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Exploration and Innovation in Addressing Maternal, Infant and Neonatal Mortality

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ABSTRACT

The Government of Nepal has been remarkably progressive in introducing innovative community-based maternal newborn and child health interventions in an effort to address the major causes of maternal and child mortality in the country. This article describes the introduction of innovative interventions, including a review of the landmark research that precipitated the discussion and provided evidence of practical feasibility, the acceptance of the intervention concept and validity, the approval process and the introduction and results from the pilot interventions. These interventions, which include the use of misoprostol to prevent post partum haemorrhage during homebirths, Morang Innovative Neonatal Intervention, gentamicin in Uniject and for the management of neonatal sepsis and newborn vitamin A supplementation, are in various stages and demonstrate the responsiveness of the Government to new approaches that address the major causes of maternal and child mortality.

Keywords: chlorhexidine; gentamicin in uniject; innovations; misoprostol; Morang Innovative Neonatal Intervention; Nepal; newborn vitamin A supplementation.

INTRODUCTION

Nepal has tremendously decreased maternal, child and neonatal mortality rates over the past two decades[1,2] despite a 10 year-long civil war from 1996 to 2006. This achievement is attributed to an encouraging, progressive policy environment underscored by the Government of Nepal's (GON) conscious and perceptive use of the existing public health system to implement community-based approaches and programmes.[3,4]

This article, third in the six article series, describes how these interventions were introduced, and the results that have influenced related policy development. This article will show that the GON has been remarkably receptive to piloting and implementing innovative community-based interventions and small-scale studies to address the major causes of maternal, child and neonatal mortality. The rapid application of positive research findings sets them apart and ahead of many conservative national health systems in other countries. These pilots include interventions addressing maternal and child mortality, including the use of misoprostol for the prevention of post-partum hemorrhage in case of homebirths in an effort to reduce maternal mortality. The Morang Innovative Neonatal Intervention (MINI) that looked at the management of newborn sepsis and a feasibility study on the use of gentamicin in Uniject by Female Community Health Volunteers (FCHVs), also for the management of possible newborn sepsis and the use of 4% chlorhexidine (CHX) lotion on umbilical cord stumps to prevent umbilical cord infections; and newborn vitamin A supplementation.[3-6] These interventions allowed the GON to test their feasibility, acceptability and potential for replication within the broader, existing government health system.

LITERATURE REVIEW

Secondary desk review was conducted for this article. Authors looked at published documents, reports, journal articles, as well as relevant websites.

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Misoprostol for Prevention of Post-partum Hemorrhage

PPH is one of the leading causes of maternal deaths globally.[7] Despite the decline in maternal mortality in Nepal, it remains high at 281 deaths per 100,000 live births.[8] One of the leading cause is PPH, which accounts for 18% of the total.[9]

The recommended strategy for addressing PPH is the Active Management of Third Stage of Labour (AMTSL).[10-12] Given that this approach requires the supervision of SBAs and overcoming other systemic barriers such as geographic and resource constraints, it can only be achieved in the long-term. Because AMTSL is a challenge in most low-resource countries, a number of research studies have attempted to find alternatives to AMTSL, one of which is the self-administration of oral misoprostol immediately after births, which has been found to significantly reduce PPH.[10,11] One such study[10] showed the efficacy of misoprostol when oxytocin, the preferred uterotonic, is unavailable in low-resource settings, like Nepal. Therefore, although oxytocin is the preferred uterotonic, until such time as its availability and correct use can be assured for all women at the time of their delivery, misoprostol is an acceptable alternative. Misoprostol is easy to transport, not temperature sensitive, easy to use and few side effects, making it a highly effective and with cost-effective "stop-gap" strategy in countries like Nepal.[3,7,11,12]

Based on global evidence and study recommendations and considering the limitations of AMTSL during delivery, the Family Health Division (FHD) committed to pilot an intervention in Banke in 2004 to test the feasibility, acceptability and safety of community based distribution of misoprostol through FCHVs for prevention of PPH during homebirths within the existing public health system. The intervention was defined as feasible, acceptable and safe if FCHVs have correct knowledge and skills about misoprostol distribution such as timing of use and possible side effects; if they were able to distribute to pregnant mothers at the appropriate time; if the pregnant women used it at the appropriate time in case of home births and in recommended doses.

Implementation design and results

Follow-up survey results from the pilot affirmed the feasibility and acceptability of distributing misoprostol by FCHVs. This is reflected in the high coverage achieved: 73% of women reported receiving misoprostol at endline.(Figure 1).[3]

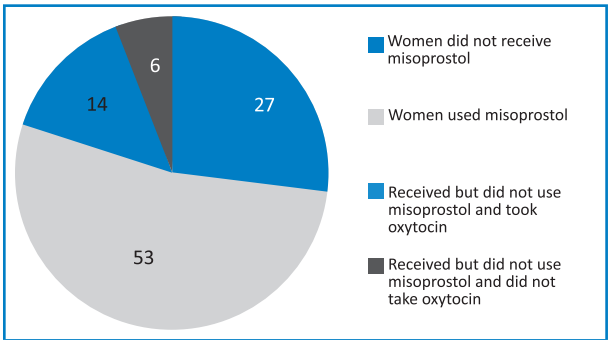

Figure 1. Use of Misoprostol by surveyed women[3]

Seventy-five percent of those who did not use the misoprostol they received, stated that they delivered at a health facility, were delivered by a health worker or received an injection after delivery by a health worker, thus were likely to have received oxytocin. Non-users who did not receive any uterotonic, stated several reasons for this: 9% forgot to take it, 6% mistakenly believed that because they delivered quickly, it was too late to receive misoprostol and 5% cited fear of side effects.[3]

Survey results demonstrate that all of them used misoprostol within the correct time frame and more than 80% of them took it before placenta delivery.[3]

Misoprostol-use is associated with prostaglandin-related side effects, notably shivering.[3] There was no significant difference on most of these symptoms reported after giving birth between those who had or had not used misoprostol, with the exception of shivering which was more commonly reported among those taking misoprostol (Figure 2).[3] Dizziness was more commonly reported among non-misoprostol users. These findings are not surprising: shivering is a common misoprostol side-effect and light-headedness is a symptom that can be associated with continued active bleeding, which is expected to be more common among those not using misoprostol.[3] Despite the presence of minor side effects the drug was well accepted and used by recently delivered women.

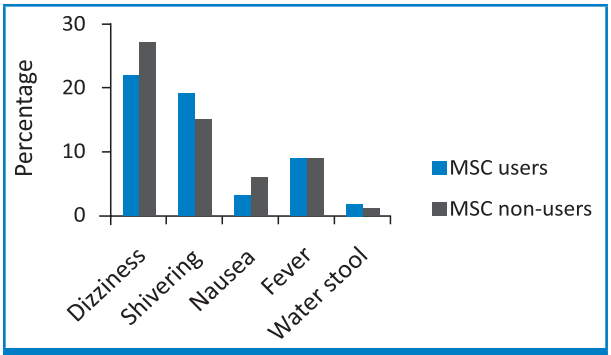

Figure 2. Side effects experienced by surveyed women[3]

The misoprostol intervention implemented with other community-based interventions helped to improve some of the maternal health indicators like utilisation of ANC,use of iron/folate, postnatal care etc over time (Table 1).[3,8]

Table 1. Impact of misoprostol on maternal health indicators[3]

	Baseline	Follow-Up
ANC 1st visit	77%	91%
ANC 4th visit	33%	57%
Use of iron tablets during pregnancy	73%	94%
Received deworming tablets during pregnancy	29%	81%
Use of TT vaccination during pregnancy	76%	94%
Women checked by trained health workers within 6 weeks of birth	24%	24%

The promising results from the pilot in Banke allowed the GON to approve expansion of misoprostol in remote districts and to increase uterotonic coverage in the context of limited facility deliveries or skilled attendance at birth - although the use of AMTSL and delivery at health facilities remains the GON's priority. In 2009, the intervention was expanded and misoprostol was included in the National Essential Drug List for the prevention of PPH. In addition, considering the challenges in accessing delivery services in very isolated villages and districts, a remote-area guideline was developed in January 2010 to expand misoprostol further. In July 2010, the GON approved national level expansion of misoprostol, with support from various implementing agencies.

Morang Innovative Neonatal Intervention (MINI) Programme

The proportion of all infant deaths represented by neonates has been increasing over the years.Overall, neonatal mortality accounts for nearly three-fourths of infant mortality in Nepal.[2] Neonatal sepsis, causing a third of these deaths, is therefore, a significant public health concern[8] and while the GON is taking important steps to increase facility and SBA-attended deliveries, progress is slow and other mechanisms are needed to address the high neonatal mortality rate (NMR). In the absence of proper clinical care, the probability of neonatal death increases.[1]

The Community Based Integrated Management of Childhood Illness (CB-IMCI) mobilized FCHVs to assess and manage infections in older children (2 months to 5 years of age) by providing oral cotrimoxazole-P for pneumonia and oral rehydration solution and -zinc for diarrhoea. They were not, however, equipped and trained to assess and manage sick neonates[14] indicating the need to develop and design a program for neonatal sepsis at the community level. The publication of two key studies, designed to assess mortality impact through community-based management of neonatal sepsis in India and Bangladesh, provided evidence that peripheral health workers can effectively identify and manage neonatal sepsis, resulting in a reduction in NMR.[15,16] Given the high NMR and encouraging results from these two studies, reduction of neonatal mortality was designated as a high priority by the MoHP. This laid the necessary groundwork for development of a pilot programme to determine whether FCHVs and the most peripheral facility-based health workers could assess, identify and correctly initiate the management of sepsis in neonates.

The endorsement of the Neonatal Health Strategy by the GON underscored that community health workers (CHWs) "should be included in pilot projects to identify neonatal infections at home and if successful could be trained to provide this service. This will include home based treatment with antibiotics such as cotrimoxazole/ referral by FCHVs, use of intramuscular injection gentamicin or other appropriate oral antibiotics by VHWs and MCHWs. Other arrangements for treatment may be considered as well".[6] This supportive policy environment was conducive to pilot a programme targeting management of sepsis to reduce neonatal mortality in Nepal.

Implementation Design and Result

MINI was first implemented in 21 village development committees (VDCs) of Morang district between 2005 and 2007 then scaled-up to all 65 VDCs. The programme was built on the CB-IMCI programme, but was initiated to determine whether FCHVs and peripheral health workers could correctly assess and manage infections in young infants under 2-months of age. MINI tested FCHVs' ability to use algorithms to detect PSBI and if present, administer an oral dose of cotrimoxazole-P antibiotic, followed by referral to a CHW (MCHW/VHW) or HF to receive intramuscular gentamicin injections daily for seven days. In addition, FCHVs made antenatal and postnatal visits to the home for essential newborn care (ENC) counseling, advice about danger signs, birth recording, to assess the weight of the newborn, and to provide other counseling.

Khanal et al show there were 11,547 births recorded from May 2005 to April 2007.[4] The birth capture rate, estimated as the proportion of expected births from census figures recorded by FCHVs was 74% and two months follow-up was 97%. It was found that sepsis occurred in 13% of young infants (0-2 months) and 9% of

neonates (0-28 days). Using this prevalence figure, only 3% of expected sepsis cases were treated at GON health facilities before MINI was implemented, while 75% were treated in intervention VDCs. Treatment compliance was excellent, with 93% completing seven days of gentamicin injections. In addition to the high compliance rate, there was a decrease in the time from onset of illness to treatment as the programme matured.[4]

Local bacterial infection, including umbilical cord infection, eye infection and skin pustules, was found in 21% of the neonates while 52.5% of newborns seen were weighed within three days of birth and among these, 14% had low birth weight. Three ENC practices in the intervention VDCs showed significant improvement over two years. Delayed bathing for at least 24 hours after delivery improved from 24% in the first year to 37% in the second year, as did breast feeding within 1 hour, from 56% to 66%. Application of nothing to the umbilical stump also improved from 84% to 94%. Families were also accepting of FCHVs in their new role for neonates, and evaluated them as being able to correctly assess and initiate treatment of sick newborns.[4]

Due to the high rate of community acceptance and the fact that FCHVs could successfully classify sick newborns, initiate treatment and facilitate referrals, along with notable improvements in ENC practices, the GON requested the expansion of MINI to all 65 VDCs in Morang as MINI II.

Although the programme phased out in December 2009, lessons learned were incorporated into the Community-Based Newborn Care Package (CB-NCP) programme.

Gentamicin in Uniject: Design Stage Trial

MINI II results showed lower gentamicin treatment rates in remote and hill VDCs, likely due to the distance between the home of sick newborns and health workers. A separate study, designed within MINI II, was implemented to test the feasibility and acceptability of FCHV use of gentamicin in uniject, a device developed by PATH and USAID to facilitate easy and safe administration of medication, especially for those with minimal clinical training.

Implementation Design and Results

The gentamicin in uniject design stage trial examined whether FCHVs could administer gentamicin using the uniject device at the home and community level. This reduced the risk that mothers might not seeking treatment when facing geographic difficulties in accessing facilities. To ensure that FCHVs could correctly administer the treatment, they were trained on the importance of determining the weight of the neonate in order to select the appropriate dose of gentamicin.

The trial showed that FCHVs correctly identified 82 sepsis cases and treated 67 of them with cotrimoxazole P and gentamicin in uniject without any serious side effects or deaths. The treatment completion with gentamicin in uniject was 100% and there was no local reaction at injection site. In all 67 cases, the FCHVs followed the correct disposal of the used devices. The focus group discussion with FCHVs and key informant interviews with community leaders at the end of the study showed that the treatment of neonatal sepsis by FCHV was well accepted by both.[17]

Chlorhexidine

The application of traditionally used, but often unhygienic and ineffective substances on freshly cut umbilical cords, such as mustard-seed oil, cow dung, vermillion and ash, increases newborn susceptibility to infections.[18] Although the WHO recommends dry and clean umbilical cord care, a review by Centro per la Valutazione della Efficacia Dell' Assistenza Sanitaria (CeVEAS) and WHO concluded that "4% chlorhexidine (CHX) solution can be indicated for cord care in developing countries, i.e. settings with rudimentary peripheral facilities and [where] unassisted home deliveries are prevalent".[19] CHX is a broad spectrum topical antiseptic, effective against gram positive and gram negative bacteria and some viruses and has been used globally for hand washing, wound cleansing and pre-operative skin antisepsis.[20]

To examine the impact of CHX cleansing of cord stumps on neonatal mortality and omphalitis (cord infection), three large community-based randomized controlled trials (RCT) were completed in rural areas of Nepal,[20] Bangladesh,[16] and Pakistan.[21] These studies indicate that among the babies that had 4% CHX applied on and around the cord stump, the risk of death before 28 days was reduced from between 24-38%.[16,20,21]

Results from these RCTs and two studies in Nepal[22] resulted in a decision by the GON to pilot a CHX intervention in 2009 in four districts, to study coverage and compliance.

Implementation Design and its result

The CHX pilot programme involved orientating and training all health workers from the hospital to peripheral level health facilities. This included an introduction of CHX, the distribution mechanism, proper application method, counseling associated with dispensing and how to carry out proper programme documentation and reporting and the proper way to use it. In addition, all FCHVs received hands on training using dolls and

were given the responsibility of distributing CHX during any contact with pregnant women from 32 weeks of gestation, along with suitable counseling using the CHX information sheet. At the household level, mothers and caregivers received orientation and counseling about CHX and its proper application. They were informed about hand washing and using CHX immediately after cord cutting, followed by keeping the cord stump clean and dry and not applying anything else to it.

Results from the pilot study showed a significant proportion of recently delivered women (RDW) used CHX on their newborns umbilical cord stump (Figure 3).

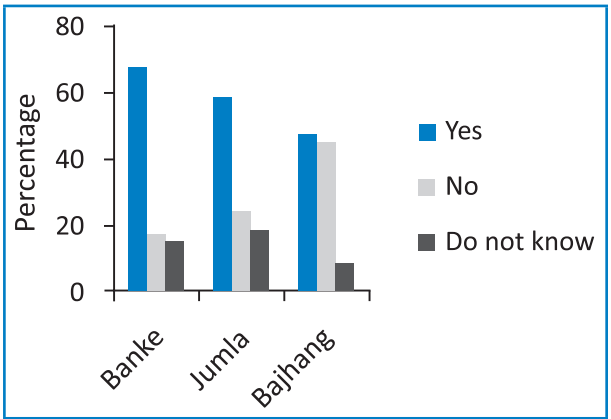

Figure 3. Use of CHX on Newborns[23]

Of the RDW who reported application of CHX on their newborn, almost 90% in all three districts reported its application within two hours of cord cutting.[23]

Approximately 70% of RDW in Banke (68%) and Bajhang (70%) who had applied CHX on their newborn complied with the CHX application requirements.[23] This rate was higher in Jumla, where 77% met the prescribed application. In Banke, a higher proportion of RDW who had delivered at home and who had delivered at a health facility in Jumla met compliance requirements, while in Bajhang there was no difference.[23]

In December 2011, the MoHP approved of national-level scale-up of CHX, integrated with CB-NCP and use of misoprostol, throughout the country.[24]

Newborn Vitamin A Supplementation Pilot

The MOHP established the National Vitamin A Programme (NVAP) in 1993, which focused on distributing high-dose vitamin A capsules to all children 6-59 months of age based on the community trial in Nepal.[25] The research findings did not show significant mortality reduction in infants under six months of age.[25] However, more recent South Asian research has shown that there is benefit from very early dosing of newborns, i.e. within the first 48 hours after birth. Two hospital-based trials[26,27] demonstrated that early vitamin A supplementation reduced mortality in infants. A third study, a randomised, placebo controlled trial in Tamil Nadu, India[28] that used a community-based approach, provided the MOHP with evidence of a successful methodology that could also be replicated with relative ease in Nepal. The trial assessed the impact of supplementing newborns with vitamin A on early infant mortality. Results indicated that infants who received 50,000 IU of vitamin A showed a 22-23% reduction in total mortality.[28] Based on these studies, the MOHP began planning for a newborn vitamin A supplementation (NVAS) pilot to explore the best possible model to reach maximum number of newborns immediately after birth which will help reduce infant mortality.

IMPLEMENTATION DESIGN AND ITS RESULT

The NVAS pilot was implemented in four districts between December 2009 to June 2011 by the Child Health Division (CHD) with assistance from external development partners. The overall objective of the intervention was to identify the most effective and safe delivery method for dosing newborns with a single dose of 50,000 IU vitamin A within 48 hours of birth and to ensure maximum coverage. Two models were tested: 1) the FCHV-dosing model and 2) the mother-dosing model.

Results demonstrated that coverage ranged between 52% and 74%.[29,30]

When the newborns dosed with vitamin A were further segregated by person who dosed, it was found that in mother-dosing model districts, it was primarily the mother or family members who did the dosing (Figure 4).Likewise, in the FCHV-dosing model districts, the majority of newborns were dosed by FCHVs (Figure 5).

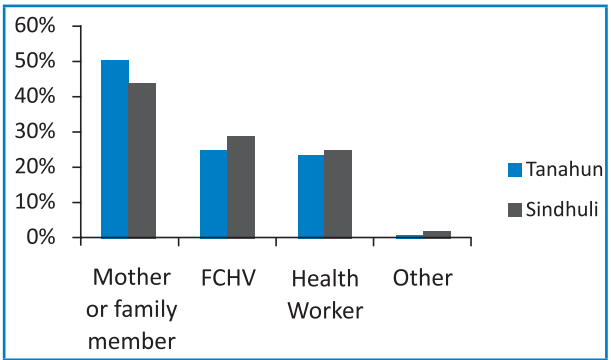

Figure 4. Mother-dosing Model[31]

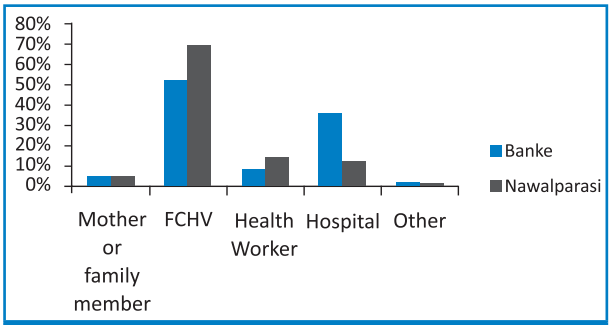

Figure 5. FCHV-dosing Model[31]

The pilot results demonstrated that reasonable coverage could be obtained through both models, and that a combination was likely to achieve adequate coverage to have a mortality impact. However, while the pilot was underway, WHO completed a meta-analysis of all NVAS controlled trials (including several in Africa that did not show a mortality impact) and concluded that there was inadequate evidence to recommend the intervention.[32] Based on the WHO conclusion and despite the strong evidence from the Asian studies, the GON has decided to delay further scale up until additional evidence provides clarification. [The entire pilot process has been well documented, providing the GON with adequate information for rapid scale up should the policy be changed].

WAY FORWARD

The examples presented here demonstrate the value of progressive policy adaptation to explore early piloting of interventions shown to be promising from controlled trial research.

These community-based interventions are examples of successful applications of the results of RCTs demonstrating mortality reduction from selected interventions. In the case of misoprostol and community-based management of neonatal sepsis and CHX, the successful pilots have led to policy change and national scale up. The pilots for newborn vitamin A supplementation and gentamicin in Uniject are well documented, and can inform the Government should it decide to move ahead with these approaches.

This rapid application of research findings would not have been possible if it were not for the highly conducive policy environment in Nepal. Careful consideration and application of evidence from landmark research trials to the implementation of feasibility studies and pilots within the country, leading to policy change and scale-up, displays remarkable government leadership (Figure 6).

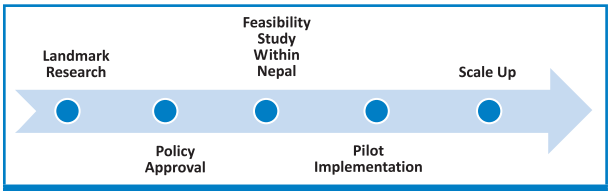

Figure 6. Steps undertaken by GON to scale-up innovations

Another distinctive feature of these interventions was the utilisation of the existing public health system and maximisation of coverage by using all appropriate health channels, especially at the community level. This highlights that sustainability was an important factor during programme planning and implementation. Thoughtful long-term planning and assessments of the pilots to determine whether they could be scaled-up also shows the government's vision for integrating them into national-level programmes.

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CONFLICT OF INTEREST

We declare no conflict of interest for this article.

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