

Lisanu Tadesse, Mariam Sylla, Luwei Pearson, Yvonne Tam, Abraham Tariku, Bilal Avan. *Ethiop Med J*, 2019, Supp. 3

ORIGINAL ARTICLE

MODELING THE POTENTIAL REDUCTION OF NEWBORN MORTALITY WITH NATIONAL SCALING UP OF COMMUNITY BASED NEWBORN CARE IN ETHIOPIA

Lisanu Tadesse¹, Mariame Sylla, MD², Luwei Pearson, MD, MSc², Yvonne Tam, MHS³, Abraham Tariku⁴, Bilal Avan⁵

ABSTRACT

Background. Ethiopia is scaling up community based newborn care (CBNC) on the platform of the Health Extension Programme after national introduction of integrated community case management of pneumonia, diarrhea, malaria and severe acute malnutrition in the four agrarian regions. Since 2013, 26,600 female health extension workers have been trained and supported to provide CBNC, including management of newborn sepsis, at an estimated 14,000 health posts or at home.

Objective. To conduct a modeling exercise to project the potential reduction of the newborn mortality rate due to the CBNC program in the four agrarian regions of Ethiopia.

Methods. We created three projections: (1) baseline projection without CBNC using 2013 data; (2) a “realistic” projection using the 2014-16 data from available survey and routine information systems and (3) a “best case” scenario which scaled up the full package of MNCH interventions according to the targets of the Health Sector Transformation Plan (HSTP) of Ethiopia.

Results. If the 2016 coverage achievements of the implementation sites (realistic projection) were applied to the four agrarian regions, we project that the CBNC program has contributed 46,180 additional neonatal lives saved between 2013 and 2016. If the HSTP targets of MNCH programmes are reached, nearly 187,514 additional neonatal lives will be saved between 2017 to 2020, with 233,696 additional neonatal lives saved between 2013 to 2020.

Conclusions. Community based newborn care delivered at scale and high quality is a significant contributor to the reduction of neonatal mortality in rural Ethiopia. Continued investment in CBNC is critical to sustain and improve the recent decline in child mortality.

INTRODUCTION

Ethiopia has made remarkable progress in child health in the past two and half decades. MDG 4 targets were achieved in 2013, two years ahead of the 2015 deadline(1). The phased scale-up of Community Based Newborn Care (CBNC) started in 2013 in the four agrarian regions, which represent 86% of the total population of the country (2). The primary objective of the CBNC initiative was to further accelerate reduction of child mortality by scaling up essential newborn care including newborn sepsis management in health facilities and at community level. The key components of CBNC include: early identification of pregnancy; provision of focused antenatal care (ANC); promotion of institutional delivery; safe and clean delivery including provision of misoprostol in case of home deliveries or deliveries at health post level;

provision of immediate newborn care, including application of chlorohexidine for cord care; recognition of asphyxia, initial stimulation and resuscitation of newborn baby for inevitable home birth; prevention and management of hypothermia; management of pre-term and/or low birth weight neonates; and identification, referral and management of neonatal sepsis/very severe disease at community level.

By the end of 2016, the Government of Ethiopia with support of development partners had trained and supported 26,600 female health extension workers (HEWs) at roughly 14,000 health posts across the country. They provide the 9 packages of community based newborn care including the treatment of neonatal sepsis using gentamycin injections and amoxicillin dispersible tablets when referral is not possible (3).

¹JSI/L10K, Ethiopia. ²United Nations Children's Fund. ³JHU

⁴Ministry of Health, Ethiopia. ⁵LSHTM

*Corresponding Author E-mail: lisanu.tadesse@moh.gov.et

The Lives Saved Tool (LiST) uses demographic projections and intervention efficacy measurements from the literature to model mortality changes based on baseline data and program targets (4, 5). LiST has been found to yield accurate projections of expected mortality for scaled up maternal and child health interventions through several validation studies (6).

LiST projections have helped implementers identify high-impact interventions for stronger programs in Burkina Faso, Ghana, and Malawi and Ethiopia (7). From Pearson et. Al., modelling potential reduction of child mortality after national scaling up of community-based treatment of childhood illnesses (iCCM) in Ethiopia, suggested that high quality iCCM, delivered and used at scale is an important contributor to the reduction of U5MR in rural Ethiopia (8).

This paper describes a LiST (ver 5.71) modelling exercise to project NMR decline for the two scenarios of CBNC scale-up against the baseline. The projections included changes of coverage of interventions directly attributable to the CBNC: antenatal visits, essential newborn care such as thermal care, clean cord care and early breast feeding, and neonatal sepsis management, among children 0-28 days in the 4 agrarian regions of Ethiopia.

METHODS AND MATERIALS

Adjust population and child mortality rate for the four agrarian regions

The analysis is restricted to the agrarian regions where CBNC has been implemented since 2013. The population projection is based on the United Nations (UN) Population Division 2017 revision of the World Population Prospect and Ethiopia Census 2007 (9). We adjusted the population projection to reflect the four agrarian regions of Ethiopia for a total population of around 80 million. The rural estimates of neonatal mortality of Ethiopia are applied to the analysis.

According to single point HIV related estimates and projections for Ethiopia 2014, the national HIV prevalence is 1.14%, so we did not consider it necessary to include the HIV module of LiST, which adjusts the mortality impact from program scale-up by projected HIV-related deaths (10).

Data source and projections

Baseline projection: The 2017 version of Inter-Agency Group for Child Mortality Estimation (IGME) estimates were used to set the 2013 baseline NMR.

The year 2013 WHO estimates of causes of mortality for children under 5 were used. The programme coverage for 2013/2014 prior to the CBNC scaling up was obtained from the L10K household survey (11).

Realistic projection: The three rounds of cross-sectional surveys conducted by the JSI/L10K project provided the bulk of data for the baseline projection and the projection of 2016 (11). Achievement coverage data related to malaria were obtained from the Management Information System (MIS) 2015 (13). The coverage of newborn sepsis treatment is derived from routine data. The estimated incidence rate of newborn sepsis is 7.6%. Based on service provision data collected from 1,675 health posts (out of an estimated 13,800 health posts) through the JSI/L10K CBNC project MIS, the utilization for the identification, treatment and referral of possible serious bacterial infection/very severe disease (PSBI/VSD) from the expected cases of the catchment populations reached 11.4% in 2016, as compared to 3.8% in 2014 and 7.6% in 2015 from 1,419 health posts.

Best Case Projection: In the “best case” CBNC scale-up scenario, we projected neonatal mortality reduction based on the assumption that MNCH programme coverage including CBNC, is scaled up to meet the HSTP targets in 2020 in the four agrarian regions of Ethiopia.

RESULTS

“Baseline Case Scenario projection” using the 2013 baseline data. Without any improvement of maternal and newborn care in the four agrarian regions of Ethiopia, we expect the NMR to be 35.8/1000 live births or the same as the 2013 rate, by 2020.

The realistic scenario projection: In 2016, the expected NMR would be 28.1/1000 live births or a 21.5% reduction in the agrarian regions due to the introduction of CBNC compared to no CBNC implementation. Due to improvement in maternal and newborn care including scaling up of community based newborn sepsis management, the CBNC program has contributed to roughly 46,180 additional newborn lives in between 2013 to 2016 compared to the baseline impact year before the national CBNC package implementation.

Table 1: Coverage of selected MNCH indicators used in the baseline, 2016 and best scenario projections

Indicator	Year		Year		HSTP target 2020
	2013/14	Source	2015/16	Source	
ANC 4 or more visits	39	CBNC Base line survey	51	L10K survey	95
TT (Protected at Birth)a	58	L10K survey	63	L10K survey	95
Iron folate supplementation of pregnant women	60	CBNC Base line survey	75.2	L10K survey	100
Skilled attendant at delivery	26	CBNC Base line survey	59.1	L10K survey	90
Facility Delivery	23	CBNC Base line survey	53.1	L10K survey	90
Thermal Care	23	Using facility delivery as a proxy for Thermal care	53.1	Using facility delivery as a proxy for Thermal care	90
Early initiation of breast feeding (within one hour)	60	CBNC Base line survey	73.8	L10K survey	90
Exclusive BF (Infants less than 1 month of age)	90	CBNC Base line survey	93	L10K survey	98
Postnatal visit in 48 hours	5	CBNC Base line survey	10.3	L10K survey	50
ITNs/IRS	55	MIS 2011	64	MIS 2015	90
Treatment of newborn infection	0/3.8	Intervention was not in place	11.4	ICCM/CBNC Utilization UNICEF	80%

The Best Case Scenario projection: By the end of 2020, if the CBNC coverage reaches the HSTP targets we expect a NMR drop to 18.1 per 1,000 live births,

around 49.4% reduction compared with the baseline NMR of 35.8 per 1,000 live birth. An estimated total of 237,545 newborn deaths could be averted between 2013 and 2020.

Table 2: Comparison of newborn mortality rate reduction between 2013 and 2020

Neonatal mortality rate (deaths per 1,000 live births)	2013	2014	2015	2016	2017	2018	2019	2020	% reduction in mortality rates
Ethiopia 2013-2020 rural baseline	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	0.0
Ethiopia 2013-2020 rural realistic	35.8	33.3	31.3	28.1	28.1	28.1	28.1	28.1	-21.6
Ethiopia 2013-2020 rural best case	35.8	33.3	31.3	28.1	25.3	22.7	20.3	18.1	-49.4

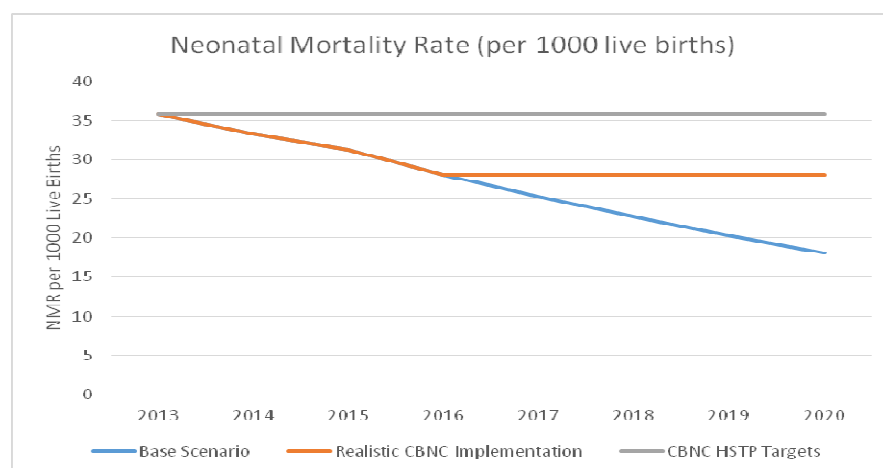
**Figure 1:** Projected trend of NMR with base scenario (no CBNC), realistic CBNC implementation and with CBNC HSTP targets

Table 2: Estimated additional lives saved by the realistic and best case scenario respectively, in children 0-28 days between 2013 and 2020 in the 4 Agrarian regions of Ethiopia (Amhara, Oromia, SNNP and Tigray)

Additional neonatal lives saved	2013	2014	2015	2016	2017	2018	2019	2020	Total (2013 - 2016)	Total (2017- 2020)	Total (2013- 2020)
Baseline	0	0	0	0	0	0	0	0	0	0	0
Realistic	0	7,619	14,08 4	24,47 7	24,89 2	25,27 5	25,61 0	25,89 6	46,18 0	101,67 3	147,85 3
Best case	0	7,619	14,08 4	24,47 7	33,91 3	42,86 1	51,35 7	59,38 3	46,18 0	187,51 4	233,69 4

Since CBNC is a package of interventions, we looked at additional neonatal lives saved by interventions. In the rural realistic model, among the 147,583 total newborn lives saved between 2013 and 2020, labor and delivery management could save 58,284 newborn lives (39%), followed by neonatal resuscitation (22,858, 15%), clean birth practices (15,998, 11%) and case management of newborn infections (12,734, 9%).

In the best case model, among the 233,694 newborn lives saved between 2013 and 2020, labor and delivery management could save 74,861 newborn lives (32%), followed by newborn sepsis management (39,159, 17%), neonatal resuscitation (32,831, 14%), and clean birth practices (20,011, 9%). Table 3.

DISCUSSION

Since 2013 under the leadership of Federal Ministry of Health Ethiopia, the CBNC programme has been scaled up in the 4 agrarian regions, representing 86% of the total population. The platform of the Health Extension Programme is essential for the rapid scaling up.

Although the CBNC programme has contributed to the reduction of the newborn mortality rate in Ethiopia, newborn deaths averted projected by this analysis are not attributable to the CBNC programme alone.

During the last decade, Ethiopia has witnessed rapid economic development, improvement in female literacy, reduction of total fertility rate, and significant improvement in women giving birth in health facilities.

Based on the review of health post records, Agazi and colleagues(x) have found significant increases in newborn sepsis cases managed by the HEWs. However, the overall utilization rate is still low compared to the estimated number of cases of newborn infections (16). The next phase of the program should continue to improve effective coverage of postnatal home visits, regular presence of HEWs at the health posts, supplies of drugs and commodities and supportive supervision.

The study of Community-Based Interventions for Newborns in Ethiopia (COMBINE) has documented that community based newborn care including sepsis management by the HEWs is both effective and cost effective. It can reduce post-day 1 newborn mortality rate by 17%, translating to a cost per DALY averted of \$223 or 47% of the GDP per capita, a highly cost-effective intervention by WHO thresholds (17).

Table 4: Additional neonatal lives saved by intervention by year

	2013	2014	2015	2016	2017	2018	2019	2020	Total (2013- 2020)	Per- cent of total live saved
Additional neonatal lives saved by intervention										
Ethiopia 2013-2020 rural realistic Pregnancy									147,856	
TT - Tetanus toxoid vaccination	0	189	385	588	598	607	615	622	3,604	2%
Syphilis detection and treatment Childbirth	0	157	321	490	498	505	512	518	3,001	2%
Clean birth practices	0	870	1,742	2,597	2,641	2,682	2,718	2,748	15,998	11%
Immediate assessment and stimulation	0	613	1,223	1,810	1,841	1,869	1,894	1,915	11,165	8%
Labor and delivery management	0	2,635	4,395	9,945	10,113	10,269	10,405	10,522	58,284	39%
Neonatal resuscitation	0	1,266	2,517	3,701	3,764	3,822	3,872	3,916	22,858	15%
Antibiotics for pPRoM	0	344	468	914	929	944	956	967	5,522	4%
Breastfeeding Age-appropriate breastfeeding prac- tices	0	134	266	390	397	403	408	413	2,411	2%
Preventive										
Clean postnatal practices	0	174	336	480	488	496	502	508	2,984	2%
ITN/IRS - Households protected from malaria	0	66	136	207	211	214	217	219	1,270	1%
Curative after birth										
Case management of premature babies	0	450	886	1,298	1,320	1,340	1,358	1,373	8,025	5%
Case management of neonatal sepsis/ pneumonia	0	719	1,410	2,058	2,092	2,125	2,153	2,177	12,734	9%
Ethiopia 2013-2020 rural best case Pregnancy									233,694	
TT - Tetanus toxoid vaccination	0	189	385	588	1,554	2,549	3,567	4,601	13,433	6%
Syphilis detection and treatment Childbirth	0	157	321	490	498	507	514	521	3,008	1%
Clean birth practices	0	870	1,742	2,597	3,101	3,546	3,924	4,231	20,011	9%
Immediate assessment and stimulation	0	613	1,223	1,810	2,221	2,624	3,014	3,389	14,894	6%
Labor and delivery management	0	2,635	4,395	9,945	11,831	13,650	15,384	17,019	74,859	32%
Neonatal resuscitation	0	1,266	2,517	3,701	4,790	5,849	6,868	7,840	32,831	14%
Antibiotics for pPRoM	0	344	468	914	1,092	1,270	1,449	1,625	7,162	3%
Breastfeeding Age-appropriate breastfeeding prac- tices	0	134	266	390	517	608	823	1,304	4,042	2%
Preventive										
Clean postnatal practices	0	174	336	480	1,299	2,018	2,628	3,112	10,047	4%
ITN/IRS - Households protected from malaria	0	66	136	207	362	522	685	851	2,829	1%
Curative after birth										
Case management of premature babies	0	450	886	1,298	1,673	2,034	2,378	2,703	11,422	5%
Case management of neonatal sepsis/ pneumonia	0	719	1,410	2,058	4,975	7,684	10,125	12,185	39,156	17%

The CBNC strategy of Ethiopia has adopted a comprehensive programme approach to scale up a package of maternal and newborn care related interventions. The projected 21.6% reduction of NMR in 2016 is not attributable to scaling up management of newborn sepsis alone.

Publications in this supplement and a survey on CBNC implementation strength show that CBNC program inputs such as training, start-up supplies, post training follow-up, and supervision are adequate, although utilization continues to be a challenge (Agazi et al). Improving demand, utilization, and quality of CBNC service is critical for reducing newborn mortality. A recent study in Ethiopia identified care-seeking barriers to CBNC services and suggested potential solutions for demand generation (18).

The best case scenario in which CBNC coverage is high in all rural regions of Ethiopia, is likely if resources are mobilized to scale up the full package of MNCH interventions, if the performance of HEWs continues to improve, if community mobilization through the Health Development Army (HDA) increases, and if innovative ways to increase utilization at the health posts are effective.

As Ethiopia is committed to ending preventable maternal, newborn and child deaths by 2030, governments and partners commitment to sustain and scale up the investment in HEP, iCCM and CBNC programs can significantly contribute to the overall goal.

Limitations: The main limitation of this study relates to the assumptions and data used in the modeling. The quality of the output is greatly affected by the input data. The coverage of sepsis management is made based on information collected from 1675 health posts supported by the JSI/L10 K projects. Since these health posts are not randomly selected, they may not represent the average performance of the estimated 14,000 health posts in the four agrarian regions in 2016. The estimates produced by LiST assume that interventions will be delivered and used at levels of quality sufficient to produce effects on mortality equivalent to those assumed in the model (4).

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