lanka and Malaysia [14, 53], and Cuba [16]. For countries struggling to meet maternal and child mortality targets, unequal distribution of progress on either female education or literacy rates due to differences in geographical or rural/urban residence or wealth strata, is cited as a factor for stagnating or increasing mortality. Papers from India [26, 54, 55], Pakistan [56], and Philippines [57, 58], for example, highlight inequitable distribution of female education as one of many reasons why national mortality targets have not yet been met.

Many of the papers in the review that present the linkage between female education and maternal and child mortality rates explain female education in terms of socio-economic change but do not describe in detail why rates of education improved. One exception is Faguet's (2007) discussion of the indirect influence that Bangladesh's Female Secondary School Project—a conditional cash transfer program supporting continuing education among young women—had on increasing the age of marriage, reducing fertility and, thus, influencing maternal mortality [32]. Other papers citing female education, however, do not go into as much detail about the policies and investments in education.

3.2.2 Environmental Management

Summary of key findings:

- There is inconsistent evidence on the impact of environmental factors on maternal and child mortality; however, in some countries, success has been attributed to scaling up access to safe drinking water, improved water sources,

and improved sanitation especially in the context of urbanization.

- There is little evidence on how improved air quality and urban crowding might influence maternal and child survival.
- The influence of environmental initiatives on countries' progress on maternal and child mortality is not well documented in the literature; papers often describe correlations, but not context and impact.

Environmental factors can be critical determinants of maternal and child health. Policies and investments in environmental management can influence, for example, the incidence of diarrhoeal disease and acute respiratory infection, as well as contribute to the ability of households and health facilities to maintain a clean environment. Access to clean water and sanitation were highlighted as significant in some papers in this review. For example, every paper on Brazil (a fast track country) mentioned the country's efforts to achieve inter- and intra-regional equity, in part through water and sanitation improvements, as a factor contributing to progress on reducing child mortality [8, 30, 49, 50].

At the same time, a number of papers point out that lack of improvements in water and sanitation need not be an impediment to progress on mortality. A review of the findings from the DHS in Rwanda (a fast track country) demonstrated that access to safe drinking water in Rwanda increased from 23% to 41% from 1992 to 2008, while access to improved toilets increased from 9% to 56% from 2000 to 2008. However, infant and child mortality in Rwanda declined steadily during this period regardless of whether households had access to safe drinking water, an improved source of water, or an improved toilet [11]. Likewise, a study in Uganda found no correlation between water source and infant mortality rates [59].

Where environmental management was correlated with maternal and child health outcomes most frequently were in papers comparing mortality rates in urban versus rural areas. Reduced access to clean water, for example, was a clear factor in lack of progress toward under-five mortality goals in the case of Kenya which, through rapid urbanization between 1992-2003, saw access to water in urban slums deteriorate 87% in the early 1990s, to around 50% in 2003 (a drop of 33%) as under-five mortality levels in those areas rose in parallel [31]. In a review of urbanization in twenty African countries, moreover, Fotso et al. (2007) correlated improved access to safe drinking water as one of many factors influencing child mortality rates [31]. In Niger, Malawi, Benin, Uganda, Burkina Faso, and Cameroon, urban areas saw small improvements in child survival alongside improvements to water and sanitation and increased vaccination coverage, while Zimbabwe and Kenya both saw an increase in urban child mortality alongside a decrease in access to clean water. Minnery et al (2013) also noted issues with urbanization, air quality, and child mortality in urban Chhattisgarh and Jharkhand states [60].

Many factors influence access to clean water and clean air—these include demographic change, urban crowding, insecurity, infrastructure expansion, and upkeep. It is,

therefore, important to better understand when and where environmental management policies and investment make the most difference for maternal and child health.

3.2.3 Infrastructure development

Summary of key findings:

- Improvements to roads, transport, and communication networks, as well as the upgrading of housing for the poor, are correlated with progress on maternal and child survival in some countries.
- The role that improved infrastructure might play in maternal and child mortality reductions is poorly documented in the literature.

Roads and transport networks influence access to health care, as well as supply chains for critical medical supplies. Communication networks affect the efficiency of referral and health information systems, as well as the health system's ability to respond to emergencies. Lack of, or inconsistent, electrification impacts quality of health service delivery, while lack of market linkages affects family livelihoods and, thus, their ability to pay for the direct and indirect costs of health care.

A few papers in this review note the importance of infrastructure for maternal and child survival. For example, Adams et al. (2013) look at equity gains in child mortality achieved by Bangladesh (a fast track country) and note the country's investment in road and transportation networks as an important factor in improving coverage of maternal and child health services to previously underserved areas [7]. Elsewhere, studies of India note the lack of access to improved housing to be a contributing factor to the difficulty that the country faces in achieving equity in infant and child mortality [26, 33]. A study of the under-five mortality rate in Uganda between 1954 and 2000 correlates ebbs and flows of investment in infrastructure and social services (which, in turn, are linked to the history of political instability in the country) to increases and decreases in child survival [61]. Likewise, in the Philippines, Collas-Monsod et al. (2004) associate access to infrastructure and roads to disparities in infant mortality rates across and within regions, as well as between rural and urban areas [57]. In Honduras, Danel (1999) links reduction in maternal mortality to a number of factors, including improved roads and transport networks [62]. Access to infrastructure, then, obviously has the potential to influence maternal and child survival rates, but remains an area that is not well documented.

3.3 Cross-sectoral enabling factors for health

Retrieved papers pointed to cross-cutting contextual factors related to large scale political, economic, or legal change that occurred simultaneously as declines in maternal and child mortality.

3.3.1 Overcoming inequalities and realizing rights

Summary of key findings:

- The adoption of laws, policies, and initiatives aimed at improving the status of the disenfranchised or disempowered—either due to gender, wealth, ethnic, or regional status—have been correlated with reductions in maternal and child mortality.
- However, the way in which countries leverage rights-based and equality-based approaches to maternal and child health, and the subsequent impact on mortality rates, remains poorly documented.

A few papers emphasized initiatives and policies—both inside and outside the health sector—that targeted the status of girls, women, the poor, or marginalized communities. For example, papers on Nepal (a fast track country) point to the country's 2002 constitutional recognition of women's right to reproductive health and abortion as a factor in the reduction of Nepal's maternal mortality rate due to the subsequent increase in access to contraception and decline in the fertility rate [34, 51]. Papers on Cambodia and Romania (fast track countries) cite more liberal abortion laws as contributing factors to reduced maternal mortality in those countries [35, 41].

Elsewhere, a study of India explores gender-based infant mortality inequalities across and within different states in India and finds an association between declines in gender-based infant mortality inequality strongly related to: a) female participation in the labor force and; b) policy and programmatic interventions to protect the Girl Child [26]. States that had made progress on gender-based infant mortality inequality—such as Tamil Nadu and Maharastra—have discouraged sex selective abortion and neglect by creating financial incentives (depositing a sum of money in the name of the girl child to help her pursue studies and marry), taking administrative and legal actions (such as the Maharastra Regulation of the Diagnostic Techniques Act of 1988 and the Tamil Nadu Government's Baby Cradle Scheme), and scaling up women's Self Help Groups in order to carry out sensitization campaigns, surveillance of scan centers, and peer support of new mothers. Furthermore, a study of four countries (Cambodia, Ethiopia, Mongolia, and Armenia) by Khan (2005) cites linkages between improved employment and rising income levels among the poor as being correlated with progress on countries' MDGs more broadly [38].

While the inability of countries to overcome inequalities and realize rights are raised repeatedly in the literature and cited as key reasons for countries' lack of progress on maternal and child mortality, most papers in this review do not definitively link these factors to national-level improvements in the infant, child, and maternal mortality rates. There is, therefore, a need for further research demonstrating more explicitly the ways in which fast track countries have leveraged approaches for realizing rights and overcoming inequalities to achieve impact on mortality rates.

3.3.2 Population Dynamics

Summary of key findings:

- Policies and initiatives aimed at reducing the fertility rate are important factors

contributing to country progress on maternal mortality.

- Urbanization can have a positive impact on maternal and child mortality rates, but only in the context of a simultaneous increase in service coverage. If urbanization is not accompanied by an expansion of service coverage, there is ample evidence in the literature that maternal and child mortality rates may increase.

The role of birth spacing and fertility (and, hence, access to contraception and female empowerment) was emphasized in a number of papers on maternal mortality. Less discussion of this factor was present in the papers on child mortality. Papers on fast track countries such as Brazil [50], Romania [35], Nepal [34, 51], Bangladesh [7, 13, 32, 63, 64], Cambodia [41], Rwanda [11], and Egypt [25] mention declines in fertility, due to improved access to contraception or larger birth intervals, as contributing factors to reductions in maternal mortality. A paper on Iran attributes policies on population control and family planning as the primary factors leading to the reduction of maternal mortality in the country over the last 30 years [65]. The policies include mandatory pre-nuptial education for couples, endorsement of family planning practices designed to promote smaller families such as the concept of birth spacing and limiting family size to three, and government encouragement of women to restrict child-bearing to between the ages of 16 and 35. Even in countries within which maternal mortality is stagnating, such as India, regional progress on maternal mortality is linked to the decline in the fertility rate and access to family planning. Tamil Nadu state, for example, has committed itself to the expansion of family planning and has seen a reduction in fertility; the authors correlate this with a decline in the maternal mortality rate [19].

A number of papers also addressed the role of population movements, particularly urbanization, and effects on maternal and child mortality. Many note the negative effect that movements of population can have if urban services are not scaled up to match population growth. The paper by Fotso et al. (2007), cited earlier, looks at population growth over time in urban areas in twenty African countries [31]. It shows that urbanization is often unaccompanied by economic growth and, thus, often leads to decreased access to clean water and vaccination coverage, and subsequently increased rates of child mortality.

Papers from India have similar findings. Chhattisgarh and Jharkhand states—which were created in 2000 by dividing them from Madhya Pradesh and Bihar respectively—were expected to show progress in maternal and child survival as it was believed that becoming independent administrative units would allow for better prioritization of maternal and child health. But this did not occur. Migration to urban areas led to an increase in both the urban poor and middle class, but services in these urban areas did not expand accordingly. Middle class urban residents utilized the private health sector; however, the private sector was unaffordable to poor people, and unregulated and inconsistent in quality. In the meantime, as both states were included within the Empowered Action Group of states (eight disadvantaged states in India that have been targeted by the federal government for more intense development initiatives) their

rural communities were targeted especially by the National Rural Health Mission and saw improvements to child mortality. Overall, under-five mortality rates did decrease between 1990 and 2007 from 119 per 1,000 live births to 92 in Chhattisgarh, and 130 deaths per 1,000 live births to 76 in 2007 in Jharkhand. But the lack of more significant progress is attributed to increases in mortality in higher wealth quintiles and urban areas [60].

3.3.3 Nutrition

Summary of key findings:

- Increased access to and utilization of micronutrient supplements, complementary feeding, and emergency feeding, along with the promotion of exclusive breastfeeding, is often vital to countries' successes in reducing maternal and child mortality.
- Nutrition gains for improving maternal and child health involve multi-sectoral investment in, and promotion of, proper food storage and preparation, improved national food security, and the integration of nutrition into national strategies for agricultural and food marketing.

In 2013, the Lancet published a series on nutrition and maternal and child survival, including the finding that 3.1 million children under the age of five die every year from undernutrition, or 45% of total child deaths in 2011. As part of the series, the Maternal and Child Study Group proposed a new framework focused on the delivery of priority evidence-based interventions to prevent and treat undernutrition across the whole life course [66]. Malnutrition affects women and children's mortality rates due to deficiencies in key nutrients such as vitamin A, zinc, and folic acid. In addition, cheap, calorie-rich, nutrient-poor diets contribute to obesity and increased risk of mortality from gestational diabetes, eclampsia, pregnancy-related hypertension, or birth obstruction by large birth weight babies [67].

Papers on Brazil (a fast track country) highlighted national and statewide programs to improve child health and nutrition, including initiatives to promote breastfeeding [30, 50]. Niger (a fast track country) updated polices on nutrition, built rehabilitation facilities for malnourished children, rolled out food and cash transfers for work initiatives, and improved access to vitamin A by distributing it within the context of integrated mass campaigns [6]. A study of WHO's Regional Child Survival Strategy for the Western Pacific (which includes fast track countries China, Mongolia, Lao, Cambodia, Vietnam, and Vanuatu) also emphasizes the importance of nutrition programs and breastfeeding promotion, along with vaccination and reduction of diarrhoeal disease, in contributing to improvements in child survival by as much as 64% [10]. Papers on fast track countries such as Bangladesh note increased coverage of vitamin A supplementation when describing progress on neonatal health [14]. Nepal (also a fast track country) has tackled maternal mortality through a number of measures, including reducing anemia by improving maternal micronutrient status [34, 51].

Even amongst those countries that are not categorized as fast track, progress on mortality is linked to gains in the nutritional status of women and children. A time trend study of Tanzania's DHS surveys notes that nutritional status of children improved during the period in which Tanzania saw declining child mortality. The authors attribute child mortality declines to gains in wealth and access to integrated health interventions with vitamin A supplementation [21]. Several papers on the Philippines—while noting the country's slow progress on maternal and child mortality reductions—cite iron and folic acid supplementation in schools, an increase in nutrition training courses, and irrigation inputs and agrarian reform, as helping to reduce child survival rates and achieve outcomes such as a reduction in stunting from one-in-three under-fives in 2003 to one-in-four in 2005 [10, 57, 58].

Elsewhere, malnutrition and undernutrition are highlighted as key determinants of maternal and child mortality, and are cited as primary hurdles that all countries, including fast track, have to overcome. For example, while Rwanda (a fast track country) has made tremendous gains with child mortality reduction since 2002, malnutrition and stunting in 2009 were still high and cited by authors as a critical contributor to child mortality [11]. Literature from India cites nutrition as a major factor in inequitable infant, child, and maternal mortality rates. States and cities that have implemented micronutrient supplement, promoted breastfeeding, and reduced anemia have fared better than other states [33, 54, 68, 69]. Bhutta et al. (2013) cite the lack of a coherent, integrated strategy on nutrition at both the federal and district levels, along with stagnating rates of stunting and undernutrition, as playing a role in Pakistan's struggle to improve maternal and child mortality rates [56]. The authors note that that the Ministry of Food Security (established in 2011) focuses predominantly on supply and pricing issues rather than nutrition. They emphasize the need for cross-sectoral cooperation and an integrated approach to addressing nutritional barriers to child survival.

3.3.4 Macro-level Economic Development and Political Change

Summary of key findings:

- Improvements to employment and income levels, the reduction of cronyism and corruption, and the decentralization of budgets and decision-making are sometimes correlated with maternal and child mortality declines.
- However, the means by which macro-level economic and political changes influence maternal and child health is poorly documented.
- In some contexts, countries can make significant reductions in maternal and child mortality even if the social, economic, or political context is not advantageous.

Macro-level economic and political issues, such as economic growth and improvements in governance, were mentioned in some papers in relation to maternal and child mortality reductions in fast track countries—for example Brazil [30, 49, 50], Mongolia and Armenia [70], Nepal [12, 51], Bangladesh [7, 13, 32], Ethiopia [70], Cambodia [10,

41, 70] and China [27, 71]. Hussein et al. (2011) note that at the same time that Nepal's maternal mortality rate declined, the country was also improving its economic position, measured by the Human Development Index (HDI) and the Gender Empowerment Measure (GEM). Likewise, several papers on Brazil point to the country's economic development and reduction of income inequalities, as measured by the GINI index, as possible factors in the improvement of maternal and child health and, thus, reductions in mortality [30, 50]. A study of the Philippines correlated differences in regional infant mortality rates to the prevalence of cronyism and corruption (what they refer to as 'political dynasty') [57].

Additionally, papers on fast track countries Brazil [8, 50], Rwanda [42], China [71], and Cambodia [10], as well as on Ghana [23] and Tanzania [21], briefly mention the role of decentralization in health, and discuss how decentralization can benefit maternal and child health outcomes by devolving decision-making, budgets, and authority to better target interventions aimed at improving health, education, and empowerment of women and children. Decentralization is also brought up in the context of inequalities, in which countries such as Pakistan [38, 56] and India [60] attribute disparities in maternal and child mortality rates by region, in part, to instances in which states, districts, or regions do not perform equally well.

It is important to note that most of these papers that study macro-level economic and political change did not statistically correlate change with mortality rates. Indeed, a number of papers demonstrated that maternal and child mortality reductions occurred in the absence of improvements to either a country's economy or system of governance. For example, Niger (a fast track country) succeeded in reducing child mortality in spite of no change in socioeconomic factors, with the exception of overseas aid [6]. Similarly, in Peru (a fast track country), while periodic severe recessions led to short-term spikes in infant mortality, the country nevertheless succeeded in steadily reducing absolute rates of infant mortality from about 100 in 1,000 live births in 1980, to 20 out of 1,000 in 2002 [72]. A paper on Bangladesh and Egypt (fast track countries) describes how targeted health interventions and foreign aid led to big gains in under-five mortality reduction in the 1990s, in the absence of significant economic development, good governance, poverty reduction and economic equity [15]. This finding is an important one because it suggests that in some contexts countries can make significant reductions in maternal and child mortality even if the social, economic, or political context is not advantageous.

4. Discussion

The findings of this review show the importance of implementing key evidence-based, health interventions in reducing maternal and child mortality. In some countries, large reductions in mortality were possible in the short term, even in unfavorable political and economic contexts, when the strategy involved rollout of proven key evidence-based health interventions. However, the results also demonstrate that evidence-based interventions alone are not sufficient for achieving or sustaining progress on maternal

and child mortality. Four keys themes emerge from this review's findings, and suggest areas for future research.

Systems

Key evidence-based health interventions do not exist in a vacuum and in most countries have been supported by investments across multiple pillars of the health system: service delivery; health workforce; information; medical commodities; financing; and health governance. In the papers reviewed, there was limited discussion of the role of all of these health systems pillars in mortality declines. Only the papers on Egypt, China, Nepal, Rwanda, and Bangladesh showed prioritization of a wide range of health systems investments. These investments were not for maternal and child health as an integrated whole, but rather through special initiatives such as those addressing newborn or reproductive health. We highlight this gap in information in the literature, as it draws attention to the fact that the means by which components of the health system relate and interact in order to achieve a country's maternal and child health targets are not yet well documented. The findings of this literature review, therefore, correspond with the recent proposal by the Lancet's Newborn Study Group to address health systems bottlenecks and apply a systems approach to the scale up of maternal and newborn health initiatives [73].

The importance of social, environmental, economic, and political factors is also highlighted in this review. In many of the papers, policies and investments outside (yet intersecting with) the health sector played an equal or greater role in sustainable, long-term maternal and child mortality reduction than targeted health interventions. This suggests that progress on maternal and child mortality is intrinsically tied to multi-pronged, multi-sectoral approaches that serve, over the long term, to strengthen health systems as a whole and are linked to overall national development.

The importance of this theme is emphasized in the literature on fast track countries that consistently cite investments in nutrition as a key factor in the reduction of maternal and child mortality. A coherent nutrition strategy requires investment in health service delivery, health workforce, medical and food commodity supply chains, health and agricultural information systems, markets and pricing policies, education and training, and a myriad of other multi-sectoral initiatives to ensure the prevention and treatment of malnutrition and undernutrition and to remedy food insecurity [67]. While nutrition is a clear area in which a multi-sectoral, systems strengthening approach is warranted, such an approach is also applicable to many of the other factors identified in this review.

Context

The papers in the review show clearly that there is no "one-size-fits-all" strategy to reducing maternal and child mortality. The factors that were most important to mortality reductions in each country depended on context, as each country represents a complex system with many interacting parts and governed by unique historical and political conditions [74]. An extremely poor, yet politically stable country with high rates

of malnutrition and infectious disease may require a different approach than a country experiencing moderate economic growth, yet facing violence and insecurity. Likewise, a politically stable country with a growing economy will likely need strategies and initiatives to tackle inequalities in health outcomes. Countries' performance on maternal and child mortality should, therefore, always be appraised in terms of their historical, political, and economic context, with the recognition that the needs, possibilities, and struggles of countries are very different from each another.

Thresholds

The papers in this review also show that countries need to adapt strategies over time in order to achieve continued progress on mortality reduction. For example, a number of papers examine the impact of factors across different time periods, and in response to the evolving status of the health system and changing causes of death. For example, a study in Brazil (a fast track country) of infant mortality decline from 47 to 20 between 1997 and 2007 found that the downward trend was faster in the 1990s than after 2000 [50]. The authors posit that this was likely because the interventions introduced in the late 1980s and 1990s—targeted at preventive postneonatal deaths–had exerted the majority of their influence by 2000, necessitating new strategies. Elsewhere, a World Bank study of maternal mortality decline in Malaysia and Sri Lanka showed a stepwise process undertaken in both countries as the health system developed [75]. When the health systems were underdeveloped, these countries focused on improving access to the treatment of complications by training and deploying midwives and strengthening facilities for emergency obstetric care. As the health system became stronger, the emphasis shifted toward improving the utilization of available services through quality improvement and empowering of clients. In the 1970s and 1980s, Thailand focused on primary- and community-based health care, increasing coverage of services and interventions in rural areas, expanding community health worker cadres, and incentivizing clinicians to stay in rural areas. This led to huge reductions in child mortality from above 160 per 1,000 live births in the 1950s-60s to below 40 per 1,000 by 1990. By the mid-1990s, though, policymakers recognized that further health impact could only be gained through macro-level health reforms, such as the introduction of Universal Health Coverage [44].

These findings reinforce the comment by Kaldewei and Pitterle (2011), writing about Jordan, that "once a country has passed a certain threshold in household income, education, and access to health care and safe drinking water," other polices may be required in order to achieve further reductions in mortality rates [45]. Our review suggests that identifying such "thresholds"—tipping points after which gains in mortality reduction slow and thus different strategies both within and outside the health sector should be tried—is a fruitful avenue of research in the future.

Overcoming inequalities

Lastly, sustained progress must also involve efforts to reduce regional, income, and gender inequalities. As mentioned earlier, the review highlights countries in which progress on maternal and child mortality rates have slowed, stopped, or even increased

because of widening inequalities. For example, Namibia is an upper-middle-income country where the maternal mortality ratio has risen since 1991, from 271 per 100,000 live births in the 1991-2000 period to 449 per 100,000 live births in the 1998-2007 period, despite increased coverage of maternal health interventions [76]. Zere et al. (2010) argue that this increase is due to inter-regional inequalities in rates of delivery by skilled providers and under-provision of comprehensive obstetric care in some regions.

While many countries have implemented key policies, programs, initiatives, and interventions, they have nevertheless found maternal and child mortality declines stagnating because of the challenges of reaching the needs of geographically and economically diverse populations, as well as groups with specialized needs such as newborns. Their difficulties in reaching MDG 4 and 5a targets and accelerating the rate of change is attributed in the papers to challenges in achieving equitable distribution of services, interventions, and socioeconomic opportunities.

Despite this focus in the papers, there was limited discussion about specific approaches that countries have used to address inequalities and progress towards MDG 4 and 5a. Exceptions include two studies of maternal and child mortality in Brazil that found that regional and socioeconomic inequalities in intervention coverage, nutrition, and health outcomes have markedly decreased [30, 50]. They attribute these changes to the country's efforts to address social determinants of health (e.g. education, water, sanitation) and wide income disparities (through, for example, cash transfer schemes and increased wages in poorer populations), as well as the adoption of the universal health system and the Family Health Program (targeted to underserved areas).

Limitations to the Study

It is important to note that this literature review has a number of methodological limitations. Our six exclusion criteria placed some restrictions on study results. All papers that assessed the role of "single factors" in mortality decline— such as maternal education, external debt, external aid flows, immunization coverage, or facility-assisted births—were excluded from the study in the absence of additional variables that explained how these factors led to changes and how these changes were affected by other contextual factors in countries. Also excluded were studies that focused on "causes" of mortality but not the factors that influenced the reduction of mortality rates, and studies of countries at a single snapshot in time instead of over a period of time. This means that a number of important papers on maternal and child mortality may have been left out of the review.

5. Conclusions

The global health community has long known "what works" in terms of achieving progress on maternal and child survival [77]. However, as this narrative review shows, we still require a better appreciation of what works when, for whom, and in what context. This review found 82 papers that study the range of factors that account for maternal and child mortality declines in LMICs. Health interventions, investments in the

health system, women's education, and broader social, environmental, economic, and political change are all important factors in countries' efforts to reduce maternal and child mortality. Nevertheless, the relative importance of these factors differs according to the country context, and depends on the particular level of development of the health system, as well as on broader social, economic, and political conditions. The struggles that countries face in overcoming inequalities is a consistent theme in the papers.

The factors contributing to countries' progress on mortality (as well as their struggles and setbacks) are complex, multi-sectoral, and systemic, and our findings highlight the need for further examination of three key issues. First, how have countries successfully addressed inequalities to achieve sustained declines in maternal and child mortality? Second, what are the tipping points after which gains in mortality reduction slow and different strategies must be deployed? Lastly, how must key pillars of countries' health systems interact in order to lead to sustainable mortality reductions? The answers to these questions, many of which are being examined in other analyses of the Success Factors study series,[7] can help countries progress toward MDG 4 and 5a targets, and also sustain their progress over the long term.

[7] http://www.who.int/pmnch/knowledge/publications/successfactors/en/

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77. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, Haider BA, Kirkwood B, Morris SS, Sachdev HP, Shekar M: **What works? Interventions for maternal and child undernutrition and survival.** *Lancet* 2008, **371:**417-440.

Annex I: Search Strings

Four search strings were used:

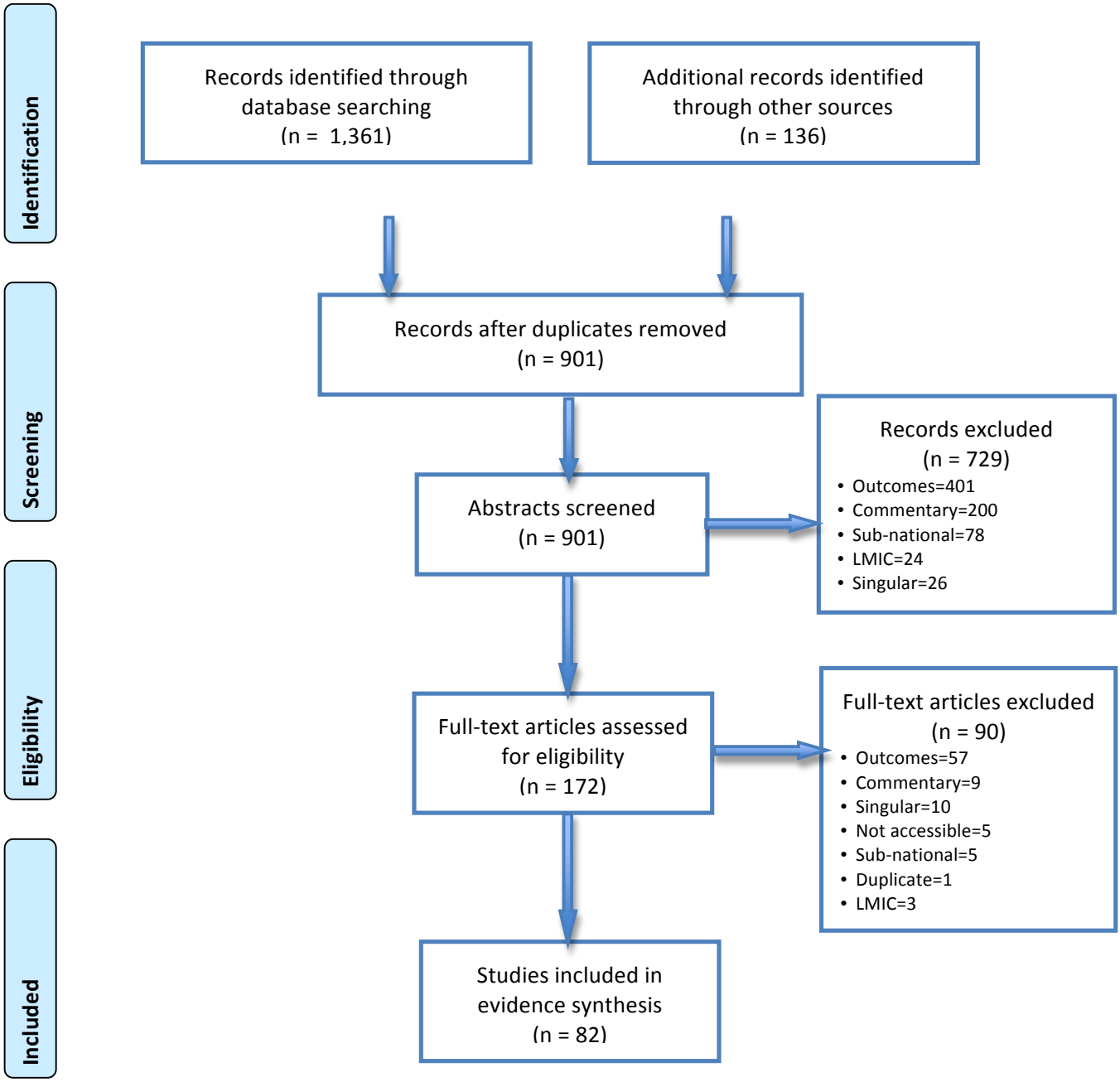
- (("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh])) AND ("Millennium development goal" OR "MDG")
- (("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh])) AND ("Millennium development goal" OR "MDG") AND ("on track" OR "progress" OR "success")
- (("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh])) AND ("Millennium development goal" OR "MDG") AND ("factors")
- (("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh]) AND ("Millennium development goal" OR "MDG") AND (“Malawi” [Mesh]) – LMICs

The following table shows documents retrieved per sources and search strings:

Source/Search Strings	Documents retrieved
A. DATABASES	
Pubmed	
(("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh])) AND ("Millennium development goal" OR "MDG") (filters on English language and dates)	140
World Bank e-library	
(("Infant Mortality/trends"[Mesh]) OR ("Child Mortality/trends"[Mesh]) OR ("Maternal Mortality/trends"[Mesh])) AND ("Millennium development goal" OR "MDG") AND ("on track" OR "progress" OR "success")	6
SSRN	
((Infant Mortality) OR (Maternal Mortality) OR (Child Mortality)) AND ("Millennium development goal" OR "MDG") in all years	24
EconLit	
((Infant Mortality) OR (Maternal Mortality) OR (Child Mortality)) AND ("Millennium development goal" OR "MDG")	32
All other search strings yielded 0 results	0
Google Scholar	

(("Infant Mortality/trends") OR ("Child Mortality/trends") OR ("Maternal Mortality/trends")) AND ("Millennium development goal" OR "MDG")	197
J-Stor	
(("Infant Mortality) OR ("Child Mortality) OR ("Maternal Mortality)) AND ("Millennium development goal" OR "MDG")	349
2. (("Infant Mortality) OR ("Child Mortality) OR ("Maternal Mortality)) AND ("Millennium development goal" OR "MDG") AND ("Millennium development goal" OR "MDG") AND ("on track" OR "progress" OR "success")	328
3. (("Infant Mortality) OR ("Child Mortality) OR ("Maternal Mortality)) AND ("Millennium development goal" OR "MDG") AND ("factors")	283
Lilacs	
(("Infant Mortality") OR ("Child Mortality") OR ("Maternal Mortality") AND ("Millennium development goal" OR "MDG") AND ("on track" OR "progress" OR "success") – filtered for English language AND just Lilacs database	2
Documents retrieved from databases	*1,361*
B. OTHER SOURCES	
Grey literature	
Purposeful search of PMNCH portal, MeasureDHS, WHO, UNICEF, and UNFPA websites using key words: "child mortality," "infant mortality," "maternal mortality," "trends," "progress," "success," "decline"	16
PMNCH Endnote Web database	
Purposeful search of the PMNCH Endnote Web Database and retrieved documents not already identified that mentioned "mortality" or "child survival" or "MDG 4" or "MDG 5"	105
Bibliographic searches (due to time constraints, bibliographic searchers were conducted on only a sample of retrieved papers)	
Documents retrieved from searches of bibliographies of retrieved papers	15
Documents retrieved from other sources	*136*
TOTAL NUMBER OF DOCUMENTS RETRIEVED	**1,497**

Annex II: Literature Review Flow Chart



Annex III: Papers Included in Literature Review

Reference	MMR, U5MR, IMR, Newborn	Country	Low- or Middle-Income	Year of public-cation	Years covered by the study
Abdesslam B. Social determinants of reproductive health in Morocco. Afr J Reprod Health. 2011 Jun;15(2):57-66.	MMR/U5MR	Morocco	Lower-middle-income	2011	1980-2011
Accorsi S, Bilal NK, Farese P, Racalbuto V. Countdown to 2015: comparing progress towards the achievement of the health Millennium Development Goals in Ethiopia and other sub-Saharan African countries. Trans R Soc Trop Med Hyg. 2010 May;104(5):336-42.	MMR/U5MR	Ethiopia	Low-income	2010	1990-2005
Adams, A M., et al. Explaining equity gains in child survival in Bangladesh: scale, speed, and selectivity in health and development. The Lancet 382.9909 (2013): 2027-2037.	U5MR	Bangladesh	Low-income	2013	1993-2011
Agüero JM, Valdivia M. The permanent effects of the recessions on child health: evidence from Peru.Estudios Económicos, Vol. 25, No. 1 (49) (ENERO-JUNIO DE 2010), pp. 247-274.	U5MR	Peru	Upper-middle-income	2010	1986-2004+
Alves D. Infant mortality and child health in Brazil. Economics & Human Biology. Volume 2, Issue 3, December 2004, Pages 391–410.	IMR	Brazil	Upper-middle-income	2003	1970-2000
Amibor, P. What will it Take to Maintain the Maternal and Child Health Gains Made in Haiti Prior to the 2010 Earthquake? Maternal and child health journal 17.8 (2013): 1339-1345.	MMR/U5MR	Haiti	Low-income	2013	1990-2013

Amouzou A, Habi O, BensaѵØd K; Niger Countdown Case Study Working Group. Reduction in child mortality in Niger: a Countdown to 2015 country case study. Lancet. 2012 Sep 29;380(9848):1169-78.	U5MR	Niger	Low-income	2012	1998-2009
Bankole A, Sedgh G, Okonofua F, Imarhiagbe C, Hussain R, Wulf D. Barriers to Safe Motherhood in Nigeria. Guttmacher Institute. March 2007.	MMR	Nigeria	Lower-middle-income	2007	1993-2003
Barker CE, Bird CE, Pradhan A, Shkya G. Support to the Safe Motherhood Programme in Nepal: An Integrated Approach. Reproductive Health Matters, Vol. 15, No. 30, Maternal Mortality and Morbidity: Is Pregnancy Getting Safer for Women? (Nov., 2007), pp. 81-90.	MMR	Nepal	Low-income	2007	1997-2006
Barros FC, Matijasevich A, Requejo JH, Giugliani E, Maranhão AG, et al (2010). Recent trends in maternal, newborn, and child health in Brazil: progress toward Millennium Development Goals 4 and 5. Journal Information, 100(10).	MMR/U5MR/ NEWBORN	Brazil	Upper-middle-income	2010	1997-2007
Bauze, AE, et al. Equity and geography: the case of child mortality in Papua New Guinea. PLoS One 7.5 (2012): e37861.	U5MR	Papua New Guinea	Lower-middle-income	2012	1976-2006
Bhandari A, Gordon M, Shakya G. Reducing maternal mortality in Nepal. BJOG 2011;118 (Suppl. 2):26–30	MMR	Nepal	Low-income	2011	1996-2006
Bhutta, ZA, et al. Reproductive, maternal, newborn, and child health in Pakistan: challenges and opportunities. The Lancet 381.9884 (2013): 2207-2218.	MMR/U5MR/ NEWBORN	Pakistan	Lower-middle-income	2013	1987-2011
Bucagu, M, et al. Impact of health systems strengthening on coverage of maternal health services in Rwanda, 2000–2010: a systematic review. Reproductive health matters 20.39 (2012): 50-61.	MMR	Rwanda	Low-income	2012	2000-2010
Campbell O, Gipson R, Issa AH, Matta N, El Deeb B, El Mohandes A, Alwen A, Mansour E. National maternal mortality ratio in Egypt halved between 1992-93 and	MMR	Egypt	Lower-middle-	2005	1992-2000

2000. Bull World Health Organ. 2005 Jun;83(6):462-71.			income		
Chatterjee A, Paily VP. Achieving Millennium Development Goals 4 and 5 in India. BJOG 2011;118 (Suppl. 2):47–59.	MMR/U5MR	India	Lower-middle-income	2011	1992-2008
Claeson M, Bos ER, Mawji T, Pathmanathan I. Reducing child mortality in India in the new millennium. Bull World Health Organ. 2000;78(10):1192-9.	U5MR	India	Lower-middle-income	2000	1978-1993
Collas-Monsod S, Monsod T, Ducanes G. Philippines' Progress towards the Millennium Development Goals: Geographical and Political Correlates of Subnational Outcomes. Journal Of Human Development. March 2004;5(1):121-149.	MMR/U5MR	Philippines	Lower-middle-income	2004	1990-2000
Countdown Coverage Writing Group; Countdown to 2015 Core Group, Bryce J, Daelmans B, Dwivedi A, Fauveau V, Lawn JE, Mason E, Newby H, Shankar A, Starrs A, Wardlaw T. Countdown to 2015 for maternal, newborn, and child survival: the 2008 report on tracking coverage of interventions. Lancet. 2008 Apr 12;371(9620):1247-58.	MMR/U5MR/ NEWBORN	multi-country	Low- and middle-income	2008	1990-2006
Croghan TW, Beatty A, Ron A. Routes to Better Health for Children in Four Developing Countries.The Milbank Quarterly, Vol. 84, No. 2 (2006), pp. 333-358.	U5MR	multi-country	Low- and middle-income		
Danel I. Maternal Mortality Reduction in Honduras 1990-1997: A Case Study. Washington DC. World Bank, 1999.	MMR	Honduras	Lower-middle-income	1999	1990-1997
Demombynes G, Trommlerová SK (2012) What has driven the decline of infant mortality in Kenya?. *World Bank Policy Research Working Paper*, (6057).	IMR	Kenya	Low-income	2012	2003-2009
Faguet JP (2007) To the MDGs and beyond: accountability and institutional innovation in Bangladesh. Bangladesh development series, 14. The World Bank, Dhaka, Bangladesh.	MMR/U5MR	Bangladesh	Low-income	2007	1950/70-2007 (IMR); 1993-2004 (U5MR);

					1986-2001 (MMR)
Feng XL, Guo S, Yang Q, Xu L, Zhu J, Guo Y. Regional disparities in child mortality within China 1996-2004: epidemiological profile and health care coverage. Environ Health Prev Med. 2011 Jul;16(4):209-16.	U5MR	China	Upper-middle-income	2011	1996-2007
Fotso JC, Ezeh AC, Madise NJ, Ciera J. Progress towards the child mortality millennium development goal in urban sub-Saharan Africa: the dynamics of population growth, immunization, and access to clean water. BMC Public Health.2007 Aug 28;7:218.	U5MR	multi-country	Low- and middle-income	2007	Kenya 1993-2003, Zambia 1992-2001
Gipson R, El MA, Campbell O, Issa AH, Matta N, Mansour E. The trend of maternal mortality in Egypt from 1992-2000: an emphasis on regional differences. Matern Child Health J. 2005 Mar;9(1):71-82.	MMR	Egypt	Lower-middle-income	2005	1992/93-2000
Grigoriou C, Guillaumont P. (2004). Child Mortality under Chinese Reforms. CERDI, Working Papers, 200410.	U5MR	China	Upper-middle-income	2004	1981-2000
Hazarika I. India at the crossroads of millennium development goals 4 and 5. Asia Pac J Public Health. 2012 May;24(3):450-63.	MMR/U5MR	India	Lower-middle-income	2012	1990-2008; 1960-2008
Hill PS, Dodd R, Dashdorj K. Health Sector Reform and Sexual and Reproductive Health Services in Mongolia. Reproductive Health Matters, Vol. 14, No. 27, Human Resources for Sexual and Reproductive Health Care (May, 2006), pp. 91-100.	MMR	Mongolia	Lower-middle-income	2006	1994-2004
Hong R, Ayad M, Rutstein S, Ren R (2009) Childhood mortality in Rwanda: levels, trends, and differentials. Calverton, Maryland: ICF Macro.	U5MR	Rwanda	Low-income	2009	1992-2008
Hord C, David HP, Donnay F, Wolf M. Reproductive health in Romania: reversing the Ceausescu legacy. Stud Fam Plann. 1991 Jul-Aug;22(4):231-40.	MMR	Romania	Upper-middle-income	1991	1989-1990

Houweling TA, Kunst AE, Moser K, Mackenbach JP (2006) Rising under-5 mortality in Africa: who bears the brunt?. *Tropical Medicine & International Health*, *11*(8), 1218-1227.	U5MR	multi-country	Low- and middle-income	2007	1980s-1990s
Houweling TA, Jayasinghe S, Chandola T. The social determinants of childhood mortality in Sri Lanka: time trends & comparisons across South Asia. Indian J Med Res. 2007 Oct;126(4):239-48.	U5MR	Sri Lanka	Lower-middle-income	2007	1987-2000
Hussein J, Bell J, Dar Iang M, Mesko N, Amery J, Graham W. An appraisal of the maternal mortality decline in Nepal. PLoS One. 2011;6(5):e19898.	MMR	Nepal	Low-income	2011	1996-2008
Jain AK. Measuring the effect of fertility decline on the maternal mortality ratio.Stud Fam Plann. 2011 Dec;42(4):247-60.	MMR	multi-country	Low- and middle-income	2011	1990-2008
Janes CR, Chuluundorj O. Free markets and dead mothers: the social ecology of maternal mortality in post-socialist Mongolia. Med Anthropol Q. 2004 Jun;18(2):230-57.	MMR	Mongolia	Lower-middle-income	2004	1990-1999
Jayawardena N, Subhi R, Duke T. The Western Pacific Regional Child Survival Strategy: progress and challenges in implementation. J Paediatr Child Health. 2012 Mar;48(3):210-9.	U5MR	multi-country	Low- and middle-income	2012	1990-2010
Kabubo-Mariara J, Karienyeh M, Mwangi F. Child Survival, Poverty and Policy Options from DHS Surveys in Kenya: 1993-2003. 2008. Available from: EconLit with Full Text, Ipswich, MA.	U5MR	Kenya	Low-income	2008	1993-2003
Kaldewei C, Pitterle I. (2011) Behavioural Factors as Emerging Main Determinants of Child Mortality in Middle-Income Countries: A Case Study of Jordan. United Nations, Department of Economics and Social Affairs, Working Papers. 26 p.p.	U5MR	Jordan	Upper-middle-income	2011	1971-2007
Khan AR. Employment and Millennium Development Goals: Analytics of the Linkage. The Bangladesh Development Studies, Vol. 31, No. 1/2 (March-June 2005), pp. 1-24	MMR/U5MR	multi-country	Low- and middle-income	2005	1990-2005

Khan A, Kinney MV, Hazir T, Hafeez A, Wall SN, Ali N, Lawn JE, Badar A,Khan AA, Uzma Q, Bhutta Z for the Pakistan Newborn Change and Future Analysis Group. Newborn survival in Pakistan: a decade of change and future implications. Health Policy and Planning 2012;27:iii72–iii87.	NEWBORN	Pakistan	Lower-middle-income	2012	2000-2010
Koblinsky MA (2003) Reducing maternal mortality : learning from Bolivia, China, Egypt, Honduras, Indonesia, Jamaica, and Zimbabwe. Washington, DC: World Bank. xiv, 132 p.	MMR	multi-country	Low- and middle-income	2003	1980-2000
Koblinsky M, Anwar I, Mridha MK, Chowdhury ME, Botlero R. Reducing maternal mortality and improving maternal health: Bangladesh and MDG 5. J Health Popul Nutr. 2008 Sep;26(3):280-94.	MMR	Bangladesh	Low-income	2008	1985/1990-2003
Kraft, AD, et al. Stagnant neonatal mortality and persistent health inequality in middle-income countries: a case study of the Philippines. PloS one 8.1 (2013): e53696.	NEWBORN	Philippines	Lower-middle-income	2013	1990-2007
Li J, Luo C, Deng R, Jacoby P, de Klerk N. Maternal mortality in Yunnan, China: recent trends and associated factors. BJOG. 2007 Jul;114(7):865-74.	MMR	China (Yunnan)	Upper-middle-income	2007	1994/5-2005
Liljestrand J, Sambath MR. Socio-economic improvements and health system strengthening of maternity care are contributing to maternal mortality reduction in Cambodia. Reprod Health Matters. 2012 Jun;20(39):62-72.	MMR	Cambodia	Low-income	2012	2000/05-2006/10
Masanja H, de Savigny D, Smithson P, Schellenberg J, John T, Mbuya C, Upunda G, Boerma T, Victora C, Smith T, Mshinda H. Child survival gains in Tanzania: analysis of data from demographic and health surveys. Lancet. 2008 Apr 12;371(9620):1276-83.	U5MR	Tanzania	Low-income	2012	2000-2010
Mbonye AK. Newborn survival in Uganda: a decade of change and future implications. Health Policy and Planning 2012;27:iii104–iii117.	NEWBORN	Uganda	Low-income	2012	2000-2010

McCaw-Binns A, Alexander SF, Lindo JML, Escoffery C, Spence K, Lewis-Bell K, Lewis G (2007) Epidemiologic transition in maternal mortality and morbidity: new challenges for Jamaica. *International Journal of Gynecology & Obstetrics*, *96*(3), 226-232.	MMR	Jamaica	Upper-middle-income	2007	1981//83-2001/3
Minnery, M, et al. Disparities in child mortality trends in two new states of India. BMC public health 13.1 (2013): 1-11.	U5MR	India	Lower-middle-income	2013	1990-2008
Moazzeni, MS. Maternal mortality in the Islamic republic of Iran: on track and in transition. Maternal and child health journal 17.4 (2013): 577-580.	MMR	Iran	Upper-middle-income	2013	1975-2008
Nakamura H, Ikeda N, Stickley A, Mori R, Shibuya K.Achieving MDG 4 in sub-Saharan Africa: what has contributed to the accelerated child mortality decline in Ghana? PLoS One. 2011 Mar 21;6(3):e17774.	U5MR	Ghana	Lower-middle-income	2011	1967-2008
Nair H, Arya G, Vidnapathirana J, Tripathi S, Talukder SH, Srivastava V. Improving neonatal health in South-East Asia.Public Health. 2012 Mar;126(3):223-6.	NEWBORN	multi-country	Low- and middle-income	2011	1990-2008
Narayana D. Intensifying Infant Mortality Inequality in India and a Reversal by Policy Intervention. Journal Of Human Development. July 2008;9(2):265-281.	IMR	India	Lower-middle-income	2008	1991-2006
Narwal, R and Lu G. Has the Rate of Reduction in Infant Mortality Increased in India Since the Launch of National Rural Health Mission? Analysis of Time Trends 2000-2009 with Projection to 2015. (2013).	IMR	India	Lower-middle-income	2013	2000-2009
Nguyen, K-H, et al. How does progress towards the MDG 4 affect inequalities between different subpopulations? Evidence from Nepal. Journal of epidemiology and community health 67.4 (2013): 311-319.	U5MR	Nepal	Low-income	2013	1990-2005

Nguyen, K-H, et al. Disparities in child mortality trends: what is the evidence from disadvantaged states in India? the case of Orissa and Madhya Pradesh. International journal for equity in health 12.1 (2013): 45.	U5MR	India	Lower-middle-income	2013	1990-2008
Nuwaha F, Mukulu A. Trends in under-five mortality in Uganda 1954-2000: can Millennium Development Goals be met? Afr Health Sci. 2009 Jun;9(2):125-8.	U5MR	Uganda	Low-income	2009	1954-2000
Padmanaban P, Raman PS, Mavalankar DV. Innovations and challenges in reducing maternal mortality in Tamil Nadu, India. J Health Popul Nutr. 2009 Apr;27(2):202-19.	MMR	India	Lower-middle-income	2007	1993-2007
Pathmanathan I, Liljestrand J, Martins JM, Rajapaksa LC, Lissner C, de Silva A, Selvaraju S, Singh P (2003) Investing in maternal health: learning from Malaysia and Sri Lanka. Human Development Network. Health, Nutrition, and Population Series. Washington D.C.: World Bank.	MMR	multi-country	Low- and middle-income	2003	1947-1970
Pradhan YV, Upreti SR, Pratap K C N, K C A, Khadka N, Syed U, Kinney MV, Adhikari RK, Shrestha PR, Thapa K, Bhandari A, Grear K, Guenther T, Wall SN; Nepal Newborn Change and Future Analysis Group. Newborn survival in Nepal: a decade of change and future implications. Health Policy Plan. 2012 Jul;27 Suppl 3:iii57-71.	NEWBORN	Nepal	Low-income	2012	2000-2010
Qiu L, Lin J, Ma Y, Wu W, Qiu L, Zhou A, Shi W, Lee A, Binns C. Improving the maternal mortality ratio in Zhejiang Province, China, 1988-2008. Midwifery. 2010 Oct;26(5):544-8.	MMR	China (Zheijiang)	Upper-middle-income	2010	1988-2008
Rath AD, Basnett I, Cole M, Subedi HN, Thomas D, Murray SF.Improving Emergency Obstetric Care in a Context of Very High Maternal Mortality: The Nepal Safer Motherhood Project 1997-2004. Reproductive Health Matters, Vol. 15, No. 30, Maternal Mortality and Morbidity: Is Pregnancy Getting Safer for Women? (Nov., 2007), pp. 72-80	MMR	Nepal	Low-income	2007	1997-2004

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Rutstein S, Ayad M, Ren R, Hong R (2009) Changing Health Conditions and the Decline of Infant and Child Mortality in Benin. Calverton, Maryland: ICF Macro.	U5MR / IMR	Benin	Low-income	2009	1996-2006
Saugstad OD. Reducing global neonatal mortality is possible. Neonatology. 2011;99(4):250-7.	NEWBORN	multi-country	Low- and middle-income	2011	
Scopaz A, Eckermann L and Clarke M. Maternal health in Lao PDR: repositioning the goal posts. Journal of the Asia Pacific economy 16.4 (2011): 597-611.	MMR	Lao PDR	Lower-middle-income	2011	1990-2008
Seneviratne HR, Rajapaksa LC. Safe motherhood in Sri Lanka: a 100-year march. Int J Gynaecol Obstet. 2000 Jul;70(1):113-24.	MMR	Sri Lanka	Lower-middle-income	2000	1881-1995
Shiffman J, Stanton C, Salazar AP. The emergence of political priority for safe motherhood in Honduras. Health Policy Plan. 2004 Nov;19(6):380-90.	MMR	Honduras	Lower-middle-income	2004	1990-1997
Shiffman J and Sultana S. Generating political priority for neonatal mortality reduction in Bangladesh. American journal of public health 103.4 (2013): 623-631.	NEWBORN	Bangladesh	Low-income	2013	2000-2011
Singh A, Pathak PK, Chauhan RK, Pan W. Infant and child mortality in India in the last two decades: a geospatial analysis. PLoS One. 2011;6(11):e26856.	U5MR/IMR	India	Lower-middle-income	2011	1992-2004
Smith SL, Neupane S. Factors in health initiative success: learning from Nepal's newborn survival initiative. Soc Sci Med. 2011 Feb;72(4):568-75.	NEWBORN	Nepal	Low-income	2011	2000-2010

Sousa A, Hill K, Dal Poz MR (2010) Sub-national assessment of inequality trends in neonatal and child mortality in Brazil. *International Journal for Equity in Health*, *9*(1), 21.	U5MR/NEWBORN	Brazil	Upperr-middle-income	2010	1991-2000
Ssewanyana S, and Younger SD. Infant mortality in Uganda: Determinants, trends and the millennium development goals. Journal of African Economies 17.1 (2008): 34-61.	IMR	Uganda	Low-income	2008	1974-1999
Thomsen, Sarah, et al. "Promoting equity to achieve maternal and child health." Reproductive health matters 19.38 (2011): 176-182.	U5MR/MMR	Multi-country	Low- and middle-income	2011	
Vapattanawong P, Hogan MC, Hanvoravongchai P, Gakidou E, Vos T, Lopez AD, Lim SS. Reductions in child mortality levels and inequalities in Thailand: analysis of two censuses. Lancet. 2007 Mar 10;369(9564):850-5.	U5MR	Thailand	Upper-middle-income	2007	1990-2000
Victora CG, Aquino EM, do Carmo Leal M, Monteiro CA, Barros FC, Szwarcwald CL (2011) Maternal and child health in Brazil: progress and challenges. The Lancet, 377(9780), 1863-1876.	MMR/U5MR	Brazil	Upper-middle-income	2011	1997-2007
Vos R. Reaching the millennium development goal for child mortality: improving equity and efficiency in Ecuador's health budget. 2005;:31 p. Available from: EconLit with Full Text.	U5MR	Ecuador	Upper-middle-income	2005	1993-1999
World Bank. China's progress towards the Health MDGs; Rural Health in China: Briefing Note Series, No. 2. Washington DC: The World Bank. 2005.	MMR/U5MR	China	Upper-middle-income	2005	1990-2005
You F, et al. Maternal mortality in Henan Province, China: changes between 1996 and 2009. PloS one 7.10 (2012): e47153.	MMR	China	Upper-middle-income	2012	1996-2009

Zere E, Tumusiime P, Walker O, Kirigia J, Mwikisa C, Mbeeli T. Inequities in utilization of maternal health interventions in Namibia: implications for progress towards MDG 5 targets. Int J Equity Health. 2010 Jun 12;9:16.	MMR	Namibia	Upper-middle-income	2010	1991/2000-1998/2007
Zimba E, Kinney MV, Kachale F, Waltensperger KZ, Blencowe H, Colbourn T, George J, Mwansambo C, Joshua M, Chanza H, Nyasulu D, Mlava G, Gamache N, Kazembe A, Lawn JE; Malawi Newborn Change and Future Analysis Group. Newborn survival in Malawi: a decade of change and future implications. Health Policy Plan. 2012 Jul;27 Suppl 3:iii88-103.	NEWBORN	Malawi	Low-income	2012	2000-2010

Annex IV: Analytical Framework and Focal Countries

Table 1: Success Factors study series analytical framework

Health sector: investments in health systems with universal access to services

1. Service Delivery (e.g. skilled birth attendance, contraceptive prevalence rate)
2. Health workforce (e.g. doctors per 1000 population)
3. Information (e.g. health information systems)
4. Medical products, vaccines and technologies (e.g. measles vaccine coverage)
5. Financing (e.g. total health expenditure per capita)
6. Health systems governance (e.g. adoption of enabling policies for women's and children's health)

Sectors outside of health: investments and policies that are health-enhancing

1. Promoting vibrant rural and urban communities, including through infrastructure development (e.g. electricity: kilowatt hours/capita)
2. Ensuring universal enrolment and completion of primary education and greatly expanded access to post- primary and higher education (e.g. girls' primary school enrolment)
3. Improving environmental management (e.g. access to clean water)
4. Building national capacities in science, technology and innovation (e.g. number of scientific publications, Global Innovation Index)

Cross-sectoral enabling factors for health

1. Population dynamics (e.g. total fertility rate, % urban population)
2. Women's political and socioeconomic participation (e.g. % female parliamentarians)
3. Overcoming inequalities and realizing rights (e.g. Gini; ratification of human rights treaties)
4. Economic development (e.g. GDP per capita)
5. Good governance and leadership across sectors (e.g World Governance Index, Global Leadership and Organizational Behavioural Effectiveness (GLOBE) scores)

Sources: These analytical categories build on the following two frameworks: UN Millennium Project (2005). *Investing in Development: A Practical Plan to Achieve the MDGs*. New York: UNDP; WHO (2007). *Everybody's Business: Strengthening Health Systems to Improve Health Outcomes: WHO's Framework for Action*. Geneva: WHO.

Table 2: Fast track countries

Ten of the 75 Countdown countries that were on-track for both MDGs 4 and 5a in 2012	*LMICs that have reduced maternal and child mortality and achieved regional best performance measures in policy areas across health and other sectors*	
Bangladesh	Botswana	Peru
Cambodia	Liberia	Turkey
China	Niger	Vanuatu
Egypt	Rwanda	Albania
Ethiopia	Brazil	Belarus
Lao	China	Bulgaria
Nepal	Egypt	Hungary
Peru	El Salvador	Macedonia FYR
Rwanda	Lebanon	Romania
Viet Nam	Maldives	Serbia
	Mexico	Ukraine
	Mongolia	

Source: Cohen et al. Country progress towards MDGs: Adjusting for socioeconomic factors reveals greater progress and new challenges. Manuscript in preparation.