USAID
FROM THE AMERICAN PEOPLE

Maternal and Child Survival Program

Modeling Mortality Impact of Three African Countries Supported by the Maternal and Child Survival Program (MCSP)

The Cases of Ethiopia, Nigeria, and Tanzania

Technical Report

www.mcsprogram.org

The Maternal and Child Survival Program (MCSP) is a global, $560 million, 5-year cooperative agreement funded by the United States Agency for International Development (USAID) to introduce and support scale-up of high-impact health interventions among USAID's 25 maternal and child health priority countries, as well as other countries. MCSP is focused on ensuring that all women, newborns and children most in need have equitable access to quality health care services to save lives. MCSP supports programming in maternal, newborn and child health, immunization, family planning and reproductive health, nutrition, health systems strengthening, water/sanitation/hygiene, malaria, prevention of mother-to-child transmission of HIV, and pediatric HIV care and treatment. Visit www.mcsprogram.org to learn more.

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the terms of the Cooperative Agreement AID-OAA-A-14-00028. The contents are the responsibility of the Maternal and Child Survival Program and do not necessarily reflect the views of USAID or the United States Government.

Table of Contents

Acknowledgements

The modeling and initial drafts of this report were done by Mufaro Kanyangarara and Victoria Chou with help from Angela Stegmuller of the Johns Hopkins Bloomberg School of Public Health (JHSPH). Also contributing to the modeling and report writing were Jim Ricca, Jennifer Hoeg, and Anuja Shah at MCSP.

We would like to thank those from the Ministries of Health in each of the countries who collaborated with MCSP on this programming and who reviewed this report and gave valuable feedback.

Cesar Victora and his students at the International Center for Equity in Health in Pelotas, Brazil prepared the subnational databases of indicator coverage trends for all models.

We want to thank the many technical advisors and monitoring and evaluation experts at MCSP who contributed to collecting, analyzing, and interpreting the data for this modeling exercise: Disha Ali, Abeba Bekele, Mary Drake, Vikas Dwivedi, Amrita Mathew, Scott Merritt, Yordanos Molla, Lolade Oseni, and Barbara Rawlins.

Additional thanks to Neff Walker and Gayane Yenokyan (JHSPH) for providing technical guidance and input and to Bill Winfrey for advice on estimation of the impact of postpartum family planning.

We also thank Katherine Lilly for her expert data visualizations, and the country Program Officers for their programmatic support. We also want to acknowledge the invaluable contributions of the interns from George Washington School of Public Health who processed program data for the modeling exercise: Imran Bari, Crystal Lam, Erin Lambie, and Amy Nye.

Thanks to Bill Weiss and Nefra Faltas at USAID for their feedback on drafts of the report, the assumptions used in the modeling, and the presentation of the results.

Acronyms

AIM	AIDS Impact Model
ANC	Antenatal care
ARR	Annual rate of reduction
CBNC	Community based newborn care
CHX	Chlorhexidine
DHS	Demographic and Household Survey
DTP	Diphtheria, tetanus, and pertussis vaccine
ENAP	Every Newborn Action Plan
EPMM	Eliminating Preventable Maternal Mortality
EQUIST	EQUitable Impact Sensitive Tool
FamPlan	Family Planning model
HDA	Health Development Army
HepB	Hepatitis B vaccine
HEW	Health Extension Worker
Hib	Haemophilus influenzae type B vaccine
HII	High impact intervention
HMIS	Health management information system
IIP	Institute for International Programs
IPTp	Intermittent preventative treatment of malaria in pregnancy
JHSPH	Johns Hopkins Bloomberg School of Public Health
KMC	Kangaroo Mother Care
KPC	Knowledge, Practices and Coverage
LiST	Lives Saved Tool
LMICs	Low and middle income countries
LQAS	Lot Quality Assurance Sampling
MANDATE	Maternal and Neonatal Directed Assessment of Technology
MCHIP	Maternal and Child Health Integrated Program
mCPR	Modern contraceptive prevalence rate
MCSP	Maternal and Child Survival Program
MICS	Multiple Indicator Cluster Survey
MMR	Maternal mortality ratio
MM Rate	Maternal mortality rate

MNCH	Maternal, newborn, and child health
MOH	Ministry of Health
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
NMR	Neonatal mortality rate
PCV	Pneumoccocal Vaccine
PMP	Performance monitoring plan
PPFP	Postpartum family planning
QI	Quality improvement
RED	Reaching Every District
RMNCAH	Reproductive, maternal, newborn, child, and adolescent health
RMNCH	Reproductive, maternal, newborn, and child health
SDGs	Sustainable Development Goals
SNNPR	Southern Nations Nationalities and Peoples' Region
U5MR	Under-5 morality rate
UNFPA	United Nations Populations Fund
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Introduction

Despite the fact that many countries have made significant progress in improving maternal, newborn, and child health (MNCH) over the past two decades, this progress has been uneven and mortality rates remain unacceptably high in many parts of the world.[1,2] By 2015, only 62 (32%) countries had achieved their target reductions in maternal and child mortality to reach Millennium Development Goals 4 and 5.[3] Under the even more ambitious Sustainable Development Goals (SDGs), the global community has committed to reducing the under-five mortality rate (U5MR) to 25 deaths per 1,000 live births; the neonatal mortality rate (NMR) to 12 neonatal deaths per 1,000 live births; and the maternal mortality ratio (MMR) to 70 maternal deaths per 100,000 live births by 2030.[4,5,6] To improve their success rates in achieving the new SDG targets, countries will need to significantly accelerate their annual mortality reduction on their journeys to self-reliance by focusing on approaches that improve the quality, coverage, and equity of high-impact interventions (HIIs) – that is, those clinical interventions and health behaviors with solid evidence for their ability to reduce mortality in low and middle income country (LMIC) settings.

Since 2014, the United States Agency for International Development (USAID) Maternal and Child Survival Program (MCSP) has aimed to help countries make significant progress in preventing child and maternal deaths. Building on the USAID Maternal and Child Health Integrated Program (MCHIP), MCSP, in partnership with Ministries of Health (MOH) and others, has implemented activities in 33 countries, including most of the 25 USAID-priority countries that account for 70% of maternal, newborn, and child deaths globally. Working at both the national level to strengthen policy environment, leadership, and management, as well as at the subnational level in regions of high need, MCSP has supported programming aimed at helping these priority countries make sustainable progress in their reproductive, maternal, newborn and child health (RMNCH) through its three strategic objectives –

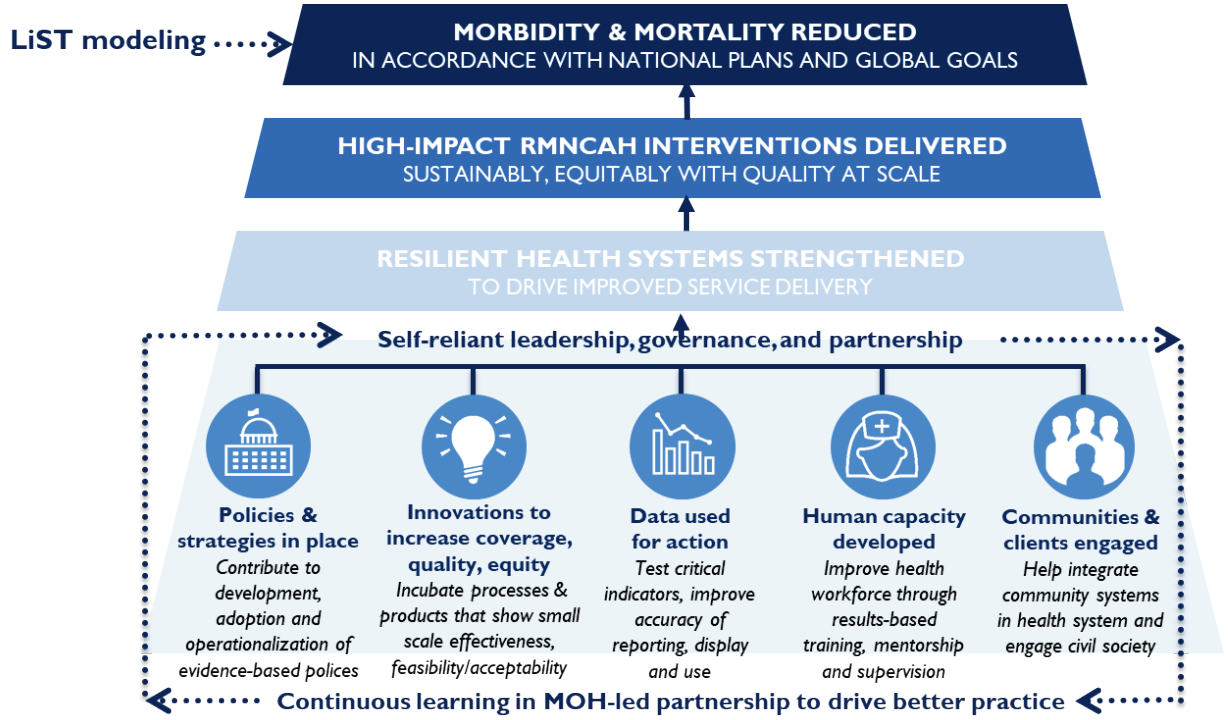
1. Support countries to increase coverage and utilization of evidence-based, high-quality RMNCH interventions at the household, community, and health facility levels
2. Close innovation gaps to improve health outcomes among high-burden and vulnerable populations through engagement with a broad range of partners
3. Foster effective policy, program learning, and accountability for improved RMNCH outcomes across the continuum of care.

As shown in Figure 1, MCSP's second and third strategic objectives and various cross-cutting areas are aimed at strengthening more self-reliant health systems to deliver HIIs with quality and at scale. Ultimately, this contributes to country achievements in reducing maternal, newborn, and child morbidity and mortality, as aligned with their national and global health targets. MCSP-supported approaches and HIIs varied by country and were tailored to respond to the epidemiological situation and support country-specific needs as negotiated with USAID Missions and Ministries of Health.

MCSP conducted this impact modeling exercise to assess country progress as well as its contributions to changes in maternal, newborn, and child mortality trends. MCSP used the Lives Saved Tool (LiST) to estimate the mortality impact of the documented changes in coverage of MCSP-supported HIIs.

[1] Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health. *Lancet* 391, 1538–1548 (2018).
[2] Alkema, L. *et al.* Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *Lancet* 387, 462–474 (2016).
[3] Molyneux, M., Molyneux, E. Reaching Millennium Development Goal 4. *The Lancet Global Health* 4, 3 (2016).
[4] Bustreo, F. *et al.* Ending preventable maternal deaths: the time is now. *Lancet. Glob. Heal.* 1, e176-7 (2013).
[5] Lawn, J. E., Blencowe, H., Kinney, M. V, Bianchi, F., Graham, W. J. Evidence to inform the future for maternal and newborn health. *Best Pract. Res. Clin. Obstet. Gynaecol.* 36, 169–183 (2016).
[6] Chou, D., Daelmans, B., Jolivet, R. R., Kinney, M., Say, L. Ending preventable maternal and newborn mortality and stillbirths. *BMJ* h4255 (2015). doi:10.1136/bmj.h4255

Figure 1. MCSP Impact Framework



This report outlines the methodology and key findings from three country cases – community-based newborn care in Ethiopia; facility-based care on the day of birth in Nigeria; and immunization in Tanzania. This report intends to:

- Help national Ministries of Health and donors assess the likely contribution to mortality impact of their investments and efforts in reaching national targets and goals.
- Offer a modeling methodology that can be considered for estimating the impact of future RMNCH programs.

Methodology

Choosing the modeling program

In the global health arena, modeling the mortality impact of interventions has been used frequently for policy development, programmatic planning, and evaluation. Existing modeling tools each have their strengths and limitations.[7,8,9] Some of the most commonly used RMNCH mortality modeling tools can be considered as belonging to a "family" of tools – i.e., the Lives Saved Tool (LiST), AIDS Impact Model (AIM), Family Planning Model (FamPlan), EQUitable Impact Sensitive Tool (EQUIST), and OneHealth – because they all use the same assumptions about intervention effectiveness and are built on the same Spectrum software platform.[10] These modeling tools have been developed by Johns Hopkins University Bloomberg School of Public Health (JHSPH), Avenir Health, the United Nations Children's Fund (UNICEF), and others. Although some other tools like Marie Stopes International's Impact 2 modeler and Population Services International's Impact Calculator are not built on the Spectrum platform, they use the same assumptions about demographic trends and intervention effectiveness and make additional assumptions about the links between programming and effects on mortality. Another tool in current use for modeling maternal and newborn mortality is Maternal and Neonatal Directed Assessment of Technology (MANDATE) developed by RTI International, uses similar estimates as LiST of intervention effectiveness but also makes additional assumptions about how programmatic strategies are likely to change the levels of utilization of these interventions and technologies.

MCSP chose to use LiST for this assessment for several reasons. Most importantly, LiST is the modeling program with the most evidence for the validity of its mortality impact estimates, with nearly 100 articles in the peer-reviewed literature about the development of its methods and the accuracy of its estimates, as well as countless other peer reviewed articles that have used LiST modeling. LiST is also well-known and commonly used by a variety of global stakeholders, from USAID for its annual Acting on the Call reports to the World Health Organization's (WHO) Countdown working groups to examine country progress in RMNCH.[11,12,13] One of the tools (i.e., One Health) in the same "family" built on the Spectrum platform has been used by many countries to estimate the impact and costs of their national strategic plans. Another member of this family (i.e., EQUIST) has been used by UNICEF to estimate the effect of pro-equity programming in many countries. Additionally, LiST is the only one of the publicly available impact modeling tools that provides estimates for the mortality effect of programming across the entire RMNCH spectrum, which allowed a single standard methodology for all MCSP modeling. Lastly, unlike several of the other models cited above, the estimates that LiST provides are not restricted to the absolute number of lives saved, but are expressed as mortality trends. This is a useful way to frame the modeling results for evaluating whether countries are on target to meet their national goals and global commitments, as expressed by the targets laid out in the Every Newborn Action Plan (ENAP), Ending Preventable Maternal Mortality (EPMM), and the SDGs. LiST was developed and is maintained by the Institute for International Programs (IIP) at JHSPH with funding from the Bill and Melinda Gates Foundation. It is publicly available at a site maintained by IIP, which explains its methods and assumptions in more detail.[14]

---

[7] Jones-Hepler, B. *et al.* Maternal and Neonatal Directed Assessment of Technologies (MANDATE): Methods and Assumptions for a Predictive Model for Maternal, Fetal, and Neonatal Mortality Interventions. *Glob. Heal. Sci. Pract.* **5,** 571–580 (2017).
[8] Walker, N., Tam, Y. & Friberg, I. K. Overview of the lives saved tool (LiST). *BMC Public Health* **13,** S1 (2013).
[9] Waters, D., Theodoratou, E., Campbell, H., Rudan, I. & Chopra, M. Optimizing community case management strategies to achieve equitable reduction of childhood pneumonia mortality: An application of Equitable Impact Sensitive Tool (EQUIST) in five low– and middle–income countries. *J. Glob. Health* **2,** 20402 (2012).
[10] Spectrum was originally developed by Futures Institute in the 1990s to model the effect of family planning on demographic trends.
[11] Friberg, I. K., Baschieri, A. & Abbotts, J. A method for estimating maternal and newborn lives saved from health-related investments funded by the UK government Department for International Development using the Lives Saved Tool. sub*BMC Public Health* 17, 779 (2017).
[12] Ayyanat, J. A., Harbour, C., Kumar, S. & Singh, M. LiST modelling with monitoring data to estimate impact on child mortality of an ORS and zinc programme with public sector providers in Bihar, India. *BMC Public Health* 18, 103 (2018).
[13] Amouzou, A., Habi, O. & Bensaïd, K. Reduction in child mortality in Niger: a Countdown to 2015 country case study. *Lancet* 380, 1169–1178 (2012).
[14] https://www.livessavedtool.org/

To estimate the impact of health interventions on MNCH, LiST requires three inputs:

1. estimates of population-level coverage changes over time for HIIs
2. measures of health status, including mortality trends and causes of death
3. estimates of the effectiveness of HIIs and affected fractions within the population whose health status is amenable to improvement by the HII.

The last two inputs are built into the LiST program. It is the first of these inputs (i.e., changes in population coverage) that the modeling team needed to complete the necessary data set. Based on these inputs, LiST estimates the number of lives saved; changes in mortality rates overall, by cause, and by intervention; stillbirths prevented; and for family planning interventions, the number of pregnancies averted and deaths averted among women of reproductive age, among other outputs. All LiST analyses for these assessments were conducted using Spectrum version 5.71.

Selecting the MCSP country programs to model

Many of MCSP's activities involve direct support for implementation of health services by in-country (usually public) entities, although MCSP also gives support to countries to strengthen their systems and build their self-reliance. MCSP modeled the impact of the direct support (See Box 1) component of its programming because such activities generate data that either can be directly entered into LiST in terms of changes in population coverage of MCSP-supported HIIs or can be converted to population coverage data that could be entered in LiST with only a few assumptions applied to the data available. The scope of the modeling, therefore, does not include other MCSP activities to support country self-reliance by promoting evidence-based policy change, strengthening governance and planning, improving health information and supervision systems, and other forms of health system strengthening. Additionally, MCSP did not attempt to directly model the impact of the MCSP's support for training health workers. Rather, the impact of any training supported by MCSP was only captured in the modeling insofar as those trained health workers then contributed to a change in the population coverage of HIIs.

Box 1: Definition of direct support for country-led implementation

"Direct support" is defined as geographically focused efforts, by MCSP, to help providers and their managers better deliver services. "Direct support" does not mean that MCSP directly provided these services (e.g., hiring MCSP workers or health clinics), but rather assisted those working in mainly public sector institutions to do their work more effectively.

"Direct support" is distinguished from national level systems support that MCSP engaged in, like policy development and improvements in other health systems, such as governance structures, that also have mortality impact. However, because of the indirect nature of this link, impact is more difficult to quantify and this was not attempted.

Table 1 shows countries considered for modeling along with the technical areas supported by MCSP in these countries. MCSP used the following criteria to select MCSP country programs to consider for modeling:

- MCSP's scope included direct intervention support in a defined geographic area with a broad range of programming that included at least two technical areas.
- MCSP had been working in the country for two or more years when the we began the modeling assessment in late 2017.

Table 1. Countries & technical areas supported by MCSP that potentially could be modeled

Country	Technical Areas Considered for Modeling							
	Maternal Health	Newborn Health	Child Health	Immunizations	Family Planning	Malaria	Nutrition	Water, Sanitation and Hygiene
Democratic Republic of Congo			•		•		•	
Ethiopia	•	•						
Haiti	•	•						
Kenya			•					
Liberia	•	•	•	•	•			
Madagascar	•	•			•			
Mozambique	•	•	•	•	•	•	•	•
Nigeria	•	•	•	•	•			•
Rwanda	•	•	•		•	•		
Tanzania	•	•		•	•			
Zimbabwe			•	•				

Note: MCSP also gave health systems and policy support to countries, but only support for implementation in defined geographic areas was suitable for the most valid modeling of mortality impact

For each candidate country, the MCSP impact modeling team reviewed country program work plans and reports to identify all HIIs that MCSP supported that are in LiST (See Annex 1 for the HIIs included in LiST). Ultimately, the team chose the programmatic components in the three countries in Table 2, based on the availability, completeness, and consistency of available data to assess coverage changes for HIIs.

Table 2: High impact interventions modeled in the three programs chosen for modeling

Technical area	High impact intervention	Ethiopia	Nigeria	Tanzania
Maternal Health	Active Management of Third Stage Labor[15]		•	
	Labor and Delivery Management		•	
	Iron Supplementation during antenatal care			
Newborn Health	Neonatal Resuscitation		•	
	Early Initiation of Breastfeeding		•	
	Thermal Care (for the newborn immediately after birth)		•	
	Chlorhexidine (for cord care immediately after birth)		•	
	Kangaroo Mother Care			
	Case Management of Neonatal Sepsis	•	•	
	Clean Postnatal Practices	•		
Family Planning	Pre-discharge Postpartum Family Planning (PPFP)		•	
Immunization	Pentavalent Vaccine (Diphtheria, tetanus and pertussis (DTP), Hepatitis B (HepB), Haemophilus influenzae type B (Hib) vaccines)			•
	Measles Vaccine			•
	Pneumococcal vaccine			•
	Rotavirus vaccine			•
	Oral polio virus vaccine			•

Design of the modeling assessment

The impact modeling team estimated the *additional* mortality impact of changes of population coverage of high impact interventions supported by MCSP. In order to do this, the team constructed two different models for each case that addressed the following specific questions:

- **Secular trend:** *What is the underlying secular trend in mortality?* Based on national and regional trends in the coverage of HIIs, what was the estimated trend in maternal, neonatal, and child mortality **in the absence of MCSP-supported programming** in the sub-national areas where MCSP worked?
- **MCSP experience:** *What was the additional mortality impact of the coverage changes of MCSP-supported HIIs?* Taking account of the changes in population coverage of the MCSP-supported HIIs, what is the **estimated *additional* impact** (above the estimated secular trend) in the sub-national areas where MCSP worked?

We used data on the population coverage of HIIs from representative national household surveys (i.e., Demographic and Health Survey (DHS) or Multiple Indicator Cluster Survey (MICS)) to construct the models for secular trend. Population coverage data are not available for most interventions delivered on maternities and several of those delivered during antenatal care because women cannot accurately recall them.[16],[17] Therefore, instead LiST estimates the population coverage for these interventions by using service

[15] As approximated by prophylactic uterotonic use immediately following birth, which has been shown to give the large majority of the effect. Hofmeyr G, Mshweshwe NT, Gulmezoglu A (2015), Cochrane Review: Cord traction to deliver the afterbirth, https://www.cochrane.org/CD008020/PREG_cord-traction-deliver-afterbirth

[16] Stanton C, Rawlins B, Drake M, et. al. (2013). Measuring Coverage in MNCH: Testing the Validity of Women's Self-Report of Key Maternal and Newborn Health Interventions during the Peripartum Period in Mozambique, PLOS ONE 8(5): e60694 https://doi.org/10.1371/journal.pone.0060694

[17] McCarthy K, Blanc A, Warren C, Mdawida B (2018), Women's recall of maternal and newborn interventions received in the postnatal period: a validity study in Kenya and Swaziland, JOGH, 8: 010605 http://www.jogh.org/col-coverage-measurement.htm

coverage of antenatal care (ANC) and facility delivery, and then makes additional assumptions about how often these clinical interventions are delivered in these settings. However, to increase the accuracy of the coverage measurements, we did not use the usual assumptions in LiST about delivery of the interventions in these settings; instead, the team used data either from health management information systems (HMIS) or supplemental data collection. This model acted as a comparison group by estimating what mortality trends would have been if pre-MCSP trends in the population coverage of all HIIs had continued during the period of programmatic support. In the MCSP experience model, the secular trend model was modified by substituting the changes in coverage that were documented by MCSP for MCSP-supported HIIs, while keeping the trends in coverage the same for all other interventions in the model.

The impact for each country program was primarily assessed at the sub-national level to best take account of the programmatic scope of support (e.g., percentage of MCSP-supported facilities and communities in a district) and scale of programming (i.e., number of districts covered).

The following outcomes were analyzed in each model:

- Mortality rates and ratios
- Annual rate of mortality reduction (ARR) using the formula[4] :

$$\text{ARR} = \left[\left(\frac{\textit{mortality rate in end year}}{\textit{mortality rate in start year}}\right)^{\frac{1}{\textit{end year}-\textit{start year}}} - 1\right] \times 100$$

- Additional lives saved in MCSP-supported areas and nationwide

The number of additional pregnancies averted and additional deaths averted among women of reproductive age[18] were analyzed for Nigeria, where MCSP supported facility-based PPFP counseling and provision of methods prior to discharge after birth.

Although this general modeling design was applied to all modeled countries, the modeling team made a few country-specific modifications described in the specific country case studies (see country annexes).

Data Sources and Analysis

Secular Trend Model

Intervention Coverage and Effectiveness Data

The modeling team triangulated sub-national data from the latest publicly available datasets from nationally representative household surveys (i.e., DHS or MICS) to establish the coverage for interventions in LiST with the additional assumptions for maternity care interventions noted above. To establish the coverage trend for all interventions in LiST, the information was abstracted from the two most recent surveys (see the country annexes for details). To get more granular information, we then constructed sub-national models for Ethiopia, Nigeria, and Tanzania and entered it into a database of subnational[19] utilization levels for those regions in which MCSP was working. A linear change in coverage was interpolated between the two time points and this trend was linearly extrapolated to the last year of analysis. If sub-national information was available for the region, then that information was used. In those cases where only national level data were available for the population coverage of an intervention, then that was used instead. In cases where the HIIs are new and have low levels of coverage and where neither sub-national nor national data were available for the utilization of an intervention – like kangaroo mother care (KMC), treatment of neonatal sepsis, and chlorhexidine (CHX) – then the HII was modeled as having no coverage change. Coverage of HIV/AIDS and Family Planning interventions were based on trends developed for the AIM and FamPlan modules,

[18] Based upon the modeled changes in maternal mortality rate, i.e. the number maternal deaths per 100,000 women of reproductive age.
[19] Coverage at the subnational level for key interventions was calculated by the International Center for Equity in Health in Pelotas, Brazil consistent with Countdown to 2030's standardized definitions for tracking coverage. The year of the most recent household survey was applied as the end year, and the year of the preceding survey was considered the start year with linear change in coverage assumed between the two discrete time points. If coverage data were not available at the subnational level for a single time point, the national values were applied.

respectively, in Spectrum. For the interventions in LiST that were supported by MCSP, the coverage levels in the sub-national database were changed to the country-specific baseline levels measured by MCSP. In the secular trend model, this baseline value was held constant until the final year of the analysis.

The models were created using LiST's default values for intervention effectiveness and affected population, except for CHX use for cord care. The effectiveness for CHX was modified from 0.23 to 0.80 to be consistent with recent studies.[20]

Demographic Data and Population Health Status

Population health status values (e.g., stunting and wasting distributions) were also obtained from the two most recent nationally representative household surveys. LiST uses the values for national level newborn and child mortality from the United Nations Interagency Group for Child Mortality Estimation, and national level maternal mortality from a World Health Organization, UNICEF, United Nations Population Fund (UNFPA), World Bank Group, and United Nations Population Division report. Sub-national mortality rates were estimated by modeling the expected level of mortality based on differences in the coverage levels in the region compared to national level. In the cases of Ethiopia and Nigeria the newborn mortality rate obtained in this manner yielded a rate that differed by more than 5% from the newborn mortality rate reported in the most recent DHS available at the time of this assessment (see country annexes for details). So the sub-national values from the DHS were used.

MCSP Experience Model

The modeling team looked over the entire set of 52 MCSP country programs. Sixteen of the programs fit the eligibility criteria for inclusion in this exercise. However, the data were only available and of sufficient completeness in the three cases presented in this report, with indicators that were either exactly or quite similar to those in LiST for the relevant MCSP-supported interventions. The reasons for this were that MCSP's monitoring and evaluation system was not funded in some countries to collect baseline and final household survey data, which gives the most accurate data for most of the interventions included in LiST. In some cases (e.g., Tanzania) the USAID Mission made the decision to cancel a planned endline survey. Only in the case of Ethiopia, was ideal information for LiST modeling available – that is, baseline and endline household survey data appropriate for population level estimates of the relevant interventions. In the case of MNH interventions delivered during facility-based maternity care, such household survey information also needs to be supplemented with select information derived from facilities in order for the most accurate estimations of population coverage. In the other three cases presented here, data of sufficient completeness from routine or program-supplemental sources were used.

The MCSP model was constructed by starting with the secular trend model and, based on the most reliable data source identified by the modeling team, substituting baseline and endline coverage levels for the selected MCSP-supported interventions in the specific subnational geographic areas. The following is the hierarchy of data sources that the modeling team used, from the most to least preferred (because of the level of accuracy):

- Knowledge, Practices, and Coverage (KPC) survey at baseline and endline (Ethiopia, which was the only MCSP country with such data available at the time of the analysis)
- Facility level supplemental quality improvement dashboard data (Nigeria)
- National HMIS data (Tanzania)

The coverage data for all other interventions in LiST (i.e., those not supported by MCSP) were kept the same as they were in the secular trend model. No changes were made to the size of the population or its demographic structure compared to the secular trend model.

[20] Imdad, A., Mullany, L., Baqui, A, et al. The effect of umbilical cord cleansing with chlorhexidine on omphalitis and neonatal mortality in community settings in developing countries: a meta-analysis. *BMC Public Health* 13 (Suppl 3), S3-S15 (2013).

A Note on Including Postpartum Family Planning in the Models via the FamPlan Module

In Nigeria, MCSP supported strengthening the provision of PPFP as part of the Day of Birth package of services. MCSP placed special emphasis on pre-discharge PPFP for women giving birth in health facilities. In special supplemental registers used in Nigeria, health workers recorded whether a woman planned, initiated, or declined PPFP before being discharged after birth. Since the LiST FamPlan module only includes an indicator for modern contraceptive prevalence among all women of reproductive age, the modeling team modified the method mix in the Spectrum FamPlan module to reflect the increases in the use of modern methods recorded in the PPFP registers, with corresponding decreases of the "Traditional (Not Specified)" method and "Periodic Abstinence" method. The team then multiplied these changes in prevalence by the affected fraction (i.e., those women of reproductive age who were postpartum) to derive an estimate of the overall change in modern contraceptive prevalence rate (mCPR) among women of reproductive age (see Table 3).

We include the effect of PPFP on the Maternal Mortality ***Rate*** [21]– number of maternal deaths per 100,000 women of reproductive age (15 – 49) – in addition to the effect of PPFP on the Maternal Mortality **Ratio**. The Maternal Mortality ***Rate*** takes account of the effect of pregnancies averted, unlike the Maternal Mortality ***Ratio*** whose denominator is live births.

Table 3: Pre-discharge PPFP coverage changes and estimated increased in mCPR among all Women of Reproductive Age

Modeled Area	% of All Women Who Gave Birth[22]	Years modeled	Absolute increase in Pre-discharge PPFP coverage among women giving birth	Estimated absolute increase in mCPR among Women of Reproductive Age
Ebonyi State, Nigeria	16.7%	2016 - 2017	34.2	5.7
		2017 - 2018	39.9	6.7
Kogi State, Nigeria	16.7%	2016 - 2017	45.3	7.6
		2017 - 2018	26.5	4.4

[21] Measuring Maternal Mortality from a Census: Guidelines for Potential Users. MEASURE Evaluation Manual Series, No. 4. Hill, Kenneth, Stanton, Cynthia, Gupta, Neeru. Carolina Population Center, University of North Carolina at Chapel Hill. July 2001.
[22] These percentages were taken from the Nigeria 2013 DHS.

Results

The results of the analysis are presented here in summary form. The changes in population coverage for key RMNCH interventions were the main program inputs for the analysis and are shown in the individual country annexes that also have more detail on the results. Table 4 shows estimates of the absolute number of lives saved for the components of the programs in each of the three countries included in the analysis:

- Ethiopia Community Based Newborn Care program
- Nigeria Day of Birth services support package
- Tanzania Routine Immunization support

The first column in Table 4 shows the estimated number of lives saved from MCSP-supported programming in the areas directly supported by MCSP and during the period of programmatic support. The next column shows the estimated number of lives that would have been saved if the supported programming had been applied to the entire regions that MCSP was working in – that is, across the entire extent of the states in Nigeria, regions in Ethiopia and Tanzania. Finally, the last column shows an estimated number of lives saved if the supported programming were to be scaled to the entire country.

Table 4: Estimated Additional Lives Saved with MCSP-supported Programming[23]

Country / Program Component	Demographic Group	Years Modeled	Lives Saved in MCSP-supported areas during program period	Lives saved if scaled to entire MCSP-supported regions	Lives saved if scaled to National Level
Ethiopia Community Based Newborn Care	Newborn	2015 - 2017	1,470	6,090	7,530
Nigeria Day of Birth Package	Newborn	2016 - 2018	500	3,320	86,400
	Maternal		50	360	9,280
Tanzania Immunization	Child	2014 - 2017	260	380	2,760

Table 5 shows another way of expressing the estimated mortality impact of the MCSP-supported programming – as the estimated Annual Rate of Reduction (ARR) for mortality. If countries are to reach their national targets for mortality reduction – based on EPMM, ENAP, WHO Women, Adolescent and Child Health Monitoring Framework, and the SDGs targets – they will need to achieve the ambitious ARR targets shown in the table. These values range from 5.4% annual rate reduction for U5MR in Tanzania to 9.5% annual rate reduction for MMR in Ebonyi and Kogi states of Nigeria. The table shows the estimates of the annual rate reduction that were achieved with MCSP-supported programming, as well as the estimated ARR that would have been achieved without this support. Cells are colored red when the estimated ARR is less than 50% of the target; yellow when it is 51-80% of the target; and green when it is at least 80% of the target.

As one can see in Table 5, in the absence of MCSP-supported programming, the estimated ARR would have reached 80% of the target ARR in only two of the 13 (15%) instances modeled. On the other hand, with MCSP-supported programming, in eight of 13 (62%) modeled cases the ARR surpassed 80% of the target ARR. In another three of 13 (19%), the country reached 50-80% of the target rate for mortality reduction. In the two cases where the annual rate reduction did not reach at least 50% of the target, there were clear contextual factors working against improvements. In the case of Oromia, Ethiopia, there was civil unrest that interrupted service delivery for a significant fraction of the time that MCSP supported programming.

[23] The values in this table were rounded to the tens place, since presenting lives saved to the units place would imply a level of precision that LiST does not offer.

Table 5: Estimated ARR of mortality with and without MCSP, compared to the ARR necessary for each country to achieve its national SDG targets

Country / Programmatic Component	Modeled areas	Mortality Impact Measure	ARR Needed to Reach SDG Target	Estimated ARR without MCSP	Estimated ARR with MCSP
Ethiopia Community Based Newborn Care	Amhara	NMR	5.9%	1.2%	4.3%
	Oromia	NMR	5.9%	0.8%	1.1%
	SNNPR	NMR	5.9%	1.4%	5.0%
	Tigray	NMR	5.9%	5.8%	8.2%
Nigeria Day of Birth Package	Ebonyi	NMR	7.3%	1.6%	16.2%
		MMR	9.5%	0.8%	10.9%
	Kogi	NMR	7.3%	0.9%	11.1%
		MMR	9.5%	0.4%	5.1%
Tanzania Immunization	Kagera	U5MR	5.4%	3.1%	3.4%
	Shinyanga	U5MR	5.4%	5.5%	5.7%
	Tabora	U5MR	5.4%	3.6%	4.0%

Discussion and Conclusions

This modeling analysis started with the current situation in the sub-national region where MCSP was working and showed that the trends in coverage of imply that that the country was falling short of SDG target mortality decline in that region. The results of this modeling exercise suggest that it is possible for countries that are not currently achieving their national mortality reduction targets, to do so by focusing energy on improving the delivery of a limited set of highly effective intervention packages at key points along the pregnancy, childbirth, postnatal and early childhood continuum. In the majority of the modeled country cases we estimated that, with MCSP support, significant progress was made toward achieving targets, and in some cases, the estimated progress that was achieved brought areas that were originally far below their targets to the point of meeting or exceeding them. This was the consequence of focusing a great amount of energy on those interventions most likely to have the greatest impact and also using effective system-oriented strategies, such as Reaching Every District (RED) to improve the ability of the system to deliver these interventions. Even with this highly effective combination of design and implementation strategies, success was not universal. Contextual factors like civil unrest and service disruption in Oromia, Ethiopia could derail progress.

Modeling mortality based on coverage of HIIs also yields a single tangible metric for key decision makers both in-country and globally to assess progress and to prioritize gaps that they need to address. With the right forethought to collect the needed information and address health information system weaknesses, such modeling could be done much more feasibly and in an ongoing manner. At the present time, this would certainly a much more feasible way to track country progress toward national and global targets than directly measured mortality, which either would require prohibitively expensive mortality estimation studies or considerable improvements in vital registration systems to give estimates accurate enough on which to base programmatic decisions. One promising development is the National Evaluation Platform initiative which was supported by JHSPH in Malawi, Mali, Mozambique, and Tanzania. This initiative brought together data from various sources at the district level, some of which could be modeled to track mortality trends on an annual basis.[24]

Limitations

There are several important limitations. First, mortality was not directly measured but was estimated from modeling the effect of the coverage changes for high impact interventions on mortality. However, several validation studies of the estimates made by LiST for newborn and child mortality have shown that LiST provides reasonably accurate estimates of newborn and child mortality reduction in a variety of settings.[25, 26] Equivalent validation studies have not been carried out for estimates of maternal mortality in LiST or for any maternal mortality program for that matter, due to the challenges of measuring maternal mortality at the population level to act as a "gold standard" comparison of modeling estimates (because it is a rarer event than child mortality); because of the greater difficulty of getting accurate coverage information for those interventions of known high impact for maternal mortality; and finally because the effectiveness values of some interventions like labor management have not been as well characterized as the effectiveness of child health interventions.

When constructing the sub-national models, coverage level data were not available for all interventions and had to be estimated by modeling methods described elsewhere.[27]

[24] Heidkamp, R. The National Evaluation Platform for Maternal, Newborn, and Child Health, and Nutrition: From idea to implementation. *J. Glob Health.* **7,** 020305 (2017).
[25] Larsen, D. A., Friberg, I. K. & Eisele, T. P. Comparison of Lives Saved Tool model child mortality estimates against measured data from vector control studies in sub-Saharan Africa. *BMC Public Health* **11,** S34 (2011).
[26] Amouzou, A. *et al.* How well does LiST capture mortality by wealth quintile? A comparison of measured versus modelled mortality rates among children under-five in Bangladesh. *Int. J. Epidemiol.* **39,** i186–i192 (2010).
[27] https://www.livessavedtool.org/s/6-Subnational-models_16Nov.pdf

Another issue to consider is the accuracy of the coverage data used for the modeling. LiST preferentially uses data on changes in population coverage for the interventions shown in Annex 1. Such data is not available for all interventions delivered on maternities and many of those delivered during antenatal care because women cannot accurately recall them.[28] Therefore, instead, LiST estimates the population coverage for these interventions by using service coverage of ANC and facility delivery and then makes additional assumptions about how often these clinical interventions are delivered in these settings. To increase the accuracy of the modeling, when the impact modeling team modeled MCSP-supported interventions delivered during maternity care, it did not use the usual assumptions in LiST about coverage of the interventions in these settings. Instead, the team used data from HMIS or supplemental data collection that directly estimated the facility-based coverage levels for these interventions.

Only one of the three countries (Ethiopia) had household survey information at baseline and endline that directly measured population coverage levels for those MCSP-supported interventions that were appropriate to measure this way. Even in the case of Ethiopia, there are wide margins of error in estimation of the coverage levels for these interventions because of the sub-sampling necessary to calculate the needed indicators. In the case of the models for the other three countries, some form of service statistics was used to estimate population level coverage. In the case of Tanzania, a part of MCSP's assistance was aimed at improving administrative data quality, as the routine immunization data used for modeling has the same quality problems that commonly plague administrative routine immunization data across the world (e.g., inaccurate population denominators due to projections from outdated census data). Some coverage levels were initially above 100%, which the impact modeling team imputed to be 100%. Other coverage levels appeared to decline after data quality improvements were introduced, and, in these cases, the team imputed an unchanging level of coverage.

In the case of interventions in LiST that were not supported by MCSP, coverage level estimates were made using assumptions that have been applied in other published LiST modeling exercises.[29,30,31] For instance, the team assumed an unchanging coverage of 0% for some interventions if the health system was not currently supporting them, like KMC.

Another potential limitation in our analysis is the application of "use of a partograph" as a proxy measure for "labor and delivery management", given WHO's updated recommendation on intrapartum care that revised prior partograph guidance.[32]

This modeling exercise does not capture the impact of all MCSP interventions implemented in the three countries, such as the indirect effects of common MCSP-supported health system strengthening activities like advocacy to update policies or improve the health information system. The effects of health worker training are only captured in this exercise when this resulted in improved practice and increased levels of coverage for the interventions modeled. Finally, we did not model MCSP-supported interventions for which there was neither adequate data available on population-level coverage nor data that could be easily converted to estimates of population level coverage. This was true of all MCSP-supported child illness care improvement activities. Taking these considerations into account, it is fairly certain that the mortality estimates produced by this modeling are conservative, and the true mortality impact was likely higher.

[28]See, for instance, various article in Journal of Global Health, supplement on Improving Coverage Measurement (2019), http://www.jogh.org/col-coverage-measurement.htm; Stanton C, Rawlins B, Drake M, et. al., (2013), Measuring Coverage in MNCH: Testing the Validity of Women's Self-Report of Key Maternal and Newborn Health Interventions during the Peripartum Period in Mozambique, PONE https://doi.org/10.1371/journal.pone.0060694

[29] Friberg, I. K., Baschieri, A. & Abbotts, J. A method for estimating maternal and newborn lives saved from health-related investments funded by the UK government Department for International Development using the Lives Saved Tool. *BMC Public Health* **17,** 779 (2017).

[30] Ayyanat, J. A., Harbour, C., Kumar, S. & Singh, M. LiST modelling with monitoring data to estimate impact on child mortality of an ORS and zinc programme with public sector providers in Bihar, India. *BMC Public Health* **18,** 103 (2018).

[31] Amouzou, A., Habi, O. & Bensaïd, K. Reduction in child mortality in Niger: a Countdown to 2015 country case study. *Lancet* 380, 1169–1178 (2012).

[32] World Health Organization (2018). *WHO recommendations on intrapartum care for a positive childbirth experience*. World Health Organization.

Recommendations

As far as the feasibility of the modeling exercise itself, the lack of routine population coverage data as well as observational studies on facility-based coverage of maternity interventions in the areas covered by MCSP made this exercise difficult to carry out. Baseline and endline household surveys data were available only in Ethiopia. Baseline and endline surveys were originally planned in six countries, but endlines were canceled in three countries for programmatic and funding reasons and the data were not yet available in a fifth country. This meant that there were no reliable data to model the impact of child illness care in any MCSP-supported coverage, although that was one of MCSP's major focus areas. Comprehensive facility-based observational data for maternity care was also not available for any of the cases. Of the 52 country programs, 16 fit the eligibility criteria to be modeled, but at the time of the exercise the assessment team could get complete enough information only for the three cases presented here.

In the future, a detailed impact modelling plan should be developed at the outset of programming and shared with USAID Missions and MOHs in collaborating countries. This should be part of an overall dialogue and planning process regarding a package of appropriate monitoring and evaluation approaches to measure progress toward national RMNCH goals and objectives. An integral part of these discussions should be to highlight the value of conducting special household surveys as well as revising national HMIS forms to capture priority RMNCH data elements needed for comprehensive program monitoring and impact modeling that are not currently part of national HMIS. Even without costly household surveys, smaller investments could yield data that would be adequate for modeling. One investment would be to monitor coverage levels on an ongoing basis with lot quality assurance sampling (LQAS). Another would be to make routinely collected facility level service data more useful for modeling by improving routine data quality. When the team used routine service statistics, it needed to estimate population denominators. In some cases, there were difficulties in accurately defining service catchment area boundaries. Even more often, countries face challenges because they are working from outdated census data that require multiple assumptions to make annual adjustments to account for population growth and migration. These assumptions are often not accurate. If service statistics and population estimates could be further improved, reasonable modeling estimates could be done at the level of districts that could be useful to managers for planning and monitoring their programs. The National Evaluation Platform initiative mentioned above has attempted to do just this.

Tracking mortality and morbidity are the ultimate measures of the health of the population and the effectiveness of the health system as well as other systems with health effects. However, even institutional information on cause of maternal, neonatal, and child death and morbidity is absent or inaccurate in many routine health information systems in LMICs.[33,34] Morbidity information is notoriously difficult and burdensome to obtain, and, in LMICs, is generally only accurately collected through population surveillance research sites like those in the INDEPTH Network. In terms of mortality, direct measurement would give the fullest picture. When accurately and completely recorded at the facility level, institutional a mortality and morbidity data yield powerful information that could guide program-decision making and quality improvement initiatives at the district and national levels, as reflected in the monitoring framework of the WHO multi-country Quality of Care Network for Maternal, Newborn, and Child Health. The absolute ideal would be that vital events information would be collected, analyzed, reported and used routinely on a population-wide basis; however, vital registration systems are currently poorly developed in all but a handful of LMICs.[35] In the absence of such data, modeling mortality offers a reasonable alternative if it can be done feasibly and yield a relatively accurate impression. As previously mentioned, LiST has been shown to yield fairly reasonable estimates of child and newborn mortality and no current modeling program has been validated for estimates of maternal mortality, but the logic and assumptions that have served so well in LiST for child and newborn mortality are likely to yield the most accurate estimates for maternal mortality as well.

[33] Network for Improving Quality of Care for Maternal, Newborn and Child Health. (n.d.). Retrieved from http://www.qualityofcarenetwork.org/

[34] M. (2018, May). Review of the Maternal and Newborn Health Content of National Health Management Information Systems in 24 Countries. Retrieved from https://www.mcsprogram.org/resource/hmis-review/

[35] Mikkelsen, L. *et al.* A global assessment of civil registration and vital statistics systems: monitoring data quality and progress. *The Lancet.* **386,** 1395-1406 (2015).

Conclusions

In the cases in which this modeling exercise proved possible, it yielded reasonable estimates from which programmatically useful conclusions can be drawn. Notably, we conclude that in many cases it is possible for countries that are not currently on track to achieve their national mortality reduction targets by focusing energy on improving the delivery of packages that include a limited set of highly effective interventions. In terms of feasibility of the modeling itself, the exercise required a substantial amount of effort, but with advanced planning and negotiation among stakeholders it could be made more feasible through collection of relevant data from routine sources or small surveys. The one exception is the area of child illness care, where accurate modeling of mortality would still require baseline and endline household survey information because construction of accurate denominators for service statistics data is impossible in the absence of accurate context-specific disease incidence rates which is made even more complicated because of the improvement in those rates brought about by the successful introduction of new vaccines.

Annex 1: High Impact Interventions included in LiST (Version 5.64)

Maternal Peri-conceptual Care

- Folic acid supplementation / fortification
- Universal iron supplementation / fortification
- Post abortion case management
- Ectopic pregnancy case management

Maternal Antenatal / Pregnancy Care

- Tetanus toxoid vaccination
- Malaria in Pregnancy – IPTp or sleeping under ITN *(In LiST these are treated equivalently)*
- Malaria case management
- Syphilis detection and treatment
- Calcium supplementation
- Micronutrient supplementation
  - Iron supplementation
  - Multiple micronutrient supplementation
- Balanced energy supplementation
- Hypertensive disorder case management
- Diabetes case management
- Magnesium sulfate for management of pre-eclampsia
- Fetal growth restriction detection & management

Maternity Care (Maternal and Newborn)

- Magnesium sulfate for management of eclampsia
- Active Management of the 3rd Stage of Labor
- Labor and delivery management
- Clean birth practices
- Maternal sepsis case management
- Induction of labor for pregnancies 41+ weeks
- Antibiotics for preterm PRoM
- Immediate assessment and stimulation
- Neonatal resuscitation
- Antenatal corticosteroids for preterm labor

Newborn / Child Care – Preventive

- Breastfeeding
  - Exclusive breastfeeding
  - Early initiation of breastfeeding
- Clean postnatal practices
- Chlorhexidine
- Complementary feeding – education only
- Complementary feeding – supplements and education
- Vitamin A supplementation
- Zinc supplementation
- Improved water source
- Water connection in the home
- Improved sanitation (use latrine/toilet)
- Hand washing with soap
- Hygienic disposal of children's stools
- ITN/LLIN Ownership or Indoor residual spraying

Newborn / Child Care – Immunizations

- Diphtheria, pertussis, and tetanus (DPT) vaccine
- Hemophilus influenzae b (Hib) vaccine
- Hepatitis B (HBV) vaccine
- Pneumococcal (PCV) vaccine
- Rotavirus vaccine
- Measles vaccine

Newborn / Child Care – Treatment

- Case management of premature babies
  - Thermal care
  - Kangaroo mother care (KMC)
  - Full supportive care for prematurity
- Case management of severe neonatal infection
  - Oral antibiotics
  - Injectable antibiotics
  - Full supportive care for sepsis/pneumonia
- Oral Rehydration Salts (ORS) for treat. of diarrhea
- Antibiotics for treatment of dysentery
- Zinc for treatment of diarrhea
- Oral antibiotics for treatment of pneumonia
- Vitamin A for treatment of measles
- ACTs for treatment of malaria
- Treatment for severe acute malnutrition
- Treatment for moderate acute malnutrition

Ethiopia Community Based Newborn Care

Estimated Mortality Impact

Background

The Maternal and Child Survival Program (MCSP) is a global, $560 million, 5-year cooperative agreement funded by the United States Agency for International Development (USAID) to introduce and support scale-up of high-impact health interventions among USAID's 25 maternal and child health priority countries, as well as other countries. MCSP is focused on supporting countries to ensure that all women, newborns and children most in need have equitable access to quality health care services to save lives. To measure the MCSP's contributions to country achievements in reducing maternal, newborn, and child morbidity and mortality in selected high priority countries, as aligned with their national and global health targets, MCSP conducted a modeling exercise using the Lives Saved Tool (LiST) to estimate the impact of MCSP-supported high impact interventions (HIIs) on mortality based on documented changes in the utilization of those HIIs. This brief describes key findings from MCSP's support to Ethiopia's national Community-Based Newborn Care (CBNC) program. MCSP hopes that it is useful to the Ministry of Health, donors, technical assistance organizations, other governmental agencies and civil society partners in assessing the likely impact of investments in sustaining or further expanding HIIs.

Quick Facts

Program Implementation Period
October 2014 – February 2019

Population Reached by Program
20% of the national population

Program Implementation Areas
14% of all woredas in Ethiopia
19% of all health centers in Ethiopia
21% of all health posts in Ethiopia

Modeled Implementation Period
2015 – 2017

Data Sources
- Secular Trend: Demographic Health Survey (DHS) 2011, DHS 2016
- MCSP Trend: MCSP Knowledge, Practices, and Coverage household surveys, 2015 (Baseline) and 2017 (Endline)

Overview of MCSP-supported Activities

MCSP supported the Ethiopia national CBNC program in agrarian areas of Amhara, Oromia, Southern Nations Nationalities and People's Region (SNNPR), and Tigray regions. The Ethiopia CBNC program aims to reduce neonatal morbidity and mortality by introducing and scaling up newborn health services at the community and at primary health care unit levels. These four regions account for approximately 81% of the national population, and MCSP worked in a subset of health centers and posts that reach approximately 20% of national population. Other international development partners concurrently supported the Ethiopian government to scale up the CBNC program in the rest of the planned areas in the country. While the MCSP CBNC program covers various preventive and treatment aspects of newborn care through the Health Extension Worker (HEW) and Health Development Army (HDA) platforms, MCSP focused part of its support on the rollout of the timely identification and quality management of newborns with possibly serious bacterial infections. MCSP focused on early identification of pregnancy to ensure pregnant women were supported by facility delivery and reached with early postnatal care, which is a key entry point for the identification of newborn danger signs.

Strategic Objectives:
1. Improve community maternal and newborn health practices and care-seeking behaviors
2. Increase provision of high-impact, quality newborn care services in the community
3. Strengthen supportive systems for provision of newborn health care

Modeling the Impact of MCSP's support to the CBNC Program

MCSP modeled the newborn mortality impact in each of the four MCSP-supported regions. For the change in the population coverage of high impact interventions, we used data from the MCSP Ethiopia Knowledge, Practices, and Coverage (KPC) household survey conducted near the start of MCSP support in 2015 and near the end of MCSP support in 2017. We considered four newborn HIIs that MCSP supported, and included the first two (in bold) in the final model. The other two interventions – chlorhexidine (CHX) use for cord care and early initiation of breastfeeding – did not show significant improvements in coverage and did not contribute to newborn mortality reduction in the model:

- **Clean Postnatal Practices**
- **Case Management of Neonatal Sepsis (i.e., treatment of Possibly Serious Bacterial Infections)**
- Chlorhexidine (CHX): There was little-to-no change in CHX coverage in any of the four regions, which MCSP planned to support but then was not implemented at scale due to issues with supply.
- Early Initiation of Breastfeeding: There was conflicting information from the analysis of the KPC and routine information sources. Since there are known issues with data quality from both sources and they did not agree, it was not clear which source should be used.

Table 1: HIIs, indicators, and KPC data modeled for MCSP Ethiopia

Demographic Group	LiST Indicator	MCSP Indicator	Amhara		Oromia		SNNPR		Tigray	
			2015	2017	2015	2017	2015	2017	2015	2017
Newborns	Clean Postnatal Practices	% of mothers who received early (within 48 hours) postnatal home visits by HEWs and HDAs (when they were counseled on clean postnatal practices)	7.5%	8.5%	2.9%	12.4%	5.5%	19.7%	16.0%	22.1%
	Case Management of Neonatal Sepsis / Pneumonia	% of pregnant women whose last baby was treated for serious illness at home by bringing the health provider to the home or by taking advice of a health provider	2.8%	32.4%	30.6%	29.3%	6.0%	35.3%	10.0%	28.6%

Note: Coverage levels were linearly interpolated between the values measured in the 2015 and 2017 household (KPC) surveys

Explanation of figures showing estimated newborn mortality trend with and without MCSP support

Although the newborn mortality reduction estimate from the modeling was directly attributable to coverage increases for just two specific evidence-based health interventions (i.e., clean postnatal practices and case management of neonatal sepsis), the improvements in the coverage levels of these interventions were only possible because of comprehensive system-wide efforts to improve the CBNC package as a whole – that is, improvements in care seeking, programmatic coverage, and the quality of services delivered by HEWs.

In the graphs below we show what the estimated mortality impact was from the increased coverage for these two life-saving interventions. In each of the graphs:

- The **solid blue lines** show the estimated *background or secular trend* in the newborn mortality rate (NMR). This line begins before MCSP started in 2015 and is extrapolated afterward, showing the estimated trend in NMR without the improvements as a result of the MCSP-supported interventions.
- The **dotted blue lines** in each graph show the improvement in NMR that Ethiopia needs *to achieve its national goal*, as expressed in the Sustainable Development Goal (SDG) and Every Newborn Action Plan (ENAP) targets for NMR – that is, a 5.9% annual mortality rate reduction.
- The **solid red lines** in each of the graphs show the modeled NMRs *with MCSP support*.

Figures 1a-d. Comparing the Estimated Secular Trend, Estimated MCSP Trend, and Target Annual Rate of Reduction (ARR) to Achieve the SDGs

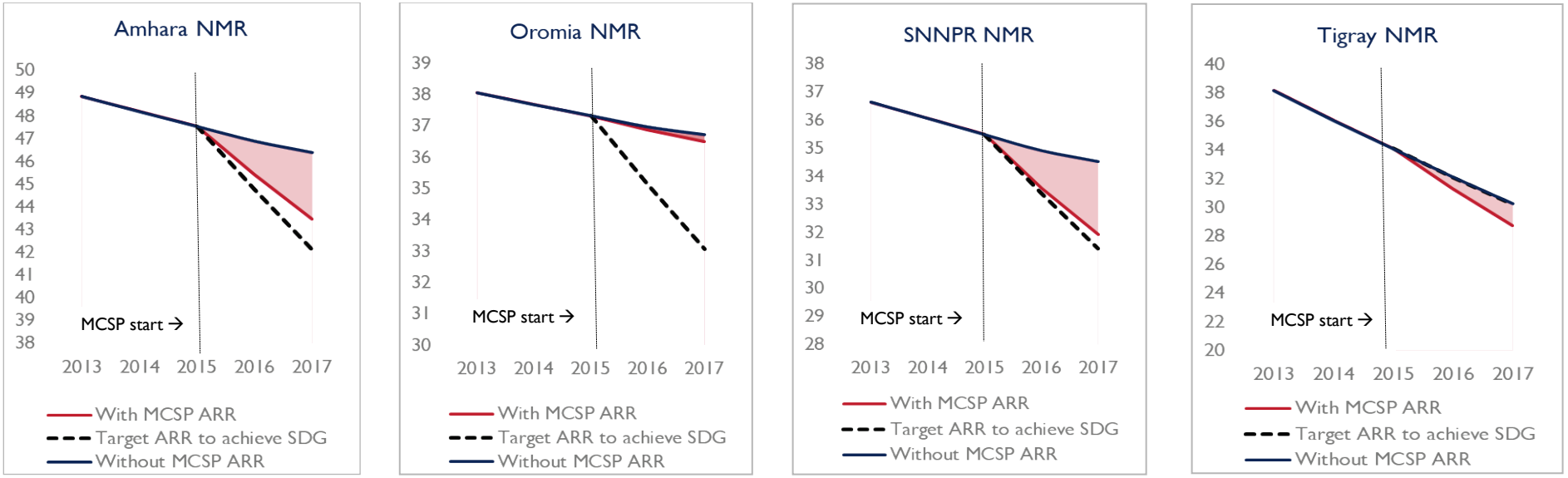


Table 2: Comparing Estimated Secular Trend, Estimated MCSP Trend, and ARR need to achieve SDG targets

Region Modeled	Baseline Mortality (2015)	ARR to Reach SDG Target	**Without** MCSP Support		**With** MCSP Support	
			Mortality (2017)	ARR	Mortality (2017)	ARR
Amhara	47.5	5.9%	46.4	1.2%	43.5	4.3%
Oromia	37.3	5.9%	36.7	0.8%	36.5	1.1%
SNNPR	35.5	5.9%	34.5	1.4%	31.9	5.0%
Tigray	34.1	5.9%	30.1	5.8%	28.6	8.2%

Table 3: Additional Estimated Lives Saved with MCSP-supported Programming

The values in this table were rounded to rounded to the tens place, since presenting lives saved to the units place implies a level of precision that LiST cannot offer.

Demographic Group	Years Modeled	Lives Saved in MCSP-supported areas during program period	Lives saved if scaled to entire MCSP-supported regions	Lives saved if scaled to National Level
Newborn	2015 - 2017	1,470	6,090	7,530

Findings and Conclusions

- MCSP support of the CBNC package made a significant contribution to improving mortality reduction in three of the four regions. The one exception was Oromia, where civil unrest interrupted not only MCSP-supported programming but much of the government's programming through its public health system.
- In Amhara and SNNPR, the modeled impact without MCSP was below the target rate. With MCSP-supported programming, the modeled impact almost reached the target mortality ARR.
- In Tigray, the modeled impact without the MCSP-supported interventions was already reaching the target for annual rate reduction, but adding the MCSP-supported programming improved it further and meant that the modeled impact significantly exceeded the target.

Nigeria Improvement of Day of Birth Package

Estimated Mortality Impact

Background

The Maternal and Child Survival Program (MCSP) is a global, $560 million, 5-year cooperative agreement funded by the United States Agency for International Development (USAID) to introduce and support scale-up of high-impact health interventions among USAID's 25 maternal and child health priority countries, as well as other countries. MCSP is focused on supporting countries to ensure that all women, newborns and children most in need have equitable access to quality health care services to save lives. To measure the MCSP's contributions to country achievements in reducing maternal, newborn, and child morbidity and mortality in selected high priority countries, as aligned with their national and global health targets, MCSP conducted a modeling exercise using the Lives Saved Tool (LiST) to estimate the impact of MCSP-supported high impact interventions (HIIs) on mortality based on documented changes in the utilization of those HIIs. This brief describes key findings from the maternal and newborn (MNH) activities included in MCSP Nigeria's programming. MCSP hopes that it is useful to Federal and State Ministries of Health, donors, technical assistance organizations, other governmental agencies and civil society partners in assessing the likely impact of investments in sustaining or further expanding HIIs.

Quick Facts

Program Implementation Period
October 2014 – March 2019

Population Reached by Program
15% of Ebonyi and Kogi state populations

Program Implementation Areas
100% of local government areas in Ebonyi and Kogi States
24% of health facilities in Ebonyi and Kogi States

Modeled Implementation Period
2016 – 2018

Data Sources
- Secular Trend: Demographic Health Survey (DHS) 2013, Multiple Indicator Cluster Survey (MICS) 2016
- MCSP Trend: MCSP-supported Facility Quality

Overview of MCSP-supported activities

The MCSP Nigeria MNCH program aimed to help the Government of Nigeria reduce maternal, neonatal and under-five mortality by improving the quality and utilization of MNCH services in public, private and faith-based facilities as well as in selected communities across Kogi and Ebonyi states. These two states account for approximately 3.8% of the national population, and MCSP worked in 321 health facilities that reached approximately 15% of the population within those states.

Strategic Objectives:

1. Improved quality of facility-based MNCH services and community-based child health services
2. Improved information systems to monitor and evaluate health outcomes
3. Increased use of life-saving innovations

Modeling the Impact of MCSP's support for the Day of Birth package for women and newborns

To model the MCSP trend, we initially identified 14 MCSP-supported HIIs – two delivered in antenatal care (ANC); 10 delivered during intrapartum care; two in the postpartum/postnatal period. These were tracked in the MCSP Nigeria MNCH performance monitoring plan (PMP), which in turn used data from Nigeria's routine health information system. After review, the impact modeling team was not able to use data from routine sources because it was either incomplete or of insufficient quality. However, there was complete data for seven of the 10 maternity care HIIs (**in bold**) because they were included in facility level quality improvement (QI) dashboards[1] and reported monthly, via revised Health Management Information System forms and a new supplemental form for postpartum family planning (PPFP). The team calculated the average of the first three monthly coverage levels for the baseline (2016), middle three months for the midline (2017), and the final three months for the endline (2018) data points. Use of a partograph was considered to be a proxy for "labor and delivery management."

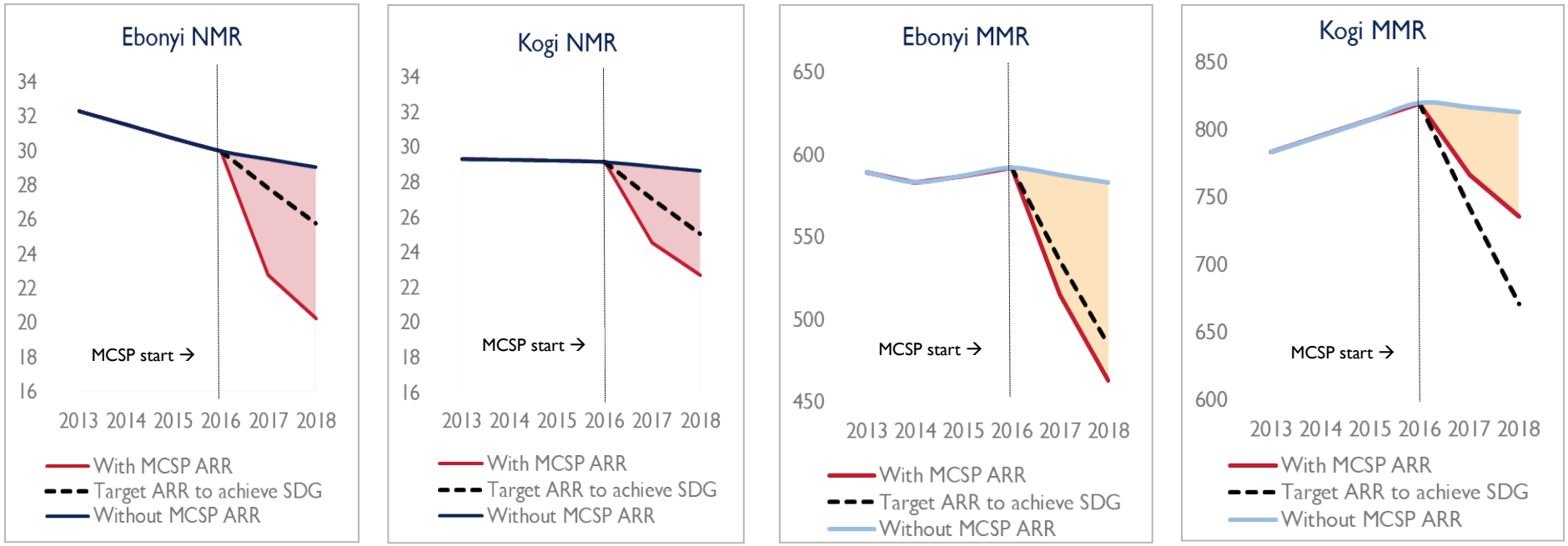
- **Labor and delivery management**
- **Active management of third stage labor**
- Magnesium sulfate for management of pre-eclampsia
- **Postpartum family planning**
- Clean birth practices
- Immediate assessment and stimulation of newborns
- **Early initiation of breastfeeding**
- **Neonatal resuscitation**
- **Chlorhexidine (CHX) care of the umbilical cord**
- **Thermal care**
- **After immediate postnatal period:** Management (full supportive care) of sepsis / pneumonia, Kangaroo mother care
- **Delivered in ANC:** Intermittent preventative treatment of malaria in pregnant women (IPTp), Tetanus toxoid vaccination

Table 1: High impact interventions, indicators, and data from quality Improvement dashboards modeled for MCSP Nigeria Day of Birth package

Technical Area	LiST Intervention	Indicator tracked	Ebonyi			Kogi		
			2016	2017	2018	2016	2017	2018
Maternal Health	Active Management of the Third Stage of Labor	% of women delivered and prophylactic uterotonic given within one minute of delivery of baby	51.5%	82.1%	97.8%	83.0%	97.8%	99.0%
	Labor & Delivery Management	% of deliveries for which partograph was used	27.1%	73.6%	93.2%	25.1%	69.4%	91.8%
Newborn Health	Neonatal Resuscitation	% of newborns with asphyxia who were successfully resuscitated	58.4%	73.5%	78.9%	55.6%	68.2%	92.7%
	Early Initiation of Breastfeeding	% of newborns put to mother's breast within 30 minutes of birth	23.1%	77.2%	94.9%	52.1%	69.7%	91.1%
	Thermal Care	% of newborns put in skin-to-skin contact with mother	7.8%	77.3%	95.1%	28.3%	76.0%	93.9%
	Chlorhexidine	% of newborns with chlorhexidine gel applied to cord	12.3%	76.4%	95.8%	55.2%	93.7%	99.6%
Family Planning	Family planning in postpartum	% of women who delivered and initiated PPFP before discharge	10.6%	44.8%	84.7%	9.2%	54.5%	81.0%

[1] The QI dashboards, an MCSP-supported intervention, were only implemented in a subset of total MCSP-supported facilities (n=91).

Figures 1a-d. Comparing Estimated Secular Trend, Estimated MCSP Trend, and Target Annual Rate of Reduction (ARR) to achieve the Sustainable Development Goal (SDG) targets



Findings and Conclusions

In each of the graphs:

- The **solid blue lines** show the estimated *background or secular trend* in mortality rates. This line begins before MCSP started in 2016 and is extrapolated afterward, showing the estimate of the expected trend in each of the states without the improvements in coverage for MCSP-supported interventions.
- The **dotted blue lines** show the improvement in the mortality rate that Nigeria needs *to achieve its national goals* as expressed in the SDG, Every Newborn Action Plan (ENAP), and Ending Preventable Maternal Mortality (EPMM) targets.
- The **solid red lines** show the modeled mortality rates *with MCSP support.*

In the years before MCSP support, the trend in neonatal and maternal mortality in both Kogi and Ebonyi states was either flat or rising and far from meeting the national targets for mortality decline needed to achieve Nigeria's national targets. With MCSP support for an integrated quality improvement package for maternal and newborn interventions delivered in facilities on the day of birth, coverage increased significantly for all interventions tracked. The estimated mortality impact from these coverage changes was enough to exceed the targets in both Ebonyi and in Kogi for NMR and in Ebonyi for MMR. The estimated MMR trend in Kogi made significant progress toward the target but did not reach it. The findings from an analysis of directly reported institutional maternal mortality and very early newborn death from these same facilities in HMIS (Figures 2-3) validates these modeling results. The directly measured mortality decline shows similarly large improvement in newborn mortality and a less dramatic improvement in maternal mortality. The directly measured institutional maternal mortality ratio trends are less stable because of the small number of deaths that occurred.

Figure 2. Institutional Maternal Mortality Rate in MCSP supported Health Facilities in Kogi

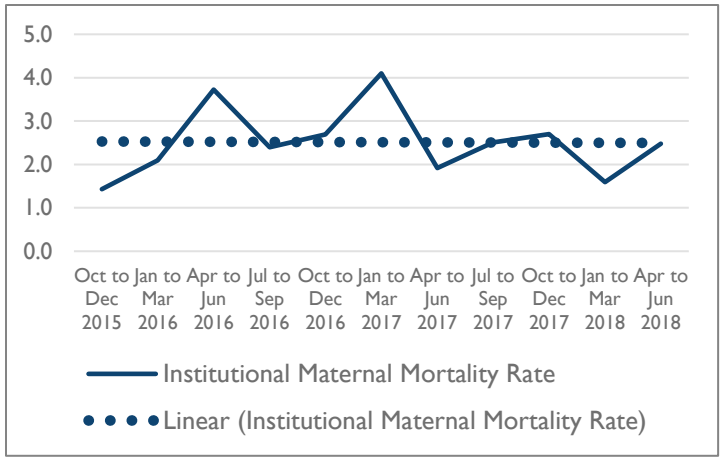


Figure 3. Institutional Neonatal Mortality Rate per 1000 livebirths in MCSP supported facilities in Kogi

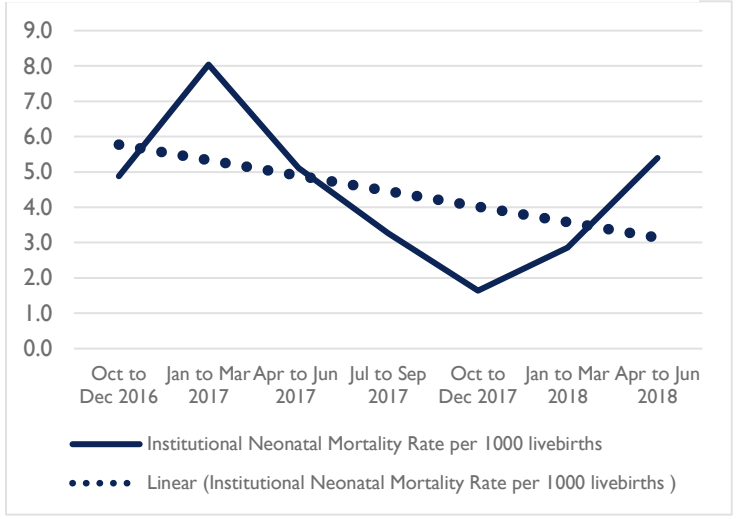


Fig. 2-3 Data Source: DHIS2; MCSP Phase 1 Facilities, N=120

The Way Forward

The challenge for Nigeria now is to sustain and expand these gains as part of its push to improve the quality care for women and newborns as a first wave country in the World Health Organization's multi-country Quality of Care Network for maternal and newborn health. It is important to note that increasing coverage of PPFP can contribute significantly to reductions in maternal mortality. The improved coverage of PPFP in MCSP-supported sites contributed estimated accelerated reductions for both maternal and neonatal mortality reduction. However, its effect on health is highlighted when one considers at the Maternal Mortality ***Rate*** (the number of deaths per 100,000 *women of reproductive age*). The estimated annual rate reduction in Maternal Mortality Rate is greater than the estimated reduction in MMR in MCSP-supported facilities. This is because of the ability of PPFP to prevent poorly spaced pregnancies, which are not counted in the standard maternal mortality *ratio* indicator, which only includes women who have a live birth.

Table 1: Comparing Estimated Secular Trend, Estimated MCSP Trend, and ARR needed to achieve national targets

Modeling Level	Mortality Rate	Baseline Mortality (2016)	ARR to Reach SDG Target	Without MCSP Support		With MCSP Support	
				Mortality (2018)	ARR	Mortality (2018)	ARR
Ebonyi	NMR	30.0	7.3%	29.1	1.6%	20.3	16.2%
	MMR	592.3	9.5%	583.0	0.8%	463.4	10.9%
	MM Rate	88.5	-	85.6	1.7%	58.8	16.8%
Kogi	NMR	29.2	7.3%	28.7	0.9%	22.7	11.1%
	MMR	819.8	9.5%	813.0	0.4%	735.9	5.1%
	MM Rate	141.3	-	137.5	1.3%	108.5	11.6%

Table 2: Estimated Additional Lives Saved with MCSP-supported HIIs

Demographic Group	Years Modeled	Lives Saved in MCSP-supported areas during program period	Lives saved if scaled to entire MCSP-supported regions	Lives saved if scaled to National Level
Newborn	2016 - 2018	500	3,320	86,400
Maternal	2016 - 2018	50	360	9,280

The values in this table were rounded to rounded to the tens place, since presenting lives saved to the units place implies a level of precision that LiST does not offer.

Tanzania Improving Routine Immunization and New Vaccines

Estimated Mortality Impact

Background

The Maternal and Child Survival Program (MCSP) is a global, $560 million, 5-year cooperative agreement funded by the United States Agency for International Development (USAID) to introduce and support scale-up of high-impact health interventions among USAID's 25 maternal and child health priority countries, as well as other countries. MCSP is focused on supporting countries to ensure that all women, newborns and children most in need have equitable access to quality health care services to save lives. To measure MCSP's contributions to country achievements in reducing maternal, newborn, and child morbidity and mortality in selected high priority countries, as aligned with their national and global health targets, MCSP conducted a modeling exercise using the Lives Saved Tool (LiST). The exercise aimed to estimate the impact of MCSP-supported high impact interventions (HIIs) on mortality based on documented changes in the utilization of those HIIs. This brief describes the findings from modeling support to Tanzania's immunization program from MCSP and from MCSP's predecessor, the Maternal and Child Health Integrated Program (MCHIP). MCSP hopes that it is useful to the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), donors, technical assistance organizations, other governmental agencies and civil society partners in assessing the likely impact of investments in sustaining or further expanding HIIs.

Quick Facts

Program Implementation Period
July 2014 – June 2019

Population Reached by MCSP Immunization Activities
28% of national population

Program Implementation Areas for Immunization
Mara and Kagera regions, plus 16 councils in Tabora, Simiyu, Shinyanga, Iringa, and Njombe

Modeled Implementation Period
2014-2017 (MCSP)
2012-2015 (MCHIP)

Impact Model Data Sources
- Secular Trend: Demographic Health Survey (DHS) 2010, DHS 2015/16
- MCSP and MCHIP Trend: National Immunization and Vaccine Division Data

Overview of MCSP and MCHIP-supported immunization activities

In Kagera region and selected councils in Simiyu, Tabora, and Shinyanga regions, MCSP supported the MoHCDGEC to strengthen its routine immunization systems and reduce the number of un- and under-immunized children.[37] MCSP-supported regions account for 28% of the national population; the subset of MCSP-supported councils account 9% of the national population (excluding Simuyu for reasons explained below). MCSP's support for routine immunization was multi-faceted and included technical assistance at both national and sub-national level with the Ministry of Heath, Community Development, Gender, Elderly and Children (MOH CDGEC) and in 19 councils in four regions. MCSP also worked with the President's Office for Regional Administration and Local Government (PORALG); Regional and Council Health Management Teams (RHMT and CHMT); District and Region Immunization & Vaccine Officers (DIVO & RIVOs); and for Pre-service work Unicef, WHO, PATH and CHAI.

[37] MCSP Tanzania also had a major component supporting Maternal and Newborn Care. The data on the high impact interventions supported through that component was not suitable for modeling. It was in the form of counts from service statistics, without denominator that could be reasonably estimated, making it difficult to calculate the coverage data required for LiST.

At the national level, MCSP:

- Provided technical assistance to different technical working groups (TWGs) - Routine Immunization; Immunization Supply Chain; Advocacy, Communication and Social Mobilization; Data Management)
- Supported Immunization and Vaccines Delivery (IVD) with national plans, reports, assessments, trainings, etc.
- Adapted and updated pre-service education (PSE) immunization curriculum for health training institutions
- Facilitated training of middle level managers (MLM) with IVD and health training institutions
- Provided technical assistance on immunization supply chain (iSC): Management transition from MSD to IVD; Cold Chain Equipment Optimization Plan (CCEOP); Effective Vaccine Management Assessment (EVMAs) and improvement plan; Training of cold chain equipment technicians
- Support polio eradication outbreak investigation, polio expert committee

At the subnational level, MCSP:

- Supported the implementation of REC in 19 under-performing councils in 4 regions
- Supported roll out of Vaccine Information Management System (VIMS) in 19 MCSP-supported councils and 5 non-MCSP councils
- Supported piloting of use of data to inform budgeting process for Comprehensive Council Health Planning (CCHP) process in 13 MCSP councils and share experience with other councils
- Supported cold chain maintenance and installation in MCSP councils
- Provided technical assistance to introduce new vaccines such as Measles Rubella (MP), HPV, IPV. Supported campaigns and post introduction supportive supervision to health facilities to ensure uptake of the vaccines

As a result of these efforts, the following achievements were documented:

- The number of unvaccinated children was reduced from 40,000 in 2013 to less than 5,000 in 2016 in MCSP councils
- Government funding for immunization operations for health facilities and councils increased in the councils as REC microplanning and budgeting tools for CCHP
- Learning from the experience of the 19 MCSP-supported councils, councils nationwide adopted the microplanning tool in their 2018/2019 planning
- The revised pre-service curriculum includes updates of immunization policies, guidelines, and vaccine technology in line with the global standard. MCSP oriented 21 tutors in two regions to further train others.
- Through the strengthening of the REC platform, improved the delivery of other primary health care interventions.

Additionally, the government of Tanzania had rolled out two of the currently routine vaccines (Pneumococcal Conjugate Vaccine (PCV) and rotavirus) in December 2012 with support from MCHIP. With the support of MCHIP and others, Tanzania achieved coverage rates equivalent to other routine vaccines after only 12 months of implementation as opposed to a more typical new vaccine rollout that can take an average of roughly three years[38] to reach high coverage of the target population. We estimated the mortality impact of MCSP's support for strengthening the routine immunization system as well as MCHIP's support for the national rollout of PCV and rotavirus vaccines, in the latter case comparing the actual experience of the rollout with what would have happened in a slower and more typical rollout taking 36 months to reach high coverage levels.

[38] Personal communication, Robert Steinglass (MCHIP Immunization Team Leader) and Folake Olayinka (MCSP Immunization Team Leader)

Modeling the impact of MCSP's support for improving Routine Immunization

The following vaccines were modeled in LiST for MCSP's support to the routine immunization system:

- Pentavalent (Diphtheria, Pertussis, and Tetnus (DTP) vaccine
- Pneumococcal conjugate vaccine
- Rotavirus vaccine
- Measles vaccine
- Oral polio vaccine

Routine immunization data, which relied on the projections of population growth based on the 2012 national census, were adjusted to reflect the more recent demographic estimates from the Population Division of the United Nations[39]. This meant increasing the estimated population by a factor of 8%. MCSP also made adjustments to improve data quality.[40] Table 1 outlines the vaccine interventions modeled in the regions where MCSP provided immunization technical support. However, MCSP did not model the impact of activities in the Simiyu region, which it also supported, because it was created in 2012. This made it impossible to develop a subnational secular trend model for the region from DHS coverage information. The results of the model represent children in the subset of MCSP-supported councils in those regions (9.4% of the national population, after excluding councils in the Simiyu region).

Table 1: High impact interventions, indicators, and immunization program data modeled for Tanzania

Note: The table only shows the population-weighted averages of district coverage levels for the first and last years of MCSP support, but there was data for each of the intervening years as well (2015, 2016)

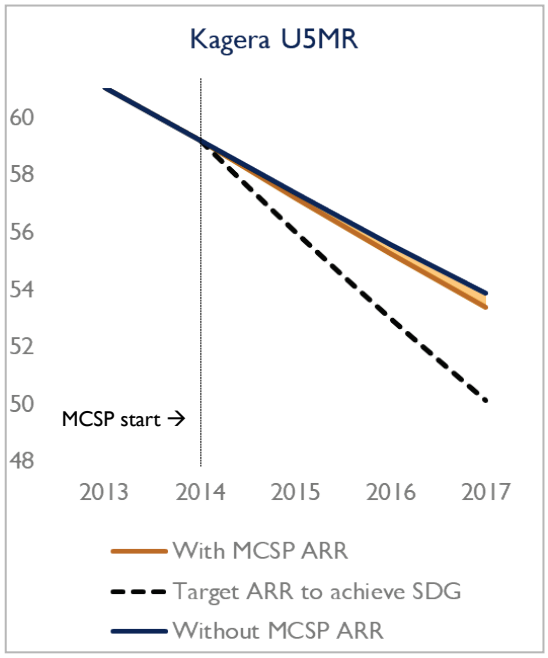
Technical Area	LiST Intervention	Indicator tracked	Tabora		Kagera		Shinyanga	
			2014	2017	2014	2017	2014	2017
Routine Immunization	Diphtheria, pertussis, and tetanus vaccine	% of children vaccinated with 3 doses of DTP-Hepatitis B (HepB)-Haemophilus influenzae type B (Hib3)	79%	86%	88%	93%	89%	98%
	Measles vaccine	% of children vaccinated with 2 doses of measles and rubella vaccine	44%	64%	47%	82%	52%	87%
	Polio vaccine*	% of children vaccinated with 3 doses of oral polio vaccine	64%	69%	85%	92%	76%	97%
	Pneumococcal vaccine	% of children vaccinated with 3 doses of pneumococcal conjugate (PCV13) vaccine	74%	85%	84%	93%	90%	98%
	Rotavirus vaccine	% of children vaccinated with 2 doses of rotavirus vaccine	80%	89%	85%	92%	85%	98%

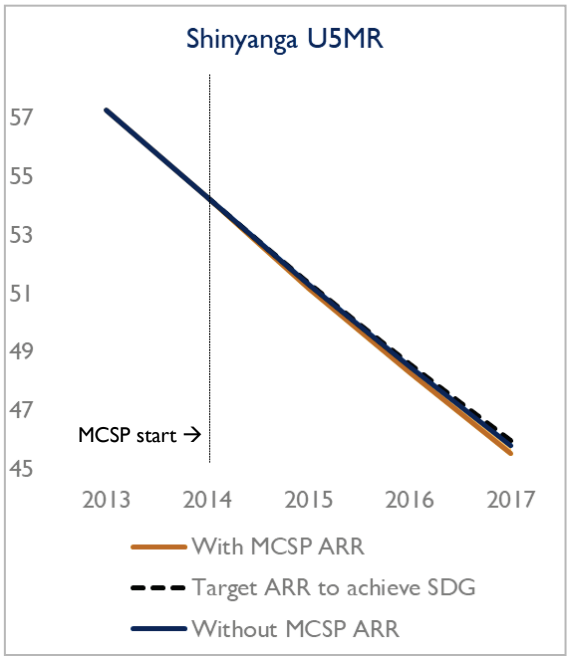
*Note: Although polio vaccine is included in LiST, under current epidemiological conditions in the country, its mortality impact is assumed to be zero.

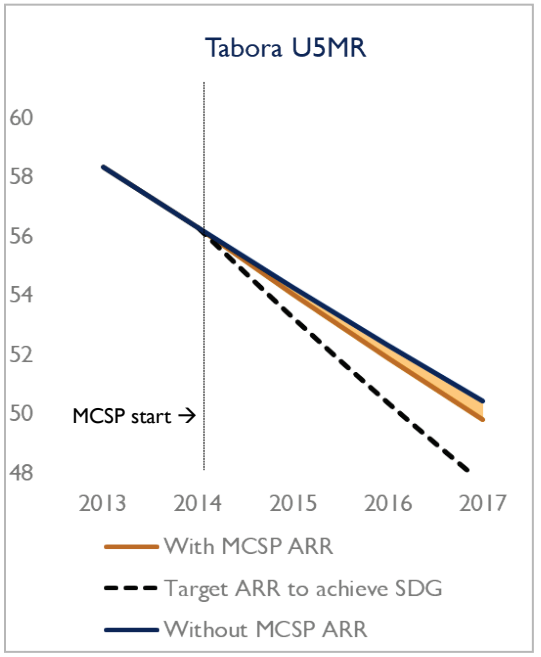
[39] United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Volume I: Comprehensive Tables. ST/ESA/SER.A/399. https://population.un.org/wpp/Publications/Files/WPP2017_Volume-I_Comprehensive-Tables.pdf

[40] Even though MCSP's assistance was aimed at improving routine data quality, the routine immunization data used for modeling had the same quality problems commonly seen in administrative routine immunization data across the world. Initially, some coverage levels were above 100% (which we imputed to be 100%) and other coverage levels appeared to be declining after data quality improvements were introduced (in these cases, we imputed an unchanging level of coverage).

Figures 1a-c. Comparing Estimated Secular Trend, Estimated MCSP Trend, and Target Annual Rate of Reduction (ARR) to Achieve Sustainable Development Goal (SDG) targets







In each of the graphs in Figure 1a-c:

- The **solid blue lines** show the estimated *background or secular trend* in the under-five mortality rate (U5MR). This line begins before MCSP started in 2014 and is extrapolated afterward, showing the estimate of the trend in U5MR in each of the four regions without the improvements in the MCSP-supported interventions.
- The **dotted blue lines** show the improvement in U5MR that Tanzania needs to *achieve its national goal* for mortality reduction, as expressed in the SDG targets.
- The **solid gold lines** show the modeled U5MRs *with MCSP support*

Table 2: Comparing Estimated Secular Trend, Estimated MCSP Trend, and ARR needed to achieve SDG targets

Modeling Level	Baseline Mortality (2014)	ARR to Reach SDG Target	**Without** MCSP Support		**With** MCSP Support	
			Mortality (2017)	ARR	Mortality (2017)	ARR
Kagera	59.2	5.4%	53.7	3.1%	53.2	3.4%
Shinyanga	54.3	5.4%	45.3	5.5%	44.9	5.5%
Tabora	56.3	5.4%	50.2	3.6%	49.5	3.6%

Table 3: Estimated Additional Lives Saved with MCSP-supported Programming

The values in this table were rounded to rounded to the tens place, since presenting lives saved to the units place implies a level of precision that LiST cannot offer.

Demographic Group	Years Modeled	Lives Saved in MCSP-supported areas during program period	Lives saved if scaled to entire MCSP-supported regions	Lives saved if scaled to National Level
Children under five	2014 - 2017	260	380	2,760

Table 4: Number of lives saved with MCHIP support for new vaccine rollout, 2012-2015

The values in this table were rounded to rounded to the tens place, since presenting lives saved to the units place implies a level of precision that LiST cannot offer.

Modeling Level	Scenario	Demographic Group	Number of additional lives saved			Total	Difference
			2013	2014	2015		
National	Rapid (actual) rollout of PCV13 and rotavirus vaccines	Children under five	4,080	7,980	12,930	24,990	4,590
National	Slow (counterfactual) rollout of PCV13 and rotavirus vaccines	Children under five	2,420	5,950	12,030	20,400	

Modeling the impact of MCHIP's support for the rapid national rollout of PCV & Rotavirus vaccines

Pneumococcal conjugate vaccine (PCV13) and rotavirus vaccine were introduced in the routine immunization schedule when MCSP supported Tanzania. They both were rapidly scaled up, starting in December 2012 with support from MCSP's predecessor, the Maternal and Child Health Integrated Program (MCHIP). We also modeled the impact of MCHIP's support for the rapid rollout of these two vaccines. A typical new vaccine rollout can take an average of 3 years to reach high coverage of the target population.[41] In this case, however, coverage rates reached that of well-established vaccines after only 12 months. We modeled the number of *additional child lives saved* during the 2012-2015 period attributable to the rapid rollout compared to a "typical rollout scenario" in which high coverage levels are reached after 36 months. The results in Table 4 show over this three-year period an additional 4,590 child lives were saved nationwide.

Conclusions

MCSP's support for routine immunization helped Tanzania move closer to its national targets for under-five mortality reduction in all three regions modeled. Immunization prevents large numbers of deaths, and improvements in the routine immunization system contributed significantly to Tanzania reaching its Sustainable Development Goal targets for mortality reduction. Complementary efforts by the Tanzania MOH in child illness care and health promotion are likely to help it meet 100% of its national target. One should also keep in mind that this type of mortality impact modeling underestimates the true impact of a mature intervention like immunization that has already reached high levels of baseline coverage, because the calculations give the additional number of lives saved, which is correlated with increases in coverage compared to baseline. The great importance of the impact of immunizations is more clearly seen when we look at the effect of the introduction of new vaccines and coverage levels rise from low baseline values. MCHIP and other partners helped Tanzania to achieve a rapid and successful national rollout of PCV and rotavirus, which are highly effective against two of the leading causes of child death (i.e., pneumonia and diarrhea). An analysis (not shown here) of all child lives saved after their rollout showed that the child lives saved by these two vaccines accounted for 43% of all child lives saved in Tanzania during the 2012-2015 period. The fact that Tanzania achieved this rapid rollout, as opposed to a more typical slow rollout, meant that over 4,500 additional child lives were saved in this three-year period.

[41] Personal communication with Folake Olayinka (MCSP Immunization Team Leader) and Robert Steinglass (MCHIP Immunization Team Leader)