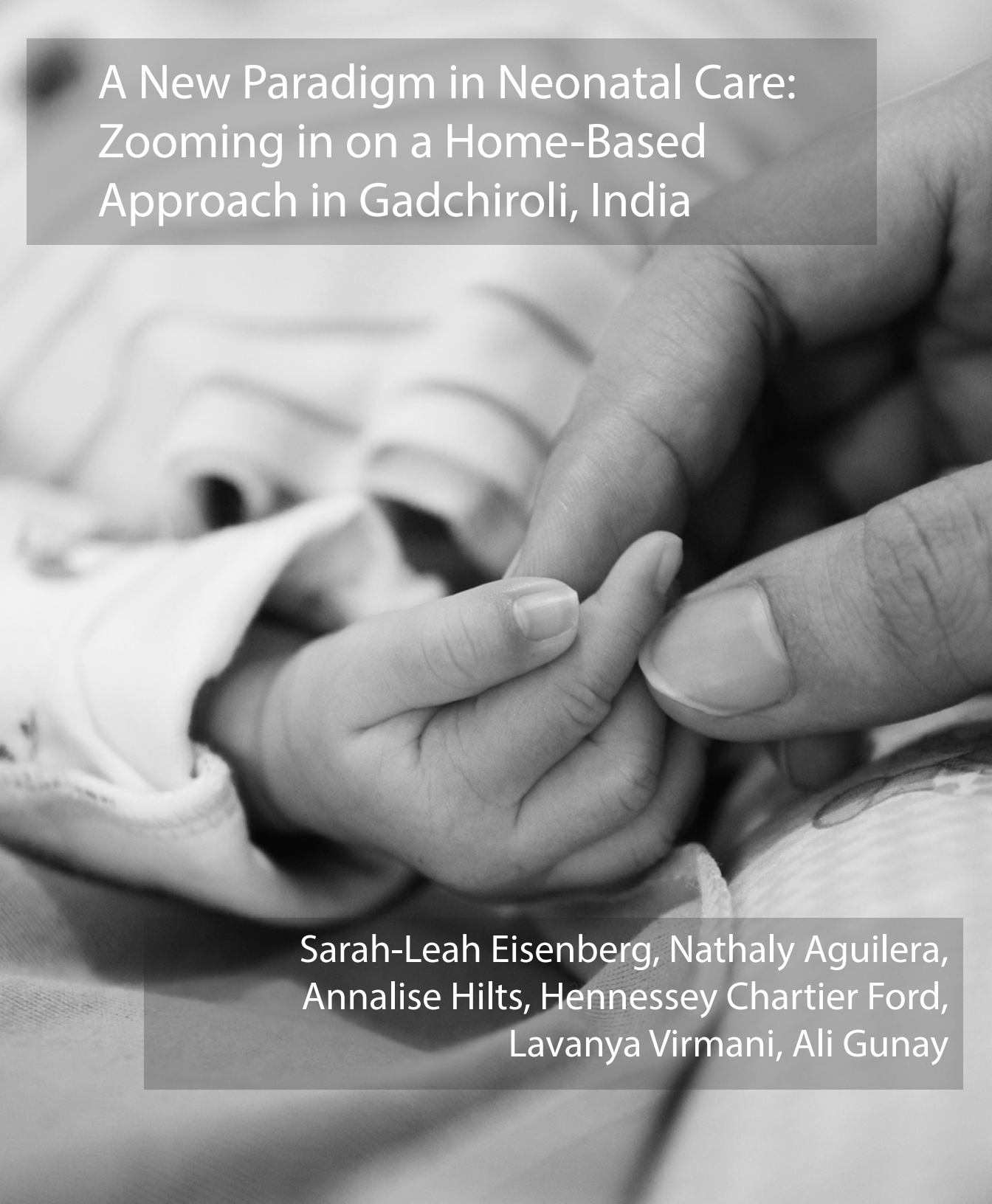




A New Paradigm in Neonatal Care: Zooming in on a Home-Based Approach in Gadchiroli, India

Sarah-Leah Eisenberg, Nathaly Aguilera,
Annalise Hilts, Hennessey Chartier Ford,
Lavanya Virmani, Ali Gunay

Abstract

Neonatal mortality accounts for the highest amount of under-five deaths worldwide, particularly in developing countries. The Society for Education, Action, and Research in Community Health (SEARCH) sought to address neonatal mortality in Gadchiroli, India. In 1993, SEARCH created the Home-Based Neonatal Care (HBNC) model in order to improve neonatal outcomes. The goal of the HBNC intervention was to deliver primary neonatal care to reduce the neonatal mortality rate (NMR) by at least 25%, and the sepsis-related NMR by at least 40% in 3 years. This case study provides a description of the HBNC, and analyzes the cost-effectiveness, outcomes, and future implications of the intervention. Compared to the 47 control villages, the HBNC improved NMR in the 39 trial villages during the study period, between 1993 and 2003. In response to the positive outcomes of the trial, a nationwide scale up was implemented in 2011, administered by the Indian government. The HBNC intervention was cost-effective and addressed the needs of the community in a culturally sensitive way. The HBNC has the potential to be reproduced in other regions with a high NMR. However, since each region is different, context-specific modifications should be taken into consideration.

Introduction

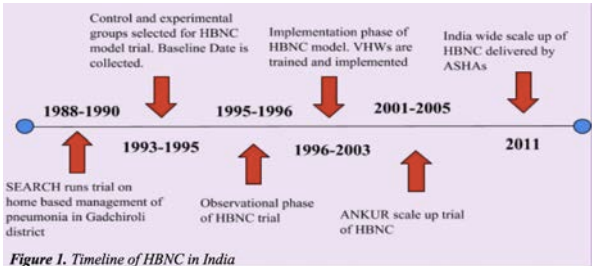
In 2017, neonatal mortality accounted for 47% of the 5.4 million under-five deaths worldwide. Currently, neonatal mortality is 14 times higher in developing countries, totalling at 69 deaths per 1000 live births, in comparison to 5 deaths

per 1000 live births in developed countries (1). Although neonatal mortality rate (NMR) has considerably decreased in India to an estimated 24 deaths per 1000 live births, the NMR was dramatically higher in the 1990s, at 59 deaths per 1000 live births (2). The Society for Education, Action, and Research in Community Health (SEARCH), a non-governmental organization working in the Gadchiroli district of India, sought to address child health and NMR in one of India's poorest areas, creating what came to be known as the Gadchiroli Field Trial in the late 1980s.

SEARCH, established in 1986, prioritizes community-identified needs and operationalizes interventions that empower the existing local workforce to achieve sustainable health outcomes (3, 4). The Gadchiroli district is the least economically and educationally developed area in the Maharashtra state of Western India, and SEARCH launched a field trial from 1988-1990 in this region to improve management of pneumonia and sepsis in neonates. At the time, the few hospitals that were established were far away from the villages where SEARCH implemented their intervention and were unable to address the needs of the community (5). SEARCH recognized this gap in the provision of local care, introducing a community-based intervention for pneumonia management in children. This new intervention included mass education about childhood pneumonia and case-management using the oral antibiotic co-trimoxazole, which was administered by the trained village health workers (VHWs) and traditional birth attendants (TBAs). The intervention signifi-

cantly reduced pneumonia-specific childhood mortality in the intervention villages compared to control. However, mortality from other causes remained similar and the SEARCH team recognized the need to broaden their strategy to include other factors associated with neonatal mortality (6). As a result, the Home-Based Neonatal Care (HBNC) model was developed. The HBNC trial had great success in Gadchiroli and was later scaled up by the Indian government to cover more rural areas. In this article, we will provide an in-depth description of the Gadchiroli HBNC model and compare its clear success to potential future outcomes of the HBNC scale-up in India.

Figure 1. Timeline of HBNC in India



The Gadchiroli HBNC Model

Goal of the HBNC trial

In the 1990s, hospitals were not readily accessible to families living in the Gadchiroli district, so most women opted to give birth at home. Rather than pushing women towards institutional delivery and transporting sick neonates to hospitals, the SEARCH team decided it would be more beneficial to establish a low-cost, HBNC system that utilized the human potential in the villages. The main goal of this intervention was to reach 75% of the neonates

in the community and 60% of the neonates with sepsis because neonatal sepsis accounts for much of the neonatal mortality in developing countries. Additionally, the researchers aimed to deliver primary neonatal care in order to better manage illness and reduce the NMR by at least 25% and the sepsis-related NMR by at least 40% in 3 years (7).

Description of the HBNC trial

	Period	Description
Baseline phase	1993-1995	- Collection of information on neonatal health and traditional practices: demographic characteristics, availability of healthcare, and vital rates (NMR, perinatal mortality rate (PMR) and infant mortality rate (IMR) - Control and intervention villages had similar characteristics
Observation phase	1995-1996	- Assessment of neonatal morbidities and causes of death - Employed simplified diagnostic criteria (ICD-9 codes) to identify neonatal disorders - Helped guide design of the HBNC intervention
Intervention phase	1995-2003	- Selection and training of VHWs and simple home visits/observations

Table 1. Description of Gadchiroli trial phases.

The Gadchiroli HBNC model was implemented in 39 villages in the Gadchiroli district and was compared to 47 adjacent control villages. The Gadchiroli district was selected as SEARCH was based and working in this district. Intervention and control villages were chosen based on where SEARCH was already well-established and respected for their previous work on improving reproductive health and neonatal pneumonia between 1986-1993 (7). All infants born in the intervention villages were eligible to participate in the trial (7). By the end of the trial, the HBNC intervention had covered 93% of newborns in the intervention area, with VHWs present for 84% of home deliveries (8). The development and implementation of the

HBNC consisted of three main phases: the baseline phase, the observational phase, and the intervention phase (7) (Table 1). All VHWs were trained to manage birth asphyxia, sepsis, breastfeeding problems, premature or low-birth-weight, and hypothermia. VHWs were paid an honorarium depending on their work and performance level (8). Other components of the intervention package included: attending deliveries along with the TBA, administration of vitamin K, early diagnosis and treatment of sepsis, health education of mothers and grandmothers, keeping track of pregnant women in the villages, monitoring of vital rates, repeated home visits after birth to monitor the newborn for infections, teaching mothers to properly breastfeed, thermal care, and weekly weighing. Throughout the intervention, the morbidity and mortality rates were carefully monitored.

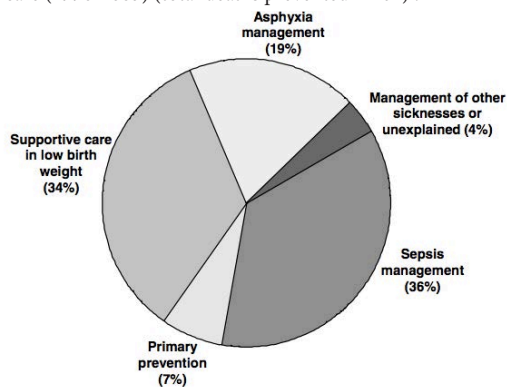
Main Outcomes of the HBNC trial

In order to evaluate the effectiveness of both the Gadchiroli HBNC program, the HBNC team focused on two main metrics: NMR and incidence of neonatal morbidities. According to the World Health Organization (WHO), neonatal mortality can be defined as the number of deaths that occur within the first 28 days of life per 1000 live births for a given population or geographical area during a given year (1). Incidence of neonatal morbidities was defined as the mean number of morbidities per 100 neonates accordingly to the definition provided by Bang and his co-authors (7).

The researchers of the Gadchiroli trial compared NMR in the control and intervention

areas from 1993-2003. By 2003, NMR in the intervention area had decreased from 62 to 25 neonatal deaths per 1000 live-births. This 70% decrease in relation to the control area was associated with sepsis and low birth weight management, as well as improved care for other neonatal morbidities such as those presented in Fig. 2 (7). Furthermore, the mean number of neonatal morbidities (per 100 neonates) decreased by 50% in the intervention area from 1995-1998. This was due to decreases in infections, in incidence of low birth weight and other neonatal morbidities as described in Fig. 3 (7). An important factor responsible for this reduced mortality was that the mothers began acquiring the knowledge and behaviours to help them manage newborn illnesses through the intervention. The researchers also discussed a dose-response relationship between increasing quality of the intervention and decreases in neonatal morbidity. The Gadchiroli field trial also had other positive effects, such as decreasing IMR and PMR by 57% and 56%, respectively.

Figure 2. Image from Bang et al., 2005: "Proportion of neonatal deaths prevented by different components of home-based neonatal care (1996-2003) (total deaths prevented = 161)".



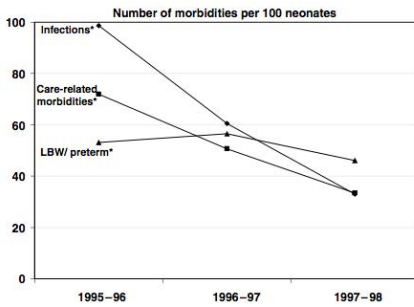


Figure 3. Image from Bang et al., 2005: “Home-based neonatal care in action”.

What determined the success of the HBNC trial?

Background research and contextual sensitivity

The success of the HBNC trial can partially be attributed to its in-depth consideration of local context. The researchers understood the traditional beliefs and practices surrounding newborn care in the area through focus group discussions with mothers and grandmothers. This tactic ensured contextual feasibility and a long-term, sustainable approach, identifying appropriate education programs and consideration of taboos and harmful practices that needed to be averted (8). The initial field trial for community-based pneumonia management had also identified an intervention strategy that was successful in reducing NMR and IMR in the villages, which served to inform the design of the HBNC package. In the initial trial, awareness of pneumonia management was achieved through mass health education in rural villages, and local terminology was adopted to ensure precise communication (8). Special training utilizing visual diagnostics was implemented to ensure that illiterate TBAs were successful in the identification of conditions and delivery of

medication (6). These strategies for catering to the community demographic were carried onto the HBNC intervention. As such, ongoing consultation and education to sensitize community members to the intervention ensured its continual success (8).

Mobilizing and empowering women in the villages

The Gadchiroli model placed the women, mothers, and grandmothers of the villages as active leaders in the implementation of the HBNC program. The program ensured the harmonious integration of the VHWs within the existing TBA network. The VHW’s remuneration was kept marginally higher per hour than the wages she could earn as an agricultural worker; incentivizing women in the villages to apply for VHW positions (8). Performance-linked remuneration was also provided, with one third of the VHW wage fixed and the other two-thirds depended on workload and performance (8). In addition to monetary incentives, the acquisition of skills and a prestigious role in the community was further motivation for the VHWs (8).

Selection and training of the VHWs

The thorough selection and training process of the VHWs resulted in the provision of high-quality care. Only women were chosen for the position, allowing for open communication between the VHWs and mothers. The selection process of VHWs involved the setting of an eligibility criteria and wide advertisement of the position within Gadchiroli to obtain high numbers of applicants (8). Women meeting the eligibility criteria attended a three-day workshop

that included personality and in-field testing to ensure a good fit for the VHW role, increasing the likelihood of success of the HBNC program (8). The training program followed a curriculum of 26 days of in-class training over a period of 10 months (8). Only small amounts of information were taught at a time and trainees were given time to practice acquired skills on the field. A field supervisor visited each VHW twice each month to provide additional training and to improve their motivation and performance. Only a 15% drop-out rate was observed (8).

Ensuring high coverage and cost-effectiveness

The VHW method allowed for the HBNC intervention to save one DALY (Disability Adjusted Life Year) for only \$7, whereas other interventions (i.e. growth monitoring, provision supplementary food) are reported to cost up to \$8235 per DALY saved (7). Moreover, the HBNC provided health services at the community level, where a void of care existed. The integration of two services (pneumonia case management and HBNC) into one resulted in a successful intervention that was sufficiently comprehensive and cost-effective.

Scaling-up of the HBNC trial

Since the 1990s, the NMR in all of India has declined from 52 per 1000 live births to 28 per 1000 live births (2013), with an acceleration in this decline in the past decade (17% decrease 1990-2000, 33% decrease 2000-2013) (9). It is projected that neonatal death rates will decrease to 22 per 1000 by 2020, extrapolating from the trends of average annual rates of reduction between 2000-2012 (9). The success of the Gad-

chiroli HBNC model motivated the intervention to be scaled up to a HBNC model delivered by Accredited Social Health Activists (ASHAs) in 2011. The program was provided through the Indian government country-wide, with the goal to “improve community newborn care practices, early detection of neonatal illnesses and appropriate referral through home visits” (10).

Potential outcomes of scaling-up

As no official metrics exist to evaluate the efficacy of the scale up, the following results are based off a cost-effectiveness study conducted by Ashok et al., which compared the two following scenarios regarding coverage of the intervention (11):

1. Developing an HBNC package using the existing ASHA network that covers 54% of the rural neonate population.
2. Developing an HBNC package that would be delivered via an extended ASHA network, which would offer coverage to 83.4% of the rural newborn population.

The authors used both scenarios as well as other estimations in order to derive possible cost-effectiveness of each intervention (Table 2). The authors assumed a cohort of 10.48 million rural newborns born in 2013 who would not have had access to any other form of care otherwise. They used a baseline incidence of morbidity of 28.3% and baseline NMR of 29.2 deaths per 1000 live births to model outcomes for each scenario. The results of their modelling are presented in Figure 4.

	Intervention 1		Intervention 2	
	54% coverage	95% uncertainty range	83% coverage	95% uncertainty range
Incidence averted	804 718	476 612 – 1 217 799	1 246 812	751 155 – 1 950 785
Deaths averted	89 022	44 199 – 149 050	138 162	76 358 – 244 072

Table 2. Adapted from Ashok et al., 2016: “Estimates of the Impact of Home-Based Neonatal Care through Community Health Workers”.

Comparison of outcomes for Gadchiroli field trial and Scale-up of HBNC

	Baseline Gadchiroli	Gadchiroli HBNC (% reduction)	Baseline rural India	Basic ASHA network (% reduction)	Extended ASHA network (% reduction)
Neonatal morbidity	370	50%	2 965 840	27%	42%
Neonatal mortality	48	70%	3 060 160	2.9%	4.5%

Table 3. Comparison of outcomes of the Gadchiroli field trial and potential outcomes for a scaling-up of the HBNC intervention in all of rural India.

Since both studies used different measures to present their results and these were not comparable, the estimates for NMD and neonatal morbidity described in the cost-effectiveness study were used in order to derive percent reduction in NMR and neonatal morbidity (11) (Table 3). Even when considering an extended ASHA network which would provide higher coverage of an HBNC intervention in rural India, the initial Gadchiroli field trial appears to be considerably more effective.

Why is the scaling-up of the intervention not as successful as the Gadchiroli model of HBNC?

One of the main reasons why the scaling-up of

the HBNC was not as successful is that the program had slow uptake. In the financial year of 2013-2014, only 4 million out of 17 million rural neonates had been visited by ASHA workers, and only 120 thousand neonates out of that 4 million had been identified as sick and referred to healthcare facilities (10). The slow uptake of the program motivated the Norwegian-India Partnership Initiative to adapt the model in regions with high levels of NMR, including Madhya Pradesh, Rajasthan, Bihar and Odisha (10). Another cadre of worker, the Yashoda, was introduced to provide care and counselling services to mothers and newborns. A supportive supervision mechanism was also introduced to support ASHAs (10). The combined effect of both ASHA and Yashoda exposure, when trained by the Norwegian-India Partnership, increased the newborn care indicators related to counselling and practice by almost threefold (10). Furthermore, there have been several issues concerning the use of ASHAs in the HBNC scale up. ASHAs receive different training than that given to VHWs in the initial 1993-2003 HBNC trial. While VHWs were selected by community members, ASHAs were involved in the healthcare system prior to the introduction of the HBNC scale up (10). As such, neonatal care duties were simply an addition to their responsibilities. While ASHAs receive four rounds of a seven-module training over the course of a year, only 17% of ASHAs have completed all four rounds, and only 2 modules involve training in neonatal care (10). This lack of training is potentially responsible for ASHAs’ low level of effectiveness at delivering newborn care services. Moreover, there are reports of

ASHAs expressing lack of clarity concerning their job responsibilities, and of large discrepancies across states in the quality of the drug kits dispersed to ASHAs (10). The reports have stated that ASHAs have not received refills in a timely manner, and at times, not at all (10). Overall, it is difficult to replicate the same attention to community detail and uniform standard of care across such a wide scale up.

Cost and Financing

Financing for the initial 1993-2013 trial was provided by the Ford Foundation and the John D and Catherine T, MacArthur Foundation USA (12). As this study began over 2 decades ago, exact amounts of grants and funding were not publicly available. However, based on the figures provided by Bang et al (12), we estimate the initial cost of implementation for the 39-village trial to be \$6045, plus an addition annual recurring cost of \$5070 (\$130 per village). Over the 10-year period of the Gadchiroli trial, this would amount to \$56745 (in 2003 USD). In comparison to other interventions, the Gadchiroli trial is considered “very cost-effective” by the WHO Cost Effectiveness Matrix (12). In comparison, the cost of a hospital stay in India can range from \$17.3 to \$44.2 per day, resulting in significant out-of-pocket expenditures (11). Since its implementation in 2011, HBNC within the ASHA network is funded through the Government of India’s Integrated Management of Child Illness program. Although precise data are not available for the exact costs and metrics associated with this scale-up, Ashok et al. provide an extended cost-effectiveness analysis of the ASHA HBNC system (11, 13). Within its

current scope, the ASHA network serves 60% of the population not currently receiving care (72% of India’s rural neonate population), at an estimated annual cost of \$33 million and a marginal cost of \$5.89 per neonate (11, 13). A further scale up to 83.4% of the population not receiving care (90% of the rural population) would raise this annual cost to \$53 million annually or \$6.54 per neonate (11, 13). In comparison, the Indian government puts \$386.1 million annually into all of its child health programs. The cost of death in the first scenario is \$382, decreasing to \$379 in the potential scale-up (13). Another significant economic benefit to this intervention is the decrease in out-of-pocket (OOP) costs, which present a significant challenge to rural families in India.

Future Implications

As development increases, there is a rising trend towards institutional deliveries. In India, the proportion of institutionalized deliveries increased from 46.9% in 2007 to 78.9% in 2015 (14). Specifically, in rural areas, institutionalized deliveries have increased by 2.5-fold in the past ten years (14). This presents important implications for scaling-up of the HBNC program. Since institutionalized deliveries have increased, there is arguably less interest in creating a program that focuses on home births, hinting that the need for a national HBNC program will naturally decrease over time. However, some communities in India, particularly those in tribal areas, may still have a cultural preference for home deliveries. Thus, ensuring that a program such as the HBNC is set up is important in order to address the needs of these

populations.

The HBNC model operationalizes a community-based approach that can be effectively applied to other low-income rural settings with poor neonatal outcomes. However, much of the model's success can be attributed to its strong community support and culturally relevant care. Therefore, in future applications, context specific modifications should be taken. A HBNC model based off SEARCH's initial Gadchiroli trial has already been undertaken in Ghana, in the form of the Newhints intervention (15). Overall, the Newhints intervention showed similar results to the Gadchiroli trial, resulting in a 12% decrease in NMR (16). These results are promising for the success and feasibility of future interventions in other African countries.

In terms of future directions and challenges of the HBNC trial, it should be noted that every country, village, and region is different in terms of their cultural practices and historical background. Appropriate levels of care and respect should be taken when beginning to conduct the HBNC intervention in a new area. The method by which researchers conduct the study should be carefully analyzed prior to the start of the intervention and the financial requirements of an HBNC program should be evaluated. In the Gadchiroli HBNC trial, the intervention and control villages were specifically chosen. Perhaps when conducting the same intervention in another area, it would be best to conduct a cluster randomized sampling of the intervention and control villages. Even so, the HBNC in-

tervention has immense potential and has been proven to be cost-effective.

The Gadchiroli trial demonstrates that addressing community needs in a context-sensitive way and involving the target stakeholders results in effective intervention outcomes. This is a lesson for all areas in global health. While increased urbanization may lead to a decreased need for home-based care, community-based interventions go a long way towards achieving "health for all".

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