

Chlorhexidine Operations Research Study

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Acronyms

BCC	Behavior Change Communication
BDT	Bangladesh Taka
CDK	Clean delivery kit
CHW	Community Health Worker
CHX	Chlorhexidine 4% solution
CMCCF,B	Community Mother and Child Care Foundation in Bangladesh
EDD	Estimated Date of Delivery
FGD	Focus Group Discussion
FWA	Family Welfare Assistant (Works at community level)
FWC	Family Welfare Centre
FWV	Family Welfare Visitor (Works in FWC)
GoB	Government of Bangladesh
HA	Health Assistant (responsible for vaccination services at the community level)
HC	Health Counselor (of the Projahnmo Project)
ICDDR,B	International Centre for Diarrhoeal Disease Research, Bangladesh
JHSPH	Johns Hopkins Bloomberg School of Public Health
MO	Medical Officer
MoHFW	Ministry of Health and Family Welfare
NGO	Non Governmental Organization
PATH	Program for Appropriate Technology in Health
Projahnmo	Project to Advance the Health and Newborns and Mothers
RDW	Recently delivered women
RTM	Research, Training and Management International
TBA	Traditional Birth Attendant
USAID	United States Agency for International Development
VHW	Village Health Worker

Executive Summary

Background

A low-cost and scalable approach to delivering chlorhexidine to neonates, suitable for settings in which a large proportion of births occur in the home, is needed. The Chlorhexidine Operations Research study (CHX OR study) sought to develop such an approach by addressing questions related to chlorhexidine distribution and use, behavior change, and community perception in a rural area of Bangladesh with a high level of home births. The study distributed chlorhexidine through routine channels on a small scale, worked through family members (rather than the system of CHWs and VHWs used in the randomized trial) to apply the chlorhexidine to neonates, and applied various behavior change communication approaches to raise awareness of chlorhexidine and teach people how to apply it. Our aim was to gain experience and collect data that would facilitate the introduction and widespread use of chlorhexidine for cord cleansing.

Methodology

The study activities were divided into two phases. The first phase included relatively limited promotion and distribution of chlorhexidine (CHX), primarily through Projahnmo project personnel and Ministry of Health and Family Welfare (MoHFW) health personnel, using the chlorhexidine product from the efficacy trial. Final product packaging for Phase 2 was determined based on a product attribute study conducted by AC Nielsen and PATH and input from study partners at the October 2008 behavior change communication (BCC) workshop. Finally, the product packaging and the accompanying instructions were pre-tested during this phase.

In the second phase chlorhexidine manufactured by Popular Pharmaceuticals Ltd. to meet local regulatory requirements and user preferences was packaged in a nozzle bottle and promoted through various channels of communication. In this phase, a range of BCC activities were undertaken, using posters, songs, leaflets, and stickers. CHX and clean delivery kits (CDKs) were distributed both free of charge through the public sector, for sale through the private sector. This second phase was intended to simulate the introduction of chlorhexidine into the public sector combined with its commercialization through the private sector, with one important difference: mass media communication was avoided due to concerns about contaminating the main chlorhexidine efficacy trial, which was also ongoing in adjacent areas of Sylhet District.

Results – Responses to different CHX products

Some of the reactions to the Phase 1 screwtop bottle & cotton ball product were:

- Some were concerned that the wide-mouthed bottle resulted in medicine being wasted;
- If the bottle tips over, then all the medicine will spill out as well, again wasting medicine;
- Keeping the cotton balls free of dirt was a concern; and
- Applying CHX with cotton balls require one to press on the cord and hold it, which was thought to have the potential to hurt the baby (pressure, finger nails, etc.).

Some of the reactions to the Phase 2 nozzle bottle product were:

- People appreciated the fact that there is more control over how much is applied, and hence less wastage of the medicine;

- The tip of the nozzle bottle is hard, and some expressed concern that it might hurt the baby if it pushes against the umbilical stump; and
- Since there is less need to use hands to hold the cord with the nozzle bottle, people are less inclined to wash their hands before application.

Results – Phase 1

In the first phase of the study, CHX was distributed in liquid form in screw top bottles, with cotton balls for application. The distribution was carried out by project health counselors.

The main lessons from Phase 1 were:

- Mother usually apply CHX for the first and subsequent applications;
- Most of the families applies CHX daily for seven days;
- CHX is usually applied soon after cord-cutting (which is after the delivery of placenta) and first breast-feeding, in other words 2-3 hours after birth;
- Hand washing before CHX application was a common practice. Use of two cotton balls as recommended was practiced by families, including completely wetting the umbilicus;
- Demonstration of CHX application on doll and further explanation of the instructions helped the understanding of many families; and
- It proved difficult to make the instructions both understandable and compact.

Results – Phase 2 including final household survey (N=299 recently delivery women)

- Rates of delivery in health care facilities were significantly higher at 46.8% than in the study site for the cluster-randomized efficacy trial, where rates typically are less than 10%.
- Cord cutting almost always (91.8%) occurred after delivery of the placenta, and the cord was mostly (56.8%) tied with a thread from the clean delivery kit.
- Over half (58.2%) of the respondents who gave birth to a live baby collected CHX (n=174/299). Of those who gave birth at home, 67.3% of 159 collected CHX, compared to 47.9% of the 140 women who delivered in health facilities. Most people obtained CHX before delivery; 85.0% of home deliveries and 82.1% of facility deliveries. All those who delivered at home and had obtained CHX applied it, 72.9% immediately after delivery. Among those delivering in a health facility, there was considerable delay in the first application of CHX, only 19.4% having it applied immediately after delivery.
- Traditional birth attendants (TBAs) were the largest delivery channel, reaching 50% of those who collected CHX (n=86/174). Other large delivery channels were the EPI health assistants at 31% (n=53/174) and Family Welfare Centers (FWC) at 22% (n=38/174). Of those who collected CHX, generally they collected the CHX and CDK bundled together. Of those who obtained CHX, 84% collected it in a bundle with a Clean Delivery Kit (CDK) (n=147/174) while 12% collected it as a stand-alone product (n=21/174).
- The reported mean number of days of application was 7.2 +/- 2.4, and 83.1% of survey respondents reported washing their hands prior to CHX application. The first application was immediately after cord cutting in 56.9% of cases, the delay in application was strongly associated with delivery in a health facility. Both prior and after cord separation, CHX was reported to have been applied to each section of the cord in more than 2 of 3 cases.
- Application of CHX in the home was also assessed through direct observation of application in the home. The results of direct observation were broadly similar to those of the household survey: 12% achieved a Low score, 25% achieved a Medium score and 48% achieved a High score for correct application of CHX.

- The Health Belief Model (HBM) is a model for understanding why some people practice health-related behaviors and others do not. The study team felt that reminders to purchase CHX than apply it soon after birth (corresponding to the “cues to action” HBM construct), were important to examine, because the previous trial in Nepal showed that much of the mortality impact of CHX was related to its application within the first 24 hours. The adjusted odds and 95% confidence interval for CHX use if the respondent was reminded by the TBA (versus no or don’t remember) were 24.41 (7.10, 100.60), if respondent was reminded by family member were 34.90 (8.09, 211.80), and if respondent was reminded by someone who had attended a community meeting were 5.20 (1.83, 15.94). Self-efficacy is a person’s confidence in being able to practice a behavior correctly. Respondents who were very confident (16.1%) or confident (31.8%) they could apply CHX correctly were 29.59 times more likely to use CHX (95% CI= 14.84, 59.80).
- Among the families who collected CHX, 46% paid for the medicine from a private channel (n=80/174) while 54% did not pay, collecting from a government channel for free. On average, families paid 47.6 Bangladesh Taka (BDT) for CHX.

Conclusions

For CHX to be an effective intervention in reducing neonatal mortality, ideally families should obtain it prior to delivery, apply it for the first time as soon as possible after delivery, and apply it correctly. In this study there was broad acceptance of, and demand for, CHX in the study communities. However, many families did not obtain CHX, and of those that did many applied it for the first time after 24 hours, or applied it incorrectly. The strongest constraining factors for effective coverage were: 1) delivery in a health facility, 2) lack of a reminder to obtain or use CHX, 3) lack of perceived benefits of CHX for the baby, and 4) low self-efficacy for CHX application. At the time of writing this report, we are still discussing what recommendations to make. The following is a preliminary set of recommendations:

1. Two very different products, CHX in a screw top bottle with cotton balls as applicators, and CHX in a nozzle bottle, both enjoyed high acceptance. There are concerns that insufficient amounts of CHX were applied with the nozzle bottle product based on observation of application during pretesting of the nozzle bottle. This warrants further investigation.
2. CHX should be promoted, and available, at both the community and health facility levels. This not only increases the proportion of babies receiving CHX during the first 24 hours, but also demonstrates to families of women delivering at home that this is a standard recommendation accepted and used by the formal health services.
3. Written instructions alone, regardless of how they are designed, appear to have limited ability to increase self-efficacy for correct application of CHX. Face-to-face explanation and demonstration likely are also needed. TBAs seem particularly willing and able to provide these explanations. When CHX is made available for sale in pharmacies and shops, program managers should work to ensure that adequate explanation and demonstration are provided at the same time.
4. Reminders to obtain and apply CHX are extremely important. Promotion of CHX might target both those who will apply CHX, and those who will remind others to apply it e.g. “husbands, be sure to remind your wife and relatives to apply CHX to the newborn as soon as possible after birth”.
5. Promotion and sales of CHX through TBAs addresses most of the factors limiting effective coverage with CHX. For TBAs to play this role, a system of resupply to TBAs for CHX would need to be created and monitored. This might occur by integrating CHX into an existing supply system for CDKs, if one exists.

Background and Rationale

Every year, approximately 10 million children die before reaching their fifth birthday. Of these 10 million deaths, 4 million occur during the first 28 days of life, and 30-50% of these neonatal deaths may be attributable to infections. While child health programs have had some success in reducing under 5 mortality over the past 20 years, this decrease has occurred primarily in children >1 month, with more limited reduction in the neonatal period.

The Project to Advance the Health of Mothers and Newborns (Projahnmo) is a partnership between ICDDR,B; the Ministry of Health and Family Welfare of the Government of Bangladesh; Bangladeshi nongovernmental organizations, including Shimantik, Save the Children-US, Dhaka Shishu Hospital and the Institute of Child and Mother Health; and the Johns Hopkins Bloomberg School of Public Health. In October, 2009, Projahnmo concluded a large efficacy study (Projahnmo Phase 2) in selected unions in Beanibazar, Zakiganj and Kanaighat Upazilas (sub-districts) of Sylhet District, Bangladesh to evaluate the impact on neonatal mortality of 7 and 1 day umbilical cord cleansing with chlorhexidine. Analysis of these results is ongoing at the time of writing (January 2010).

Projahnmo Phase 2 builds on an earlier efficacy trial of chlorhexidine in rural Nepal. Both efficacy studies have examined the effect of chlorhexidine under ideal conditions. In the Sylhet trial, a two-tier system of Village and Community Health Workers (VHWs and CHWs) was created, and the VHWs were responsible for application of chlorhexidine to the neonate during postpartum home visits. While this approach has been effective in reaching almost all newborns in the study area, it is not suitable for routine, large-scale programs, because it requires large numbers of trained, paid, and supervised personnel and immediate notification of births.

If the efficacy of umbilical cord cleansing with chlorhexidine is confirmed by the Projahnmo Phase 2 study in Bangladesh, and other studies planned in Tanzania and Zambia, chlorhexidine then will be introduced for widespread use. A low-cost and scalable approach to delivering chlorhexidine to neonates, suitable for settings in which a large proportion of births occur in the home, is therefore needed. The Chlorhexidine Operations Research study (CHX OR study) sought to develop such an approach by addressing questions related to chlorhexidine distribution and use, behavior change, and community perception in a rural area of Bangladesh with a high level of home births. The study distributed chlorhexidine through routine channels on a small scale, worked through family members rather than VHWs to apply the chlorhexidine to neonates, and applied various behavior change communication approaches to raise awareness of chlorhexidine and teach people how to apply it. Our aim was to gain experience and collect data that would facilitate the introduction and widespread use of chlorhexidine for cord cleansing.

Study Activities

Phases of the study

The Projahnmo Chlorhexidine Operations Research Study (CHX OR) introduced chlorhexidine for umbilical cord cleansing in neonates in four Unions in Beanibazar sub-district (upazila) of Sylhet District, with the aim of distributing CHX to households through routine delivery channels on a small scale, to gain experience and information that would facilitate the large-scale introduction of cord cleansing with CHX.

The study activities were divided into two phases. The first phase included relatively limited promotion and distribution of chlorhexidine, primarily through Projahnmo project personnel and Ministry of Health and Family Welfare (MoHFW) health personnel, using the chlorhexidine product from the efficacy trial. Final product packaging for Phase 2 was determined based on a product attribute study conducted by AC Nielsen and PATH and input from study partners at the October 2008 behavior change communication (BCC) workshop. Finally, the product packaging and the accompanying instructions were pre-tested during this first phase.

In the second phase chlorhexidine manufactured by Popular Pharmaceuticals Ltd. to meet local regulatory requirements and user preferences was packaged in a nozzle bottle and promoted through various channels of communication. In this phase, a range of BCC activities were undertaken, with promotion through meetings, posters, songs, leaflets, and stickers, and CHX was distributed both for free and for sale through public and private sectors, respectively. This second phase was intended to simulate the introduction of chlorhexidine into the public sector combined with its commercialization through the private sector, with one important difference: mass media communication was avoided due to concerns about contaminating the main chlorhexidine efficacy trial, which was also ongoing in adjacent areas of Sylhet District.

The CHX OR study was conducted in 4 unions (administrative units) in Beanibazar sub-district, Sylhet District, Bangladesh. From April 2008-April 2009, study activities were conducted in 2 unions, Mathiura and Tilpara. In May 2009 Mullapur and Lauta unions were added in order to ensure adequate sample size for the final study phase and end line survey. Each union was divided into 60 blocks of approximately 40 households each.

The CHX OR study employed 6 health counselors (HCs): 2 each in Mathiura and Tilpara unions, and 2 covering all of Mullapur and Lauta unions. Their responsibilities differed in each project phase and are described in more detail below. The HCs were chosen based on a written exam and an interview. The written exam covered general knowledge, mathematics, healthcare, clean cord care, antenatal and postnatal care. The selected HCs underwent 5 days of training in July 2008, which concluded with a field-test. The HCs were supervised by a field manager, a communications officer, and a field research officer. During phase 1, supervision occurred for both male and female HC 2-3 times per week while in phase 2, supervision occurred for female HCs only, 2 times per week. Supervision consisted of observation of HC activities, including community meetings and visits to neonates, with immediate feedback provided; and monthly review of data collection forms completed by the HCs.

Formative Research (May-June 2008)

A previous formative research study conducted in Sylhet District in 2006 examined newborn skin and umbilical cord care practices to inform the design of the cluster-randomized trial of chlorhexidine. During the first two months of the CHX OR study, further formative research was conducted in order to: 1) Assess acceptability of CHX; 2) Assess preferences for who would apply chlorhexidine in the home; and 3) Determine what information needs to be contained in counseling materials. A total of 65 females and 5 males were interviewed for the purpose of this formative research: 20 mothers of children less than 3 months of age; 20 senior females from households of these same mothers; 10 Traditional birth attendants; 5

Depot Holders from the NDSP Program; 5 Village Doctors; 5 Family Welfare Assistants; and 5 Projahnmo-1 Community Health Workers or Community Mobilizers.

Results suggested that despite promotion of dry cord care in the first phase of the Projahnmo study from 2002-2005, and mass media promotion of new health technologies, traditional ways of taking care of the newborn's umbilicus are still prevalent, and programs should acknowledge this reality in their planning. Though mother is the primary caretaker of the neonates, others in the family also play significant roles through providing advices and contributing financially (i.e. especially the males in the family). CHX, as an alternative technology for umbilical cord care, was well accepted. Informants stated that they definitely preferred if CHX was not sold, but rather distributed without cost through the governmental channels. However, given the stock-outs and difficulty in accessing care through the government services in some cases, people stated that they would consider obtaining/buying from a private source. In terms of BCC materials, people preferred detailed illustrations with simple instructions.

Phase 1 (August 2008-December 2008)

CHX Product and Distribution

The CHX product from the main cluster-randomized efficacy trial was used in Phase 1, packaged in screw-top bottles in triangular cardboard boxes with an instruction leaflet and a resealable plastic bag containing cotton balls. The application method for the CHX was the same as in the efficacy trial: CHX was to be applied to the umbilicus using 2 cotton balls for each application. The instruction leaflet was a simplified version of the instructions provided to the Village Health Workers in the efficacy trial. In one union a 5 picture/step version of the instructions was used and in the other a 6 picture/step version was distributed.

CHX was distributed through project health counselors and through the public health sector. One female HC in each union maintained a registry of pregnant women in their union. The HCs updated the pregnancy registry on an ongoing basis throughout Phase 1 during household visits and community meetings. Female HCs provided CHX to women with an expected delivery date (EDD) within 2 months. CHX was delivered through both household visits to women with upcoming EDDs, and through community meetings conducted by the female HCs, during which they distributed CHX to women with EDDs in the following 2 months. CHX was also distributed free of charge at Family Welfare Centers (FWCs) during antenatal care (ANC) visits to women with EDDs in the following 2 months.

Behavior change communication in Phase 1 occurred through community meetings conducted by both male and female HCs. Approximately one female community meeting was held per block per month. For each meeting, the female HC asked for a volunteer household in which to hold the meeting, and invited pregnant women, women of reproductive age, and their family members within the block. Meeting topics included birth and newborn care preparedness messages, umbilical cord infections, and CHX and its correct application. Each meeting included the application of CHX to a doll by a volunteer from the audience, followed by a demonstration of CHX application by the HC. Male community meetings covered the same topics in somewhat less depth, and without demonstration of CHX application.

Documentation and Data Collection

Process documentation in Phase 1 included observation of CHX application by the volunteer at the female community meetings, and observation of CHX application to the neonate in the

home. In both cases, the female HC used an observation checklist to record the quality of CHX application and document any problems with CHX application. For the observation of application to neonates, the female HCs attempted to visit all births of which they were notified within 7 days of birth to observe application.

Qualitative data collection included in-depth interviews with caregivers of newborns, applicators of CHX, husbands, and healthcare providers. The objectives of the in-depth interviews were to assess acceptability of, response to, and use of CHX among parents and relatives of newborns and other applicators. The interviews also helped identify difficulties encountered in the application of CHX and examined understanding of instructions, counseling, and other BCC materials. In addition, all community meetings in Phases 1 and 2 were documented in community meeting reports completed by HCs (Appendix 3).

Development of Instructions

Detailed written and pictorial instructions for CHX application with cotton balls by the female village health workers in the Bangladesh CHX efficacy trial were the starting point for the Phase 1 instructions. Prior to Phase I, we conducted focus group discussions (FGD) with key informants to obtain feedback on the efficacy trial instructions and input on desired features of caregiver instructions for CHX application. Taking into consideration the results of the FGDs, project staff then prioritized the steps in the efficacy trial instructions according to how important they were to include in the caregiver instructions in order to create an initial version of the instructions for subsequent pretesting in the community. Six members of the study staff scored each step from 1 (high importance) to 3 (low importance). Based on this ranking, 5-6 pictures from the efficacy trial instructions were selected for the Phase 1 instruction leaflet (Appendix 2)

Development and Pre-testing of Final Product Packaging

At the October 2008 BCC workshop, PATH presented the results of a product attribute study conducted by AC Nielsen in Sylhet in early 2008. Based on the study results and preliminary observations from Phase 1 of CHX application using cotton balls, workshop participants decided that a nozzle bottle without applicator should be used for the product packaging in Phase 2.

In November 2008, instructions for the nozzle bottle packaging were developed and pretested in 7 households from Mathiura and Tilpara. Household members were interviewed to assess understanding of the instructions, and were asked to apply CHX to a doll according to the instructions. The nozzle bottle was pretested in January 2009 among 50 households in Mathiura and Tilpara unions. The pretest protocol included distribution of CHX packaged in a nozzle bottle, with the associated instructions, to women with an EDD within the next month, household visits within 7 days of birth to observe application to the neonate; and documentation of quality of application and problems encountered during application. Following the nozzle bottle pretest the instructions were further refined and pretested in 2 households from Mathiura and Tilpara. Finally, a pre-test of bundling options (CHX and clean delivery kit together) was conducted with four different options. Though the results indicated that people preferred packaging of all into one, the intervention didn't produce secondary packaging due to the tight timeline for study activities.

Phase 2 (May –September 2009)

CHX distribution and promotion

Phase 2 CHX was manufactured and packaged by Popular Pharmaceuticals in 60 ml bottles containing 45 ml of liquid. The product was distributed both as a stand-alone product and packaged with CDKs produced by Community Mother and Child Care Foundation in Bangladesh (CMCCF,B) that contained a plastic sheet, sterile blade, gauze, thread, and soap. A folded instruction sheet was wrapped around the CHX bottle and secured with a rubber band.

Because this phase was intended to simulate national-level introduction of CHX, a variety of public and private sector delivery channels were used. CHX bundled with a clean delivery kit (CDK) was distributed free of charge through Family Welfare Centers (FWCs), Satellite Clinics, EPI Health Assistants (HAs), Family Welfare Assistants (FWAs), and project HCs. CHX was sold as a stand-alone product and bundled with CDKs by pharmacies and TBAs. Bottles of CHX were delivered to each FWC, Satellite Clinic, EPI HA, FWA, HC, pharmacy, and TBA.

Behavior change communication in this phase made use of local media in addition to the in-person counseling conducted at community meetings. Posters and leaflets contained information about where to collect CHX, its benefits for babies. Separate application instructions were produced. Stickers that provided information on where to collect CHX, whether for purchase or for free, and when to use CHX were also developed. The posters and stickers were displayed in bazaars, schools, madrasas, and pharmacies. The leaflets and stickers were also distributed by HCs at community meetings. In addition, a song was developed that provided information about CHX and was played by rickshaw throughout the communities of each of the unions.

Community meetings were continued in this phase but with a different purpose and emphasis. While in Phase 1 the female meetings aimed to raise awareness of birth and newborn care preparedness and to explain to women how to apply CHX to the umbilical cord and use the components of the CDK, in Phase 2 the female and male community meetings were intended to raise awareness of CHX and CDKs, including their benefits, price, and distribution points. The female and male community meetings continued to be organized and facilitated by project health counselors, but included neither explanation of the CHX instructions, nor demonstrations of CDK use or of CHX application. CHX distributors were also asked to explain the application instructions to individuals collecting CHX.

Process documentation

Household visits to observe CHX application to the neonate in the home continued in this phase. These visits were made by the field research officer, and 25 applications were observed from May 20 to September 5 2009. An observation checklist was used to record CHX application practices, use of CDK, source of CHX, and exposure to BCC materials.

In-depth interviews with caregivers of newborns, applicators of CHX, husbands, and healthcare providers continued in Phase 2. In addition, interviews and focus group discussions with CHX distributors were conducted. The field research officer conducted in-depth observations of female community meetings focused on participants' questions and concerns about CHX.

Additionally, the communications officer held 8 meetings from May 20 –August 30 2009 with TBAs to review correct application of CHX, correct delivery and clean cord techniques and answer any questions the TBAs had about the processes. From these meetings, the officer prepared a meeting report which was a compilation of all questions that the TBAs had about CHX procurement, application and general antenatal and newborn care practices.

End line Survey

A household survey was conducted from August 12 to September 5, 2009 to measure CHX coverage in Phase 3 of the study, as well as associated variables such as cord care practices and source of CHX. Prior to and concurrent with the survey, project staff mapped the study area and listed women with a delivery on or after May 7, 2009. Additional listing was performed after the start of the survey to ensure that more recently delivered women were listed and included in the sampling frame. Interviews were attempted with all recently delivered women (RDWs) listed. 314 interviews were completed.

The survey questionnaire included questions regarding antenatal care, delivery, cord cutting and applications to the cord, timing and method of CHX application, source of CHX and CDKs, exposure to BCC materials, payment and willingness to pay for CHX and CDKs, and perception of CHX and CDKs. The survey interviews were conducted by 8 surveyors who underwent of classroom and practical training. Surveyors were overseen by 2 supervisors, who in turn were supervised by the Field Manager.

Ten percent of households surveyed were randomly selected by supervisors for re-interview. Supervisors also observed interviews and provided on-the-spot feedback and refresher training to surveyors, when necessary. Refresher training was provided to surveyors in response to problems such as missing data. Data were cleaned and entered by the Data Management Section (DMS) of the ICDDR,B Child Health Unit, and data analysis was performed by DMS and project staff in Sylhet using Stata version 10.

Results

Phase 1 and development of instructions

The efficacy trial instructions that were the starting point for the instructions developed in the first phase of the study. These instructions were extensive, describing in detail the hand-washing process and the use of cotton balls to apply CHX to the umbilical area. From these, simplified instructions were developed in Phase I that maintained a focus on the application process, including the use of cotton ball applicators, but devoted only one picture to hand-washing. From August 16 to October 31 2008, 266 community meetings were conducted and at each meeting a volunteer applied CHX to a doll (total of 266 observations). In addition project health counselors visited the households of 27 live births to directly observe in-home application of the CHX. A relatively high proportion of caregivers and other respondents correctly performed individual steps of the application process. However, all critical steps were completed correctly only among 55% (n=146 of 266) of the doll applications observed during community meetings and 78% (n=21 of 27) of the direct observations of the in-home applications to newborns. Moreover, while all caregivers planned to apply CHX for 7 days, only 70% (16 of 23) reported applying CHX within 24 hours of birth. However, this may be explained by the relatively high proportion of hospital births observed (52%): of the 30% of neonates who received the first application > 24 hours after birth, all were hospital births. In-depth interviews with caregivers indicated that many did not recognize that the umbilical area

was pictured on the instruction leaflet. Illiterate caregivers also expressed a desire for more colorful and clear pictures.

Seven family groups of 3-5 individuals participated in the Phase II instruction pretest. Three of the 14 applicators were illiterate; half had completed 0-8 years of education, while half had obtained a secondary school certificate (SSC; 10th grade equivalent) or higher secondary certificate (HSC; 12th grade equivalent). Most of the applicators (12 of 14) were pregnant women, senior females, or unmarried girls, who typically act as caregivers for newborns in the study area. Applicators performed most steps of the application process correctly. Most applicators washed their hands prior to CHX application (n=12 of 14) and soaked the umbilical area (n=10 of 14). Similarly, in most cases CHX was applied to the umbilical base (n=12 of 14), stump (n=13 of 14), and tip (n=9 of 13). However, when taken together, only 5 of 13 applicators directly applied CHX to all parts of the umbilical area (base, stump, and tip) and soaked the umbilical area (one individual had missing information). The written instructions regarding timing and frequency of application were understood by all applicators.

Individual interviews were conducted with all members of all household groups (n=26). Most participants recognized the neonate and umbilical area shown in pictorial 2 (81%), and recognized that the cord had separated in pictorial 3 (71%). However, consistent with our observations of CHX application in the pretest, there was poor understanding of the other key messages of pictorials 2 and 3: only 46% understood that pictorial 2 showed the application of CHX to the umbilical base, stump, and tip, and the same proportion understood that pictorial 3 showed application to the umbilical base and center. Many participants interpreted the pictorials literally and were confused by the depiction of multiple bottles of CHX in pictorials 2 and 3, which were intended to demonstrate CHX application to the different parts of the umbilical area, and soaking of the umbilical area. As a result, we substantially simplified the pictorials used in Phase II, showing only one action per pictorial.

The pretest of the resulting instructions, and subsequent experience in Phase II, suggested that the five different pictorials were confusing, and that applicators continued to have difficulty understanding where on the umbilicus the CHX should be applied (data not shown). For literate applicators, there also appeared to be some confusion as a result of discrepancies between the written and pictorial instructions showing where on the umbilicus to apply CHX.

To summarize the lessons from Phase 1:

- Mother usually apply CHX for the first and subsequent applications;
- Most of the family used CHX daily for seven days;
- CHX is usually applied after cord-cutting (which is after the delivery of placenta) and first breast-feeding, in other words 2-3 hours after birth;
- Hand washing before CHX application was a common practice. Use of two cotton balls was practiced by families, including completely wetting the umbilicus;
- Demonstration of CHX application on doll and further explanation of the instructions helped the understanding of many families; and
- It proved difficult to make the instructions both understandable and compact.

Phase 2 and results of the final household survey

Characteristics of survey respondents

Table 1 in Appendix 1 displays the characteristics of the respondents for the final household survey conducted in August-September 2009. A total of 314 recently delivered women (RDWs) were identified, of whom 299 had a live birth. Over 90% of RDWs were aged between 15 and 34, all but one was married, and 81.5% were literate.

Maternal and newborn care practices

Tables 2 and 3 show maternal and newborn care practices that were measured in the survey. Three in four women (75.6%) had attended antenatal care, but only one in four (25.4%) had attended ANC four or more times as recommended by the MoHFW. Only 33.1% had received a tetanus toxoid injection during pregnancy. Both ANC attendance and tetanus toxoid vaccination increased with maternal education as expected.

Table 2 shows results on facility delivery and attendance at birth. Rates of delivery in health care facilities were significantly higher at 46.8% than in the study site for the cluster-randomized efficacy trial, where rates typically are less than 10%. Health care facilities where deliveries took place include Family Welfare Centers, the Upazila Health Complex in Beanibazar, the Sylhet Medical College hospital and various private clinics and hospitals in Sylhet and Beanibazar. Delivery by a skilled attendant, using an expansive definition of “skilled” including trained TBAs, doctors and nurses, was 56.6%. Table 3 shows data on cord care practices. Cord cutting almost always (91.8%) after delivery of the placenta, and the cord was mostly (56.8%) tied with a thread from the clean delivery kit.

Distribution of CHX

Table 4 summarizes findings on collection of CHX by families. Over half (58.2%) of the respondents who gave birth to a live baby collected CHX (n=174/299). Of those who gave birth at home, 67.3% of 159 collected CHX, compared to 47.9% of the 140 women who delivered in health facilities. Most people obtained CHX before delivery; 85.0% of home deliveries and 82.1% of facility deliveries. All those who delivered at home and had obtained CHX applied it, 72.9% immediately after delivery. Among those delivering in a health facility, there was considerable delay in the first application of CHX, only 19.4% having it applied immediately after delivery.

Table 5 summarizes the most statistically significant factors associated with obtaining CHX, which include home delivery, attendance at a community meeting, exposure to the communication materials of the project, and reminder by a TBA or family member to collect CHX.

Table 6 shows sources of CHX, and whether both CHX and CDK were collected. In many cases the mother of the newborn obtained the CHX (n=86), but other people who contributed significantly to the procurement of CHX were the father of the newborn (n=27) and the paternal grandmother (n=21). Traditional birth attendants (TBAs) were the largest delivery channel, reaching 50% of those who collected CHX (n=86/174). Other large delivery channels were the EPI health assistants at 31% (n=53/174) and Family Welfare Centers (FWC) at 22% (n=38/174). Of those who collected CHX free of charge, generally they collected the CHX and CDK bundled together. Of those who obtained CHX, 84% collected it in a bundle with a Clean Delivery Kit (CDK) (n=147/174) while 12% collected it as a

stand-alone product (n=21/174). Those in the highest wealth quintile were more likely to obtain the two products separately, reflecting the fact that they were more likely to purchase the products, and the two products generally were sold separately.

These data suggest that there are a number of reasons why people did not collect CHX (Table 5). 38% of those who did not obtain CHX reported that their main reason for not procuring was not knowing where to collect CHX (n=48/125). Delivering in a facility also proved to be a large determinant of whether or not people collected CHX. 52% of those who delivered in a facility did not collect CHX. Another reason for non collection was drug stock outs. Data from focus group discussions, interviews and community meetings indicate that some women wanted to obtain free bottles of CHX through government channels, but were not granted the product due to unavailability. Not having a family member or mother attend a Projahnmo community meeting was also associated with a lack of collection. 56% of families where no one attended a meeting did not collect CHX, while 80% of mothers who attended the meetings collected CHX. Not having a skilled birth attendant assist in delivery also increased the woman's chances of not collecting CHX ; 50% of those whose birth was not attended by a skilled birth attendant did not collect CHX while only 23% of those whose delivery was assisted by a skilled birth attendant did not collect CHX. Finally, less exposure to behavior change communication channels was associated with a lower rate of CHX collection (see Table 5). Opposition to CHX by family members was not a notable barrier to collection. The survey results suggest that the rate of CHX collection could be increased by:

- Increasing attendance at community meetings;
- Making CHX part of routine care in health facilities;
- Increasing exposure to information about CHX, preferably with a strong mass media component; and
- Increasing reminders to collect CHX.

Other factors emerged in the qualitative interviews. These included:

- Some women knew about CHX, but had no interest. This was particularly the case for multigravidae, who stated that for other babies they had applied traditional medicine to the umbilical stump and the children had been fine;
- Some women had searched for CHX in government facilities, but had not found it. In such a case, some had sent their husbands to a pharmacy to find it after delivery;
- Those delivering in a health facility figured that the doctors would supply any medicine that might be necessary; and
- Some people had never heard about the community meetings, or about the project. Since community meetings were a major source of information about CHX, this limited exposure to information about CHX.

CHX application practices and application instructions

Non-use of CHX: Fourteen women who obtained CHX did not go on to apply it. All 14 respondents gave birth in a health facility. All were between the ages of 19 and 30, with 64% (n=9/14) being 24 or less years of age. Most of the women collected the CHX before delivery (n=12/14). In depth interviews with women who collected CHX but did not use it indicated that most planned on giving birth in the facility. When their delivery time arrived, they were not prepared and forgot to bring the CHX with them to the facility.

Application of CHX in the home: Table 7 presents reported CHX application practices from the final household survey. The mean number of days of application was 7.2 +/- 2.4, and

83.1% of respondents reported washing their hands prior to CHX application. The first application was immediately after cord cutting in 56.9% of cases, the delay in application was strongly associated with delivery in a health facility. Both prior and after cord separation, CHX was reported to have been applied to each section of the cord in more than 2 of 3 cases.

The majority of respondents who used CHX used the medicine almost completely correct (obtained a medium or high score) (91%, 145/160). Overall, 48% achieved a high score (see Table 5). Looking just at the indicator for application within the first 24 hours after birth, 84% performed this aspect correctly. A factor significantly associated with application within the first 24 hours of birth was first application of CHX by the TBA. This is discussed in more detail below.

Application of CHX in the home was also assessed through direct observation of application in the home with Observation Checklist A by the field research officers. The results of direct observation were broadly similar to those of the end line survey: 12% achieved a Low score, 25% achieved a Medium score and 48% achieved a High score for correct application of CHX. The scores were obtained through the same method as those taken from the end line survey, with one exception: days of application was not included in the calculation.

Application of other substances to the cord: Table 8 shows that the most common applications to the cord were nothing or dry cord care and CHX. However, a wide range of other substances were applied including mustard oil, ash, mud, heat massages, various traditional and homeopathic medicines as well as modern medicines such as Hexasol, Nebanol powder and Gentian Violet. Generally, CHX was accepted almost universally, and people didn't apply anything else while CHX was being applied (1-7 days). There is a tendency to fall back on traditional practices after the seventh day such as heat massage (*shekh dewa*), if the cord still has not fallen off by that time. CHX was never used for any other purposes other than umbilical cord care.

Process of application of CHX: As mentioned above, most women wash their hands prior to CHX application, although others do not see the need for it (due to the nozzle bottle). The clearest picture in the instruction sheet is the first one, which is on washing hands, and this seems to be what sticks in people's minds. Women were observed to take a few days to get used to the nozzle bottle. People are extremely careful to apply CHX so that it doesn't spill beyond the umbilical area, since it is *nabhir oushodh* (umbilical medicine) only. People make every effort to not waste the expensive medicine. However, taking excessive care to not waste and/or spill CHX may result in an inadequate amount being applied, and warrants further investigation.

People touch the cord during application primarily during the first 2 to 3 days. There is a difference in application of CHX depending on whether the cord is soft or hard. If the cord is soft, people are more likely to touch and manipulate the cord so as to apply CHX both over and under it. If the cord is hard, people are cautious about touching it, and hesitate to manipulate it out of fear that it might hurt the baby. This results in CHX being applied on top of, but not underneath the cord. There is usually a specific time of the day for CHX application, and people are consistent about it.

Differences in reaction to the two products: In Phase 1, the CHX product was cotton balls moistened from a small screw-top bottle. In Phase 2, the CHX product was a nozzle bottle

with no applicator. Some of the reactions to the Phase 1 screwtop bottle & cotton ball product were:

- Some were concerned that the wide-mouthed bottle resulted in medicine being wasted;
- If the bottle tips over, then all the medicine will spill out as well, again wasting medicine;
- Keeping the cotton balls free of dirt was a concern;
- Applying CHX with cotton balls require one to press on the cord and hold it, which was thought to have the potential to hurt the baby (pressing, finger nails, etc.)

Some of the reactions to the Phase 2 nozzle bottle product were:

- People appreciated the fact that there is more control over how much is applied, and hence less wastage of the medicine;
- The tip of the nozzle bottle is hard, and some expressed concern that it might hurt the baby if it pushes against the umbilical stump;
- Since there is less need to use hands to hold the cord with the nozzle bottle, people are less inclined to wash their hands before application;

Concern about drying of the cord: The efficacy trials in Nepal and Sylhet have documented that the cord takes longer to drop off with daily application of CHX. People noted that it took longer for the cord to dry out, but people weren't sure why that was the case. Some, but not all, thought of CHX as a possible contributing factor.

Instruction and explanations about CHX application: Although the project invested considerable effort in developing printed instructions on CHX (Appendix 2), people expressed a preference for explanations from providers. Generally, people pay more attention to what they hear from the providers than what they read on an instruction sheet. More often than not, the sheet is not preserved. However, someone in the family goes through it and then tells others how to apply it. Many people rely on “common sense” rather than listening to instructions from a provider or reading the instruction sheet.

In contrast, TBAs took this task most seriously, and made efforts to guide family members through first time application and provide verbal instructions in addition to the instruction sheet. Pharmacists are often not sure about the application of CHX, and demonstrate less interest in learning about correct application. When asked, they directed customers to look at the sheet. Furthermore, the pharmacists who had received orientation from the project often were absent and their replacements were far less careful in providing explanations to the customers.

Government health care personnel were observed to demonstrate how to apply CHX correctly with a stick or a pen, representing the umbilical stump, instead of making reference to the instruction sheet.

Comments on packaging and bundling of the products: People appreciated having the printed instructions attached with an elastic band to the bottle of CHX, but expressed concern that the instruction sheet thus hides the label on the CHX bottle, making it confusing to figure out what it is just by looking at it. People thought the bundling of the CHX and CDK together was more appropriate for free distribution through government providers, but for private sector sales separate products are preferred. It should be pointed out here that the form of bundling for Phase 2 of this short study is not the ideal form for a national scale-up. For a

national scale-up, secondary packaging and a clear outside label likely are more appropriate, provided that the secondary packaging does not add significantly to the cost.

Clean Delivery Kits: Distribution and Use

During Phase 1 of this study, the standard clean delivery kit (CDK) sold by BRAC throughout Bangladesh was distributed. During Phase 2 of this study, an alternative kit produced by the NGO Community Mother and Child Care Foundation in Bangladesh (CMCCF,B) was provided. Both kits have thread for tying the cord, a blade for cutting the cord, soap, a plastic sheet, and gauze. The CMCCF,B kit has regular beauty soap (Meril soap) instead of the carbolic soap found in the BRAC kit, a larger, sturdier and opaque (rather than transparent) plastic sheet, and printed instructions on cord cutting, cord tying and cord care on the package.

In Phase 2 of the study, the CMCCF,B kit was provided free of charge, bundled with CHX, through Family Welfare Centers (FWCs), Satellite Clinics, EPI Health Assistants (HAs), and Family Welfare Assistants (FWAs). CHX was sold through pharmacies and by traditional birth attendants. Unlike the first phase, in the second phase project Health Counselors did not have a formal role in CHX distribution.

There were also differences in promotion of the kits during community meetings during the two phases. In Phase 1, instructions on how to use the kit were given during community meetings. There was no marketing of the kits, as they were being distributed free of charge. In Phase 2, the price, benefits and distribution points for the kits were explained. The kits were marketed to people, rather than being explained to people.

Tables 11 and 12 summarize findings on CDKs during Phase 2 of the study from the final household survey. In the end line survey, 52% of respondents who gave birth to a live baby collected a Clean Delivery Kit (n=154). 107 of the 154 who collected a CDK gave birth at home and 61% of mothers who gave birth at home used a CDK (n=97). 45% of those who collected a CDK paid for it. Of the entire survey, 82% said that they would pay for CDK. CDKs were used in 61% (97/159) home deliveries. They were most commonly obtained free of charge through FWCs (21%) or during outreach vaccination sessions conducted by HAs (34%), or purchased from TBAs (34%). Purchase of CDKs through pharmacies was minimal. Reported use of the different components of the CDK was very high: 80.4% placed mother on plastic sheet from CDK, 82.5% placed baby on plastic sheet from CDK, 97.9% used blade from CDK to cut cord, 95.9% used thread from CDK to tie cord, and 86.6% used gauze from CDK. It had not been anticipated that so many people would place the newborn on the plastic sheet during the first few days after birth.

Direct observation with Checklist A complimented the survey data. In these observations, 70% of recently delivered women used a CDK. Of those who reported using a CDK, 94% gave birth in a home (1 reported using a CDK, though she gave birth in a facility).

There was great demand for the CMCCF,B kit during the second phase of the study. In qualitative interviews, people explained that they appreciated having all necessary supplies for safe delivery in one place. People preferred the plastic sheet in the new kit which they said was thicker and less slippery. They stated that the blade was less risky in terms of infections, and didn't require boiling and was ready to use, and thus was ideal for an emergency situation. The one drawback of the new kit was the type of soap. The Carbolic

soap in the BRAC kit was preferred to the Meril soap (“beauty soap”) in the CMCCF,B kit, as it smelled and looked different and was more “medicinal” than the Meril soap.

Role of traditional birth attendants in sales and distribution of CHX and CDK

One of the major findings of this study was the critical role played by traditional birth attendants (TBAs) in three domains: 1) promotion of CHX and CDK and instruction in their use at the household level; 2) sales and distribution of CHX and CDK; and 3) application of CHX, particularly the crucial first application immediately following delivery, and use of materials contained in the CDK. The promotion, sales and explanation of CHX and CDKs were part of the official roles, explained to them during orientation sessions conducted by the project.

The application of CHX, use of CDK, and promotion of sales at the time of delivery were responsibilities they themselves assumed as implementation of the intervention progressed. The role in application arose in part out of hesitancy on the part of some families to apply CHX, combined with the increasing confidence and self-efficacy among the TBAs as they successfully applied CHX to more and more newborn babies. There were somewhat different estimates of who applied CHX for the first time from the final household survey and the direct observation using Checklist A. The TBA performed the first application of CHX in 24% and 32% of the deliveries based on the final survey and Checklist A respectively, while the estimates for first application by mothers were 46% and 32%.

Each of the provider groups (TBAs, pharmacists, and government health personnel) attended similar one-day orientation sessions, but TBAs were more engaged during the sessions, appeared to learn and retain more than the other providers, and left the sessions more committed to sales, promotion and application of the new interventions. This engagement and commitment occurred despite the fact that TBAs had difficulty understanding the instruction sheets, with neither the written instructions nor the pictorials meaning much to them. Demonstration of the application of CHX on a doll, and/or use of a stick, pen or finger to represent the umbilical cord or stump, were what gained the attention of TBAs. Another surprise to project field staff was the interpretation and response of TBAs to some of the material presented. The TBAs viewed the plastic sheet in the CDK primarily in terms of newborn care, rather than as a tool for maintaining hygiene during the delivery itself. They also viewed the gauze as material for wiping up.

During the course of implementation, there was considerable variation in the role and effectiveness of TBAs across the four Unions. Two of the Unions, Tilpara and Lauta, had markedly greater sales of CHX and CDKs than was the case in the other two Unions. From May to September 2009, TBAs had 58 CHX and 49 CDK sales in Tilpara Union, 40 and 26 respectively in Lauta Union, but only 14 and 12 in Mollahpur and 17 and 5 in Mathiura. There are several explanations for this situation. One is the marked variation in the rate of institutional deliveries between the Unions, from 63.0% in Mathiura (Close to the Upazila Health Complex in Beanibazar) to 37.1% in Lauta (somewhat distant from the health complex). Families assumed that CHX and CDK or equivalent would be available in health facilities, and consequently did not purchase them from TBAs or obtain them from another source. One TBA commented:

“Ekhon tenara katakuti kortey haspatalay jayga!”

“Now they go out to the hospitals for operations!”

Also, in the Unions closer to Beanibazar town, people were better able and more comfortable with purchasing CHX from pharmacies, as the pharmacies in Beanibazar town are highly regarded compared to other pharmacies in the area. This resulted in decreased sales of CHX and CDKs from TBAs in the vicinity of Beanibazar. One mother remarked:

“Beanibajarey khoj nilam pailam na jokhon tokhon ki ar Dashura bajarey pawon jaibo.”

“I looked for it in Beanibazar but couldn’t find it. If I don’t get it there, then how can I expect to find it in Dashura Bazar!”

Another difference noted in sales of CHX by TBAs and pharmacies was the degree of specificity in the product that was sold. Families went to TBAs and pharmacies and asked for “*nabhir oushudh*”, which is a generic term meaning “umbilical medicine”. TBAs had only one product fitting this description, CHX, and therefore they always sold CHX to the family. Pharmacies, on the other hand, carry a range of products fitting the description of “*nabhir oushudh*” or umbilical medicine, and therefore families were sometimes sold other products such as Hexasol or Nebanol when they came to the pharmacy to purchase CHX.

An area of occasional confusion or even conflict with families was the sale of CHX and CDKs to families. The recommended retail price was 45 taka for CHX and 18 taka for a CDK, for a total of 63 taka, approximately one US dollar in mid-2009. While pharmacists quoted the price for each product separately, and commonly sold only CHX to families, TBAs would quote an overall price for the two products of 60 to 70 taka. TBAs made an effort to push for the sale of both products at once. Furthermore, TBAs did not let families know that the products were available free of charge from government health personnel. This resulted in some suspicion and distrust on the part of families, and/or bargaining with TBAs for a reduced price. One family member was heard to complain to a TBA:

“Tomra to chor... tomra to haspatal thon free oushod aina bikri koro.”

“You guys are thieves... You guys get free medicines from the hospital and then sell it at a high price.”

There was also some mistrust or suspicion between the different providers distributing or selling the two products. While TBAs were not bothered by sales of the products by pharmacies, some pharmacies were unhappy that TBAs were selling the products and therefore cutting into their sales. TBAs were also displeased with the free distribution through the government system. One reason was that this free distribution damaged their credibility, making them appear to be deceitful in their sale of products that “were supposed to be free”. A voucher system is one way to get around this problem.

In summary, the enthusiasm and energy that TBAs put into the promotion and sales of CHX and CDKs was a key finding of the study. Furthermore, TBAs are known to the community, often performed the crucial first application of CHX immediately after birth, demonstrated the application to families so they could apply it on subsequent days, and finally TBAs are the ones who attend the home deliveries where CHX might be expected to have the greatest impact on neonatal morbidity and mortality. Challenges to be overcome in working with TBAs include potential for conflict with government health personnel who provide the products free of charge, the fact that there is no established system for resupplying TBAs with products for sale through either the public or private sectors, and the observation that

TBAs often didn't inform families that the products were also available free of charge from government providers.

Channels of communication

Tables 13 through 16 present findings from the final household survey on exposure to the different channels of communication during the period of implementation. The project tried to reach pregnant women and their families through both print materials and interpersonal communication, as described in more detail in Table 13. The print materials were posters, stickers, leaflets, and the instruction sheet included with the CHX product. Interpersonal communication occurred through community meetings, TBA meetings, and provider orientation meetings. Finally, a folk song about CHX was created that was both played from rickshaws as they passed by, and also played in full at the conclusion of community meetings.

Table 14 summarizes levels of exposure to these different channels of communication. The channel with the greatest reach was the CHX bottle itself, followed by posters and leaflets. Although the project invested considerable time and effort in creating the folk song about CHX and creating and pretesting the instructions, these two channels reached a smaller proportion of the population. Furthermore, when asked in an open-ended question where they had heard of CHX (Table 15), interpersonal sources rose to the top: community meetings, health assistants and family welfare centers.

Applying the Health Belief Model to understanding factors affecting CHX purchase and timely application

The Health Belief Model (HBM) is a model for understanding why some people practice health-related behaviors and others do not. It is particularly applicable to situations where the main or only reason to practice a behavior is related to health, for example application of sunscreen, wearing a helmet or receiving a vaccination. It is not as applicable to situations where there are reasons related to recreation/pleasure, lifestyle and peer pressure for practicing the behavior that are unrelated to health, for example behaviors related to tobacco, alcohol and food. In the case of CHX, the main reason for applying it is health-related, so the HBM was thought to be appropriate.

The constructs (behavioral determinants) in the Health Belief Model, and their application to understanding acceptance and use of CHX, are the following:

- Perceived susceptibility to the health problem prevented or treated by the behavior being promoted. Perceived susceptibility is low if people do not think that umbilical infections or sepsis could affect their newborn.
- Perceived severity of the health problem prevented or treated by the behavior being promoted. Perceived severity is low if people do not think that umbilical cord infections and sepsis are serious
- Perceived benefits. These will be low if people do not think newborn will benefit from CHX application.
- Perceived barriers. These are high if people think that CHX is too costly, or difficult to obtain.
- Cues to action. A cue to action is a reminder to practice a behavior at a specific time. Examples of cues to action in everyday life include alarm clocks, and reminders in the mail or email for appointments and meetings. In the specific case of CHX, the study team

felt that reminders are very important, because the previous trial in Nepal showed that much of the mortality impact of CHX was related to its application within the first 24 hours. If there is no one may remind person to apply CHX at the right time, right after birth, the mortality impact may not be realized.

- Self-efficacy is a person's confidence in being able to practice a behavior correctly. The study team felt that if CHX were unfamiliar, and the person didn't see or didn't understand the instructions for how to apply it, then the person may have low self-efficacy for correct application of CHX, and therefore not make an effort to obtain and apply CHX.

The results of measurement of the constructs (behavioral determinants) in the Health Belief Model, and their associations with use of CHX and CDKs are presented in Table 17. The findings are summarized below.

- Perceived susceptibility of newborns to umbilical infections was measured through two questions: possibility of baby getting an umbilical infection, and degree of worry about the child getting an umbilical infection. The responses for the first question indicated a very low perception of the potential to get an umbilical infection, with only 6 of 299 survey respondents stating that it was possible or very possible their baby would get an umbilical infection. There is no association with use of CHX. The proportion of respondents who were worried about umbilical infections was higher, but still low. There was a slight positive association between degree of worry and CHX use, with a Chi square for linear trend of 5.301, d.f.=1, $p = 0.021$.
- Perceived severity of umbilical infections was measured by how bad people feel umbilical infections are. Most respondents judged them to be very bad (11.0%) or bad (70.6%). There was no association between CHX use and perceived severity measured in this way.
- Perceived benefits. Most respondents felt that babies benefitted either a lot (26.4%) or benefitted (30.1%) from CHX application. There was a strong positive association between perceived benefits and CHX use, with a Chi square for linear trend of 7.676, d.f.=1, $p = 0.0056$.
- Perceived barriers were measured through six items on the survey measuring perceived difficulty of obtaining CHX, whether family members were opposed to using CHX, whether it was difficult to apply CHX to the umbilicus, whether it was difficult to apply when the umbilicus was stiff, whether the price was too high, and whether it was difficult to obtain CHX free of charge. For all six questions, there was a low degree of perceived difficulty or cost, and there were no significant associations with CHX use.
- Cues to action were measured by whether a TBA (*dhonni*), family member or person who had attended a community meeting had reminded the respondent to apply CHX. Cues to action and self-efficacy demonstrated the strongest associations with CHX use. The adjusted odds and 95% confidence interval for CHX use if the respondent was reminded by the TBA (versus no or don't remember) were 24.41 (7.10, 100.60), if respondent was reminded by family member were 34.90 (8.09, 211.80), and if respondent was reminded by someone who had attended a community meeting were 5.20 (1.83, 15.94).
- Self-efficacy was measured by asking whether the respondent felt she could apply CHX correctly on her own. There was a very strong association with CHX use. The most common response among non-users was don't know (80.6%), while only 10.0% of users replied don't know. Respondents who were very confident (16.1%) or confident (31.8%) they could apply CHX correctly were 29.59 times more likely to use CHX (95% CI= 14.84, 59.80).

Willingness to pay

Survey results on whether people paid for CHX or CDK as well as their reported willingness to pay for CHX or CDKs are displayed in Table 18. Among the families who collected CHX, 46% paid for the medicine from a private channel (n=80/174) while 54% did not pay, collecting from a government channel for free. On average, families paid 47.6 Bangladesh Taka (BDT) for CHX, but reported that they would be willing to pay, on average, 38.4 BDT. Reported willingness to pay was far higher than the proportion that actually paid, reflecting the fact that CHX could be purchased or obtained free of charge: 92.3% reported they were willing to pay for CHX.

In the qualitative process documentation, people who did not purchase CHX or a CDK were interviewed to explore the reasons for their decisions. They stated that generally they are willing to pay for CHX or a CDK, but choose free distribution first. Only when the free product is not in stock, or they can't find the place where the product is available free of charge, or it is too far to travel to the site of free distribution, or there is no time (woman is already in labor) to access the free product, do people state that they are willing to pay. People are willing to pay for CHX, but it is a last resort.

Stated willingness to pay was higher among female than male informants. Also, when the family is planning on delivery in a health facility, they see less need to procure CHX. Finally, some older women see no reason for this innovation, as exemplified by this statement from an older woman:

“Amar ager hurutain er shomoy to ila lagey nai, ehono lagbo na...”
 “I didn't need such things for my other kids and I won't need them for this child either.”

Some expressed skepticism in general about the “medicine”, and wondered why they were being promoted by project health counselors rather than by physicians. One older woman stated:

“Tenara dhokabaj... tanara nokol oushod banaya bechun.”
 “They are imposters who make fake medicines...”

Procurement and use of CHX was related to the concept of “birth preparedness”. While birth preparedness has been promoted during the first and second phases of the Projahnmo projects in Sylhet District, it is still not really exercised by many families. People wait and wait until the time comes, and then it is too late to take certain actions such as procuring CHX and a CDK. Limited access to cash accentuates this tendency.

Reasons that people purchased CHX, while CHX was available free of charge from government health workers (FWAs, HAs, FWVs etc.) were:

- One of the most important and convenient sources of CHX and CDKs was government Health Assistants (HAs) who are responsible for vaccination (EPI). As outreach vaccination only happens once a month, if people miss it they may be forced to purchase.
- There are not enough FWAs and HAs, and they do not make their rounds frequently enough, to ensure full coverage of the population.
- In some Family Welfare Centers, the FWV posts are vacant, so there is no one to distribute CHX and CDKs.

Even when these factors favorable to purchase of CHX and CDKs are in place, people may not purchase the products for the following reasons:

- Making a visit to the FWC involves time and money. The cost savings from free distribution of the products may be outweighed by the transport costs.
- Although 45 taka is not a large sum of money, many families do not have this amount of money readily available, which delays the purchase of the products. The fact that CHX and CDKs tend to be procured or purchase either right at the time of delivery or after the delivery, but hardly ever during pregnancy as a part of preparedness for delivery, combined with the lack of readily available funds, results in people not obtaining the products.

When people were purchasing the products, they preferred for them to not be sold bundled (CHX and CDK bundled together as one package). People stated that CDK may not be needed all of the time, especially if families don't get around to purchasing CHX until after the delivery, at which time the CDK is no longer needed. Some families also found the combined cost of the two products to be unaffordable. They found buying one product or the other to be far more affordable. If the two were sold together, they recommended a combined price of BDT 30-40, and certainly not more than BDT 50.

Despite these financial considerations, most families stated a preference to have both the CHX and the CDK, though not necessarily both at the same time. People view CDK and CHX as related since CDK is for delivery and cord cutting, while CHX is for the care of the cord. People expressed less willingness to pay for CDKs, since they are perceived to be universally free (in fact, CDKs are not sold in the market).

Conclusions and Recommendations

For CHX to be an effective intervention in reducing neonatal mortality, ideally families should obtain it prior to delivery, apply it for the first time as soon as possible after delivery, and apply it correctly. In this study there was broad acceptance of, and demand for, CHX in the study communities. However, many families did not obtain CHX, and of those that did many applied it for the first time after 24 hours, or applied it incorrectly. These factors limiting effectiveness are summarized in Figure 3. Factors limiting the effectiveness of the intervention can be grouped into two categories, according to Figure 3. All of these factors are associated with CHX use according to data from this study. The strongest constraining factors statistically are 1) delivery in a health facility, 2) lack of a reminder to obtain or use CHX, 3) lack of perceived benefits of CHX for the baby, and 4) low self-efficacy for CHX application. In Figure 3, the factors are categorized into two groups: problems with promotion, sales and distribution, and problems with acceptance, affordability and application of CHX. Significant associations were found in both groups of factors.

Group 1: Problems with promotion, sales and distribution

- Insufficient exposure to information about CHX
- Lack of information about where to obtain CHX
- CHX is not in stock with the public or private sector provider distributing or selling it
- CHX not available or not applied during deliveries in health facilities
- Provider distributing or selling CHX does not provide instructions on how to apply it, or demonstrate how to apply it
- No reminder to obtain or apply CHX

Group 2: Problems with acceptance, affordability and application of CHX

- Persons did not see the benefits of CHX for the baby
- Person could not afford CHX
- Family did not get around to applying CHX within the first 24 hours
- Low self-efficacy for correction application of CHX

At the time of writing this report, we are still discussing what recommendations to make. The following is a preliminary set of recommendations:

1. Two very different products, CHX in a screw top bottle with cotton balls as applicators, and CHX in a nozzle bottle, both enjoyed high acceptance. There are concerns that insufficient amounts of CHX were applied with the nozzle bottle product based on observation of application during pretesting of the nozzle bottle. This warrants further investigation.
2. CHX should be promoted, and available, at both the community and health facility levels. This not only increases the proportion of babies receiving CHX during the first 24 hours, but also demonstrates to families of women delivering at home that this is a standard recommendation accepted and used by the formal health services.
3. Written instructions alone, regardless of how they are designed, appear to have limited ability to increase self-efficacy for correct application of CHX. Face-to-face explanation and demonstration likely are also needed. TBAs seem particularly willing and able to provide these explanations. When CHX is made available for sale in pharmacies and shops, program managers should work to ensure that adequate explanation and demonstration are provided at the same time.
4. Reminders to obtain and apply CHX are extremely important. Promotion of CHX might target both those who will apply CHX, and those who will remind others to apply it e.g. “husbands, be sure to remind your wife and relatives to apply CHX to the newborn as soon as possible after birth”.
5. Promotion and sales of CHX through TBAs addresses most of the factors limiting effective coverage with CHX. For TBAs to play this role, a system of resupply to TBAs for CHX would need to be created and monitored. This might occur by integrating CHX into an existing supply system for CDKs, if one exists.

Appendix 1: Tables

Characteristics of respondents in final household survey in July-August 2009

Characteristics of respondents in the final household survey of recently delivered women in July-August 2009

Respondent characteristics	Frequency (n=314)	(%)
Outcome of birth		
Alive	299	95.2
Stillbirth	4	1.3
Abortion	11	3.5
Sex of infant (only for live birth)		
Male	144	48.2
Female	155	51.8
Outcome type		
Single birth	297	94.6
Multiple Birth	6	1.9
Don't know	11	3.5
Maternal age		
<15	0	0.0
15-24	135	43.0
25-34	148	47.1
35-44	31	9.9
>44	0	0.0
Marital status		
Married	313	99.7
Other	1	0.3
Maternal literacy		
Can read	256	81.5
Cannot read	58	18.5
Maternal education		
No formal education	59	18.8
1-5 years education completed	84	26.8
6-9 years completed	147	46.8
10+ years completed	24	7.6
Paternal literacy		
Can read	243	77.4
Cannot read	71	22.6
Paternal education		
No formal education	73	23.3
1-5 years education completed	114	36.3
6-9 years completed	90	28.7
10+ years completed	34	10.8
Don't know	3	1.0

General maternal and newborn care practices**Antenatal and delivery care practices in final household survey**

N=299 live births

	Overall	Maternal education						Attendance at community meetings			
		Cannot read	Can read	No formal education	1-5yrs completed	6-9 yrs completed	10+ yrs completed	Mother attended only	Family member attended only	Mother and family member attended	No one attended
Attended any ANC	226 (75.6)	26 (48.2)	200 (81.6)	27 (49.1)	59 (72.8)	118 (84.9)	22 (91.7)	41 (68.3)	6 (75.0)	54 (90.0)	125 (73.1)
Attended ANC (4+)	76 (25.4)	6 (11.1)	70 (28.6)	6 (10.9)	12 (14.8)	46 (33.1)	12 (50.0)	13 (21.7)	3 (37.5)	15 (25.0)	45 (26.3)
Received TT injection during pregnancy	99 (33.1)	15 (27.8)	84 (34.3)	15 (27.3)	25 (30.9)	47 (33.8)	12 (50.0)	17 (28.3)	2 (25.0)	16 (26.7)	64 (37.4)
Facility delivery#	140 (46.8)	10 (18.5)	130 (53.1)	10 (18.2)	31 (38.3)	81 (51.3)	18 (75.0)	19 (31.7)	5 (62.5)	28 (46.7)	88 (51.5)
Total	299	54	245	55	81	139	24	60	8	60	171
Delivery assisted by skilled attendant **	90 (56.6)	26 (59.1)	64 (55.7)	27 (60.0)	28 (56.0)	34 (58.6)	1 (16.7)	29 (70.7)	0 (0.0)	20 (62.5)	41 (49.4)
Total	159	44	115	45	50	58	6	41	3	32	83

* Unless otherwise indicated

**Home delivery only

***Skilled attendant includes TTBA, Doctors and nurse

#Facility delivery - FWC, THC, Medical college hospital, Private clinic/ hospital

Cord cutting and tying practices in final household survey

N=159 home deliveries

	Overall	Maternal education						Attendance at community meetings			
		Cannot read	Can read	No formal education	1-5yrs completed	6-9 yrs completed	10+ yrs completed	Mother attended only	Family member attended only	Mother and family member attended	No one attended
Timing of cord cutting											
Before delivery of placenta	8 (5.0)	1 (2.3)	7 (6.1)	2 (4.4)	2 (4.0)	3 (5.2)	1 (16.7)	3 (7.3)	0 (0.0)	2 (6.3)	3 (3.6)
After delivery of placenta	146 (91.8)	41 (93.2)	105 (91.3)	41 (91.1)	47 (94.0)	54 (93.1)	4 (66.7)	36 (87.8)	2 (66.7)	30 (93.8)	78 (94.0)
Don't know	5 (3.1)	2 (4.6)	3 (2.6)	2 (4.4)	1 (2.0)	1 (1.7)	1 (16.7)	2 (4.8)	1 (33.3)	0 (0.0)	2 (2.4)
Material used to tie cord											
Thread from CDK	93 (58.5)	21 (47.7)	72 (62.6)	22 (48.9)	35 (70.0)	33 (56.9)	3 (50.0)	27 (65.9)	3 (100.0)	23 (71.9)	40 (48.2)
Other thread	59 (37.1)	20 (45.5)	39 (33.9)	20 (44.4)	40 (28.0)	23 (39.7)	2 (33.3)	12 (29.3)	0 (0.0)	9 (28.1)	38 (45.8)
Plastic clamp (from hospital)	1 (0.6)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.2)
Cord was not tied before cutting it	3 (1.9)	1 (2.3)	2 (1.7)	1 (2.2)	0 (0.0)	1 (1.7)	1 (16.7)	1 (2.4)	0 (0.0)	0 (0.0)	2 (2.4)
Don't know	3 (1.9)	2 (4.6)	1 (0.9)	2 (4.4)	1 (2.0)	0 (0.0)	0 (0.0)	1 (2.4)	0 (0.0)	0 (0.0)	2 (2.4)
Pieces of thread used (median, range)	2.7±1.2 3, (1,8)	2.5±0.8 3, (1,4)	2.7±1.3 3, (1,8)	2.6±0.8 3, (1,4)	2.9±1.3 3, (1,8)	2.6±1.4 2, (1,7)	2.8±0.4 3, (2,3)	2.6±0.9 3, (1,4)	2.3±0.6 2, (2,3)	2.5±1.2 2, (1,7)	2.8±1.4 3, (1,8)
Length of cord after cutting (angul) (median, range)	4.3±1.4 4, (1,8)	4.2±1.6 4, (1,8)	4.4±1.3 4, (1,8)	4.2±1.6 4, (1,8)	4.4±1.6 4, (1,8)	4.3±1.0 4, (3,8)	4.7±1.6 4, (4,8)	4.1±1.4 4, (1,8)	4.0±0.0 4, (4,4)	4.4±1.2 4, (3,8)	4.4±1.5 4, (1,8)
Total	159	44	115	45	50	58	6	41	3	32	83

Distribution and collection of chlorhexidine

Collection and application of chlorhexidine in home and health facility deliveries

	Deliveries at home	Deliveries at health facilities	All deliveries
Number of live births in final household survey	159 live births	140 live births	299 live births
Chlorhexidine was collected and/or purchased	107/159 (67.3%)	67/140 (47.9%)	174/299 (58.2%)
Timing of collection/purchase			
Before delivery	91/107 (85.0%)	55/67 (82.1%) 43/55 used	146/174 (83.9%)
After delivery	16/107 (15.0%)	12/67 (17.9%) 10/12 used	28/174 (16.1%)
Timing of first application			
Immediate after cord cutting	78/107 (72.9%)	13/67 (19.4%)	91/174 (52.3%)
Within 24 hrs of birth	19/107 (17.8%)	25/67 (37.3%)	44/174 (25.3%)
After 24 hrs, during first week	10/107 (9.3%)	15/67 (22.4%)	25/174 (14.4%)
Never applied	0/107 (0.0%)	14/67 (20.9%)	14/174 (8.0%)

Factors associated with collection of chlorhexidine

(N=299 live births)

	Collected CHX Freq (row percent)	Did not collect Freq (row percent)	Odds Ratio (95% CI)
Sample size	174 live births	125 live births	
Place of delivery			
Delivered in health facility	67 (47.9%)	73 (52.1%)	1
Delivered at home	107 (67.3%)	52 (32.7%)	2.24 (1.37, 3.68)
Attendance at community meetings organized by the project			
No one attended	74 (43.5%)	96 (56.5%)	1
Mother attended	48 (80.0%)	12 (20.0%)	5.19 (2.46, 11.15)
Family member attended	7 (87.5%)	1 (12.5%)	9.08 (1.07, 200.71)
Both family member and mother attended	45 (75.0%)	15 (25.0%)	3.89 (1.93, 7.94)
Exposure to communication materials of the project *			
Low (score 0, 1, 2)	36 (28.8%)	89 (71.2%)	1
Med (score 3, 4, 5)	83 (74.8%)	28 (25.2%)	7.33 (3.96, 13.65)
High (score 6, 7)	55 (88.7%)	7 (11.3%)	19.42 (7.60, 51.81)
Reminder by TBA to collect CHX			
No reminder	117 (49.4%)	120 (50.6%)	1
Reminded by TBA	56 (94.9%)	3 (5.1%)	19.15 (5.57, 78.88)
Reminder by family member to collect CHX			
No reminder	120 (49.6%)	122 (50.4%)	1
Family member reminded	54 (96.4%)	2 (3.6%)	27.45 (6.36, 166.56)

*BCC exposure level : (low= score of 0-2, med= score of 3-5, high= score of 6-7) with each BCC channel weighted equally with 1 point (Poster, Leaflet, Song, Sticker, Community meeting, CHX bottle, CHX instructions)

Sources and purchase of chlorhexidine: Associations with maternal education and wealth

	Overall	Maternal Education						Wealth Quintiles				
		Cannot read (n=30)	Can read (n=144)	No formal education (n=31)	1-5yrs completed (n=56)	6-9 yrs completed (n=76)	10+ yrs completed (n=11)	1 st (bottom) (n=40)	2 nd (n=36)	3 rd (n=42)	4 th (n=31)	5 th (top) (n=25)
Where did people collect or purchase chlorhexidine? (N=174 who collected chlorhexidine)												
Projahnmo HC	5 (2.9)	3 (10.0)	2 (1.4)	3 (9.7)	0 (0.0)	2 (2.6)	0 (0.0)	1 (2.5)	1 (2.8)	0 (0.0)	3 (9.7)	0 (0.0)
FWC	38 (21.8)	5 (16.7)	33 (22.9)	5 (16.1)	12 (21.4)	16 (21.1)	5 (45.5)	9 (22.5)	7 (19.4)	6 (14.3)	9 (29.0)	7 (28.0)
Satellite clinic	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
EPI Health assistant	53 (30.5)	11 (36.7)	42 (29.2)	11 (35.5)	19 (33.9)	21 (27.6)	2 (18.2)	15 (37.5)	13 (36.1)	14 (33.3)	8 (25.8)	3 (12.0)
FWA	6 (3.5)	0 (0.0)	6 (4.2)	0 (0.0)	2 (3.6)	4 (5.3)	0 (0.0)	2 (5.0)	1 (2.8)	1 (2.4)	1 (3.2)	1 (4.0)
TBA	62 (35.6)	11 (36.7)	51 (35.4)	12 (38.7)	18 (32.1)	29 (38.2)	3 (27.3)	12 (30.0)	14 (38.9)	19 (45.2)	8 (25.8)	9 (36.0)
Pharmacy	9 (5.2)	0 (0.0)	9 (6.3)	0 (0.0)	4 (7.1)	4 (5.3)	1 (9.1)	1 (2.5)	0 (0.0)	1 (2.4)	2 (6.5)	5 (20.0)
Other	1 (0.6)	0 (0.0)	1 (0.7)	0 (0.0)	1 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.4)	0 (0.0)	0 (0.0)
What products were collected or purchased? (N=299 live births)												
CHX only	21 (7.0)	3 (5.6)	18 (7.4)	3 (5.5)	5 (6.2)	11 (7.9)	2 (8.3)	1 (1.6)	6 (10.7)	5 (7.8)	4 (6.0)	5 (10.4)
CDK only	6 (2.0)	2 (3.7)	4 (1.6)	2 (3.6)	1 (1.2)	1 (0.7)	2 (8.3)	2 (3.1)	1 (1.8)	2 (3.1)	1 (1.5)	0 (0.0)
CHX and CDK bundled	147 (49.2)	27 (50.0)	120 (49.0)	28 (50.9)	50 (61.7)	63 (45.3)	6 (25.0)	39 (60.9)	30 (53.6)	36 (56.3)	25 (37.3)	17 (35.4)
CHX and CDK separately	5 (1.7)	0 (0.0)	5 (2.0)	0 (0.0)	1 (1.2)	2 (1.4)	2 (8.3)	0 (0.0)	0 (0.0)	1 (1.6)	1 (1.5)	3 (6.3)

	Overall	Maternal Education						Wealth Quintiles				
		Cannot read (n=30)	Can read (n=144)	No formal education (n=31)	1-5yrs completed (n=56)	6-9 yrs completed (n=76)	10+ yrs completed (n=11)	1 st (bottom) (n=40)	2 nd (n=36)	3 rd (n=42)	4 th (n=31)	5 th (top) (n=25)
Don't collect CDK / CHX	119 (39.8)	22 (40.7)	97 (39.6)	22 (40.0)	24 (29.6)	62 (44.6)	11 (45.8)	22 (34.4)	19 (33.9)	20 (31.3)	35 (52.2)	23 (47.9)
Don't know	1 (0.3)	0 (0.0)	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)
Time of collection of chlorhexidine (N=174 who collected chlorhexidine)												
Before delivery	146 (83.9)	24 (80.0)	122 (84.7)	25 (80.7)	52 (92.9)	63 (82.9)	6 (54.6)	36 (90.0)	29 (80.6)	37 (88.1)	26 (83.9)	18 (72.0)
After delivery	28 (16.1)	6 (20.0)	22 (15.3)	6 (19.4)	4 (7.1)	13 (17.1)	5 (45.5)	4 (10.0)	7 (19.4)	5 (11.9)	5 (16.1)	7 (28.0)

*

Chlorhexidine application practices

Reported chlorhexidine application practices on final survey

(N=299 live births)

	Freq	%
Obtained CHX (Collected or purchased)	174/299	58.2
Used CHX	160/299	53.5
Number of days applied - Mean, SD Median (Range)	7.2 +/- 2.4 7 (1, 20)	
Washed hands before CHX application	133/160	83.1
First application immediately after cord cutting	91/160	56.9
First application later but within 24 hours of birth	44/160	27.5
Area of CHX application: Prior to cord separation		
Base	108/160	67.5
Stump	119/160	74.4
Tip	109/160	68.1
Area of CHX application: After cord separation		
Middle Umbilicus	45/66	68.2
Around Umbilicus	42/66	63.6

Substances applied to umbilical cord*

	Immediately after cord	Before cord separation	After cord separation
Mustard oil	2 (0.7)	5 (1.7)	5 (1.7)
Other oil	0 (0.0)	1 (0.3)	0 (0.0)
Ash	0 (0.0)	3 (1.0)	5 (1.7)
Mud	0 (0.0)	2 (0.7)	3 (1.0)
Saliva	0 (0.0)	0 (0.0)	1 (0.3)
Breast milk	0 (0.0)	0 (0.0)	0 (0.0)
Chlorhexidine	98 (32.8)	160 (53.5)	68 (22.7)
Other antiseptic	3 (1.0)	1 (0.3)	1 (0.3)
Herbs/spices	0 (0.0)	0 (0.0)	0 (0.0)
Other **	70 (23.4)	66 (22.1)	90 (30.1)
Apply nothing	130 (43.5)	71 (23.8)	137 (45.8)

** Others include : Heat Messages, Hexasol, Dust of rice, Tamarind powder, Nebanol powder, Extract of ginger, Bractoben, Plastic's for safe, Antiseptic , Bractone ointment, Zisol, Extract of tamarind, Kandi Medicine, Cream, Homeopathic medicine, Pebison Cream, Ink, Medicine, Vermilion, Tibet Powder, Boric Powder, Sprit, Gentian Violet

Reported correct application of CHX by different indicators: Overview analysis

Frequencies and row percents, N=160

Correct Application defined :				
<ul style="list-style-type: none"> • Low= score of 0-2 • Medium= score of 3-5 • High= score of 6-7 				
Each component given one point : application within first 24hrs of birth, application to base, application to stump, application to tip, application for 0<=x<=7; application for 3<=x<=6; application for x=7.				
		Reported correct application of chlorhexidine, of those who used CHX (n=160) – Freq & Row %		
		Low (n=15)	Med (n=69)	High (n=76)
Exposure to communication materials*				
Low (score 0, 1, 2)	9/32 (28.1%)	11/32 (34.4%)	12/32 (37.5%)	
Med (score 3, 4, 5)	3/75 (4.0%)	30/75 (40.0%)	42/75 (56.0%)	
High (score 6, 7)	3/53 (5.7%)	28/53 (52.8%)	22/53 (41.5%)	
Where was chlorhexidine collected?				
Family Welfare Centre	4/37	11/37	22/37	
Health Assistant	2/44	21/44	21/44	
Traditional birth attendant	4/59	29/59	26/59	
Who collected chlorhexidine?				
Mother of newborn	6/80	32/80	42/80	
Father of newborn	1/22	18/22	3/22	
Paternal grandmother	2/20	8/20	10/20	
Other	2/23	6/23	15/23	
Wealth Quintile				
Lowest	4/39	13/39	22/39	
Second	0/35	10/35	25/35	
Middle	3/37	18/37	16/37	
Fourth	4/29	17/29	8/29	
Highest	4/19	11/19	5/19	
Person first applying CHX				
Traditional birth attendant	1/39 (2.6%)	15/39 (38.5%)	23/39 (59.0%)	
Mother of newborn	8/74 (10.8%)	36/74 (48.6%)	30/74 (40.5%)	
Other	2/23 (8.7%)	6/23 (26.1%)	15/23 (65.2%)	
Attended community meeting				
Yes	3/88 (3.4%)	42/88 (47.7%)	43/88 (48.9%)	
No	12/72 (16.7%)	27/72 (37.4%)	33/72 (45.8%)	
Maternal literacy				
Can read	2/30	9/30	19/30	
Cannot read	13/130	60/130	57/130	

* Respondents were given one point for each communication material to which they were exposed (poster, song, community meeting, CHX bottle, CHX instruction, sticker, leaflet). Their score was the sum of all points received from exposure to communication materials.

Associations with reported correct application of chlorhexidine

	Used CHX	Washed hands with soap before applying	Number of days applied	First application			Applied to the umbilical			After cord separation, applied**	
				Immediately after cord cutting	Within 24 hrs of birth	>24 hrs after birth	Stump	Base	Tip	In middle of umbilicus	Around umbilicus
Overall (n=299 live births)	160 (53.5)	133 (83.1)	7.2 ± 2.4 7 (1, 20)	91 (56.9)	44 (27.5)	25 (15.6)	108 (67.5)	119 (74.4)	109 (68.1)	45 (68.2)	42 (63.6)
Maternal literacy											
Can read (n=245)	130 (53.1)	105 (80.8)	7.3 ± 2.7 7 (1, 20)	71 (54.6)	37 (28.5)	22 (16.9)	87 (66.9)	98 (75.4)	86 (66.2)	38 (69.1)	36 (65.5)
Cannot read (n=54)	30 (55.6)	28 (93.3)	6.9 ± 0.8 7 (3, 9)	20 (66.7)	7 (23.3)	3 (10.0)	21 (70.0)	21 (70.0)	23 (76.7)	7 (63.6)	6 (54.6)
Maternal education											
No formal education (n=55)	31 (56.4)	29 (93.6)	6.9 ± 0.83 7 (3,9)	21 (67.7)	7 (22.6)	3 (9.7)	21 (67.7)	21 (67.7)	24 (77.4)	7 (63.6)	6 (54.6)
1-5years education completed (n=81)	55 (67.9)	49 (89.9)	7.3 ± 2.8 7 (1, 20)	38 (69.1)	9 (16.4)	8 (14.6)	37 (67.3)	46 (83.6)	38 (69.1)	17 (77.3)	13 (59.1)
6-9 years completed (n=139)	66 (47.5)	49 (74.2)	7.3 ± 2.6 7 (1, 19)	29 (43.9)	25 (37.9)	12 (18.2)	43 (65.2)	49 (74.2)	44 (66.7)	18 (66.7)	18 (66.7)
10+ years completed (n=24)	8 (33.3)	6 (75.0)	6.9 ± 1.9 7 (3, 10)	3 (37.5)	3 (37.5)	2 (25.0)	7 (87.5)	3 (37.5)	3 (37.5)	3 (50.0)	5 (83.3)
Receipt of instructions on chlorhexidine application											
Received instructions about how to apply CHX(n=181)	139 (76.8)	115 (82.7)	7.2 ± 2.6 7 (1, 20)	80 (57.6)	36 (25.9)	23 (16.6)	95 (68.4)	102 (73.4)	95 (68.4)	41 (67.2)	41 (67.2)
Cell phone ownership											
Owns a cell phone (n=101)	43 (42.6)	33 (76.7)	7.2 ± 2.9 7 (1, 19)	25 (58.1)	9 (20.9)	9 (20.9)	28 (65.1)	32 (74.4)	26 (60.5)	15 (65.2)	18 (78.3)
Family member owns cell phone (n=216)	112 (51.9)	91 (81.3)	7.3 ± 2.8 7 (1,20)	54 (48.2)	39 (34.8)	19 (17.0)	79 (70.5)	83 (74.1)	72 (64.3)	34 (66.7)	36 (70.6)
Neither respondent nor family owns cell phone (n=70)	43 (61.4)	39 (90.7)	6.9 ± 0.71 7 (3, 9)	32 (74.4)	5 (11.6)	6 (14.0)	28 (65.1)	31 (72.1)	34 (79.1)	10 (76.9)	4 (30.8)

** CHX applied after cord separation (If Q503G=yes)

Clean Delivery Kits: Distribution and Use

Source and use of clean delivery kits (CDK)

	Freq	%
Used CDK (of Home Deliveries n=159)	97/159	61.0
Source of clean delivery kit		
Family Welfare Centre	20/97	20.6
Health Assistant	26/97	26.8
Traditional Birth Attendant	39/97	40.2
Characteristics of Use		
Placed mother on plastic sheet from CDK	78/97	80.4
Placed baby on plastic sheet from CDK	80/97	82.5
Used blade from CDK to cut cord	95/97	97.9
Used thread from CDK to tie cord	93/97	95.9
Used gauze from CDK	84/97	86.6
Use of CDK Soap		
Before delivery	86/97	88.7
After delivery	88/97	90.7
Before CHX application	21/97	21.7
Did not use	1/97	1.0

Patterns of use of clean delivery kits

N = 97 home deliveries where CDK used**

	Used CDK	Placed mother on plastic sheet from CDK	Placed baby on plastic sheet from CDK	Used blade from CDK to cut cord	Used thread from CDK to tie cord	Used gauze from CDK	Use of CDK soap			
							Before delivery	After delivery	Before CHX application	Did not use
Overall (n=159)	97 (61.0)	78 (80.4)	80 (82.5)	95 (97.9)	93 (95.9)	84 (86.6)	86 (88.7)	88 (90.7)	21 (21.7)	1 (1.0)
Maternal literacy										
Can read (n=115)	74 (64.4)	63 (85.1)	60 (81.1)	72 (97.3)	72 (97.3)	62 (83.8)	68 (91.9)	65 (87.8)	18 (24.3)	1 (1.4)
Cannot read (n=44)	23 (52.3)	15 (65.2)	20 (87.0)	23 (100.0)	21 (91.3)	22 (95.7)	18 (78.3)	23 (100.0)	3 (13.0)	0 (0.0)
Maternal education										
No formal education (n=45)	24 (53.3)	16 (66.7)	21 (87.5)	24 (100.0)	22 (91.7)	23 (95.8)	19 (79.2)	24 (100.0)	3 (12.5)	0 (0.0)
1-5years education completed (n=50)	35 (70.0)	30 (85.7)	29 (82.9)	35 (100.0)	35 (100.0)	29 (82.9)	33 (94.3)	29 (82.9)	10 (28.6)	0 (0.0)
6-9 years completed (n=58)	35 (60.3)	30 (85.7)	27 (77.1)	34 (97.1)	33 (94.3)	31 (88.6)	32 (91.4)	33 (94.3)	8 (22.9)	0 (0.0)
10+ years completed (n=6)	3 (50.0)	2 (66.7)	3 (100.0)	2 (66.7)	3 (100.0)	1 (33.3)	2 (66.7)	2 (66.7)	0 (0.0)	1 (33.3)
Explanation of instructions										
Read CDK instructions or instructions were explained (n=86)	85 (98.8)	70 (82.4)	72 (84.7)	83 (97.7)	81 (95.3)	74 (87.1)	77 (90.6)	78 (91.8)	21 (24.7)	1 (1.2)

* Home delivery only

** Variables analyzed here are Q405 Q407 Q408 Q412 Q414

Channels of communication

Summary of qualitative findings regarding channels of communication

	Where was it distributed?	Challenges in implementation
Leaflet	<ul style="list-style-type: none"> • Male and female meeting • Used by TBA for explanation • Distributed during song miking 	<ul style="list-style-type: none"> • For scale up, must determine if needed in addition to CHX instruction
CHX instruction sheet	<ul style="list-style-type: none"> • Attached to CHX bottle • Has the potential to reach the greatest number of people through CHX distribution 	<ul style="list-style-type: none"> • After providers explain, people do not read the instructions • Instructions are not fully self-explanatory, people need some assistance • Sketches are difficult to translate
Poster	<ul style="list-style-type: none"> • Market place • Health service point • Meeting point in road • Demonstrated in community meeting 	<ul style="list-style-type: none"> • People do not read the poster in-depth • Thus, a simpler version may be more effective
Sticker	<ul style="list-style-type: none"> • In community meeting place • Health service point • Other public gatherings 	<ul style="list-style-type: none"> • Message differs from posters; confuses people • No pictorial instructions; only used by literates
Folk song	<ul style="list-style-type: none"> • Played in community meetings – mainly targeting women • Played through miking – targeting both men and women 	<ul style="list-style-type: none"> • Words and sentences unclear to many people • More easily understood in community meeting (closed space) • Song does not mention sales
Community meetings	<ul style="list-style-type: none"> • In four unions of Beanibazar Sub-district 	<ul style="list-style-type: none"> • Did not reach men of reproductive age.
TBA meetings	<ul style="list-style-type: none"> • In four unions of Beanibazar, reaching 70 out of 74 TBAs` 	<ul style="list-style-type: none"> • Facilitation and Facilitator • Organizing such meeting with these voluntary group
Orientation of Service Provider	<ul style="list-style-type: none"> • GoB: MO (1); FWV (2); HA (12); FWA (8) • Private: TBAs (74); Drug Sellers (28) 	<ul style="list-style-type: none"> • Participation of senior health professionals and community leaders strengthened the orientations

Exposure to channels of communication

N=299 live births

	Freq	%
Poster	147	49%
Song	84	28%
Leaflet	142	47%
Sticker	104	35%
Community meeting	124	41%
CHX bottle	221	74%
CHX instructions	93	31%
Total	299	100%

Associations of exposure to specific communication materials with maternal education and wealth

	Collected CHX			Maternal education						Wealth Quintiles				
	Overall	Yes	No	Cannot read	Can read	No formal education	1-5yrs complete	6-9 yrs complete	10+ yrs complete	1 st	2 nd	3 rd	4 th	5 th
Sample size	299	174	124	54	245	55	81	139	24	64	56	64	67	48
Have heard of or seen CHX	225 (75.3)	173 (99.4)	52 (41.9)	40 (74.1)	185 (75.5)	41 (74.6)	68 (84.0)	98 (70.5)	18 (75.0)	49 (76.6)	44 (78.6)	55 (85.9)	47 (70.2)	30 (62.5)
Source of information about CHX														
FWC	38 (16.9)	33 (19.1)	5 (9.6)	3 (7.5)	35 (18.9)	3 (7.3)	12 (17.7)	17 (17.4)	6 (33.3)	5 (10.2)	10 (22.7)	8 (14.6)	8 (17.0)	7 (23.3)
Satellite clinic	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPI health assistant	48 (21.3)	37 (21.4)	11 (21.2)	9 (22.5)	39 (21.1)	10 (24.4)	16 (23.5)	17 (17.4)	5 (27.8)	12 (24.5)	8 (18.2)	12 (21.8)	11 (23.4)	5 (16.7)
FWA	5 (2.2)	4 (2.3)	1 (1.9)	0 (0.0)	5 (2.7)	0 (0.0)	2 (2.9)	3 (3.1)	0 (0.0)	1 (2.0)	1 (2.3)	1 (1.8)	1 (2.1)	1 (3.3)
Village doctor	3 (1.3)	3 (1.7)	0 (0.0)	1 (2.5)	2 (1.1)	1 (2.4)	1 (1.5)	1 (1.0)	0 (0.0)	1 (2.0)	0 (0.0)	1 (1.8)	0 (0.0)	1 (3.3)
TBA	39 (17.3)	37 (21.4)	2 (3.9)	12 (30.0)	27 (14.6)	12 (29.3)	10 (14.7)	13 (13.3)	4 (22.2)	10 (20.4)	9 (20.5)	10 (18.2)	5 (10.6)	5 (16.7)
Pharmacist	2 (0.9)	2 (1.2)	0 (0.0)	0 (0.0)	2 (1.1)	0 (0.0)	1 (1.5)	0 (0.0)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.1)	1 (3.3)
Family member/relative	2 (0.9)	2 (1.2)	0 (0.0)	1 (2.5)	1 (0.5)	1 (2.4)	0 (0.0)	1 (1.0)	0 (0.0)	0 (0.0)	1 (2.3)	0 (0.0)	1 (2.1)	0 (0.0)
Friend/ neighbor	4 (1.8)	3 (1.7)	1 (1.9)	1 (2.5)	3 (1.6)	1 (2.4)	2 (2.9)	0 (0.0)	1 (5.6)	2 (4.1)	0 (0.0)	1 (1.8)	0 (0.0)	1 (3.3)
Poster	29 (12.9)	24 (13.9)	5 (9.6)	4 (10.0)	25 (13.5)	4 (9.8)	9 (13.2)	14 (14.3)	2 (11.1)	5 (10.2)	2 (4.6)	6 (10.9)	11 (23.4)	5 (16.7)
Song	20 (8.9)	17 (9.8)	3 (5.8)	3 (7.5)	17 (9.2)	3 (7.3)	7 (10.3)	9 (9.2)	1 (5.6)	2 (4.1)	1 (2.3)	7 (12.7)	6 (12.8)	4 (13.3)
Leaflet	20 (8.9)	16 (9.3)	4 (7.7)	3 (7.5)	17 (9.2)	3 (7.3)	7 (10.3)	9 (9.2)	1 (5.6)	2 (4.1)	0 (0.0)	7 (12.7)	6 (12.8)	5 (16.7)
Sticker	16 (7.1)	14 (8.1)	2 (3.9)	3 (7.5)	13 (7.0)	3 (7.3)	5 (7.4)	6 (6.1)	2 (11.1)	1 (2.0)	1 (2.3)	5 (9.1)	4 (8.5)	5 (16.7)

	Collected CHX			Maternal education						Wealth Quintiles				
	Overall	Yes	No	Cannot read	Can read	No formal education	1-5yrs complete	6-9 yrs complete	10+ yrs complete	1 st	2 nd	3 rd	4 th	5 th
Community meeting	93 (41.3)	69 (39.9)	24 (46.2)	15 (37.5)	78 (42.2)	15 (36.6)	27 (39.7)	47 (48.0)	4 (22.2)	20 (40.8)	14 (31.8)	26 (47.3)	22 (46.8)	11 (36.7)
CHX bottle	30 (13.3)	25 (14.5)	5 (9.6)	5 (12.5)	25 (13.5)	5 (12.2)	8 (11.8)	15 (15.3)	2 (11.1)	2 (4.1)	4 (9.1)	10 (18.2)	8 (17.0)	6 (20.0)
CHX instructions	18 (8.0)	17 (9.8)	1 (1.9)	3 (7.5)	15 (8.1)	3 (7.3)	4 (5.9)	10 (10.2)	1 (5.6)	1 (2.0)	1 (2.3)	6 (10.9)	5 (10.6)	5 (16.7)
Others*	17 (7.6)	8 (4.6)	9 (17.3)	3 (7.5)	14 (7.6)	3 (7.3)	3 (4.4)	11 (11.2)	0 (0.0)	3 (6.1)	6 (13.6)	4 (7.3)	4 (8.5)	0 (0.0)
Have seen BCC materials														
Poster	147 (65.3)	122 (70.5)	25 (48.1)	26 (65.0)	121 (65.4)	27 (65.9)	45 (66.2)	65 (66.3)	10 (55.6)	32 (65.3)	33 (75.0)	34 (61.8)	30 (63.8)	18 (60.0)
Song	84 (37.3)	68 (39.3)	16 (30.8)	17 (42.5)	67 (36.2)	17 (41.5)	29 (42.7)	33 (33.7)	5 (27.8)	21 (42.9)	16 (36.4)	19 (34.6)	17 (36.2)	11 (36.7)
Leaflet	142 (63.1)	115 (66.5)	27 (51.9)	26 (65.0)	116 (62.7)	27 (65.9)	41 (60.3)	64 (65.3)	10 (55.6)	34 (69.4)	27 (61.4)	31 (56.4)	31 (66.0)	19 (63.3)
Sticker	104 (46.2)	81 (46.8)	23 (44.2)	20 (50.0)	84 (45.4)	21 (51.2)	32 (47.1)	43 (43.9)	8 (44.4)	25 (51.0)	20 (45.5)	24 (43.6)	19 (40.4)	16 (53.3)
Community meeting	124 (55.1)	97 (56.1)	27 (51.9)	24 (60.0)	100 (54.1)	25 (61.0)	42 (61.8)	52 (53.1)	5 (27.8)	29 (59.2)	22 (50.0)	35 (63.6)	24 (51.1)	14 (46.7)
CHX bottle	221 (98.2)	172 (99.4)	49 (94.2)	39 (97.5)	182 (98.4)	40 (97.6)	68 (100.0)	96 (98.0)	17 (94.4)	48 (98.0)	43 (97.7)	54 (98.2)	47 (100.0)	29 (96.7)
CHX instructions	93 (41.3)	86 (49.7)	7 (13.5)	15 (37.5)	78 (42.2)	15 (36.6)	31 (45.6)	38 (38.8)	9 (50.0)	21 (42.9)	16 (36.4)	22 (40.0)	21 (44.7)	13 (43.3)
Other**	4 (1.8)	3 (1.7)	1 (1.9)	3 (7.5)	1 (0.5)	3 (7.3)	0 (0.0)	1 (1.0)	0 (0.0)	2 (4.1)	1 (2.3)	1 (1.8)	0 (0.0)	0 (0.0)

* Others includes - Projahnmo person, Other family members, Pharmacy, Woman's father home, BRAC, Union office, Mathiura office.

** Others includes - Told about Medicine, go to Family Welfare Centre, Traditional Birth Attendant

Associations of overall level exposure to communication materials with maternal education and wealth

Index of Exposure	Over- all	Collected CHX		Maternal education						Wealth Quintiles				
		Yes	No	Cannot read	Can read	No formal educa- tion	1-5yrs complete	6-9 yrs complete	10+ yrs complete	1 st	2 nd	3 rd	4 th	5 th
Sample size	299	174	124	54	245	55	81	139	24	64	56	64	67	48
Scale reliability coefficient	0.84	0.72	0.84	0.88	0.83	0.88	0.80	0.85	0.74	0.87	0.78	0.83	0.83	0.88
Grade 0	64 (21.4)	1 (0.6)	63 (50.8)	13 (24.1)	51 (20.8)	13 (23.6)	10 (12.4)	35 (25.2)	6 (25.0)	15 (23.4)	9 (16.1)	8 (12.5)	15 (22.4)	17 (35.4)
Grade 1	35 (11.7)	15 (8.6)	19 (15.3)	6 (11.1)	29 (11.8)	6 (10.9)	8 (9.9)	19 (13.7)	2 (8.3)	6 (9.4)	5 (8.9)	8 (12.5)	10 (14.9)	6 (12.5)
Grade 2	27 (9.0)	20 (11.5)	7 (5.7)	6 (11.1)	21 (8.6)	6 (10.9)	7 (8.6)	13 (9.4)	1 (4.2)	5 (7.8)	5 (8.9)	10 (15.6)	5 (7.5)	2 (4.2)
Grade 3	40 (13.4)	32 (18.4)	8 (6.5)	7 (13.0)	33 (13.5)	7 (12.7)	13 (16.1)	14 (10.1)	6 (25.0)	7 (10.9)	14 (25.0)	6 (9.4)	7 (10.5)	6 (12.5)
Grade 4	38 (12.7)	24 (13.8)	14 (11.3)	4 (7.4)	34 (13.9)	4 (7.3)	13 (16.1)	17 (12.2)	4 (16.7)	7 (10.9)	6 (10.7)	11 (17.2)	11 (16.4)	3 (6.3)
Grade 5	33 (11.0)	27 (15.5)	6 (4.8)	3 (5.6)	30 (12.2)	4 (7.3)	9 (11.1)	16 (11.5)	4 (16.7)	7 (10.9)	6 (10.7)	5 (7.8)	8 (11.9)	7 (14.6)
Grade 6	31 (10.4)	26 (14.9)	5 (4.0)	7 (13.0)	24 (9.8)	7 (12.7)	11 (13.6)	13 (9.4)	0 (0.0)	9 (14.1)	7 (12.5)	7 (10.9)	6 (9.0)	2 (4.2)
Grade 7	31 (10.4)	29 (16.7)	2 (1.6)	8 (14.8)	23 (9.4)	8 (14.6)	10 (12.4)	12 (8.6)	1 (4.2)	8 (12.5)	4 (7.1)	9 (14.1)	5 (7.5)	5 (10.4)

Applying the Health Belief Model to understanding factors affecting CHX purchase and timely application

Associations between constructs in the Health Belief Model and use of CHX and CDK

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Did you think there was any possibility that your baby would have an umbilical infection?					
Very possible	4 (1.3)	1 (0.6)	3 (2.2)	0 (0.0)	4 (2.0)
Possible	2 (0.7)	2 (1.3)	0 (0.0)	0 (0.0)	2 (1.0)
Somewhat possible	45 (15.1)	26 (16.3)	19 (13.7)	12 (12.4)	33 (16.3)
Low possibility	36 (12.0)	27 (16.9)	9 (6.5)	17 (17.5)	19 (9.4)
Not possible	212 (70.9)	104 (65.0)	108 (77.7)	68 (70.1)	144 (71.3)
How worried were you about your baby getting an umbilical infection?					
Very worried	14 (4.7)	11 (6.9)	3 (2.2)	6 (6.2)	8 (4.0)
Worried	56 (18.7)	33 (20.6)	23 (16.6)	18 (18.6)	38 (18.8)
Somewhat worried	48 (16.1)	27 (16.9)	21 (15.1)	12 (12.4)	36 (17.8)
Slightly worried	20 (6.7)	12 (7.5)	8 (5.8)	9 (9.3)	11 (5.5)
Not worried	161 (53.9)	77 (48.1)	84 (60.4)	52 (53.6)	109 (54.0)
Are umbilical infections very bad, somewhat bad or not bad at all and nothing to worry about?					
Very bad	33 (11.0)	17 (10.6)	16 (11.5)	9 (9.3)	24 (11.9)
Bad	211 (70.6)	114 (71.3)	97 (69.8)	74 (76.3)	137 (67.8)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Somewhat bad	40 (13.4)	23 (14.4)	17 (12.2)	12 (12.4)	28 (13.9)
Slightly bad	3 (1.0)	0 (0.0)	3 (2.2)	0 (0.0)	3 (1.5)
Not bad	12 (4.0)	6 (3.8)	6 (4.3)	2 (2.1)	10 (5.0)
How much benefit do babies get from having CHX applied to their umbilicus (nabhi)?					
Benefited a lot	79 (26.4)	60 (37.5)	19 (13.7)	32 (33.0)	47 (23.3)
Benefited	90 (30.1)	63 (39.4)	27 (19.4)	38 (39.2)	52 (25.7)
Benefited somewhat	68 (22.7)	26 (16.3)	42 (30.2)	16 (16.5)	52 (25.7)
Slight benefit	3 (1.0)	1 (0.6)	2 (1.4)	1 (1.0)	2 (1.0)
No benefit	12 (4.0)	10 (6.3)	2 (1.4)	9 (9.3)	3 (1.5)
How difficult is it to obtain CHX? **					
Very difficult	1 (0.6)	1 (0.6)	0 (0.0)	0 (0.0)	1 (1.3)
Difficult	13 (7.5)	12 (7.5)	1 (7.1)	7 (7.5)	6 (7.5)
Somewhat difficult	25 (14.4)	21 (13.1)	4 (28.6)	13 (13.8)	12 (15.0)
Slightly difficult	8 (4.6)	7 (4.4)	1 (7.1)	3 (3.2)	5 (6.3)
Not difficult	125 (71.8)	118 (73.8)	7 (50.0)	70 (74.5)	55 (68.8)
Don't know	2 (1.2)	1 (0.6)	1 (7.1)	1 (1.1)	1 (1.3)
Regarding obtaining CHX, how much of a barrier were your family members? **					

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Opposed a lot	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Opposed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Somewhat opposed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Slightly opposed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
No opposition	169 (97.1)	160 (100.0)	9 (64.3)	94 (100.0)	75 (93.8)
Don't know	5 (2.9)	0 (0.0)	5 (35.7)	0 (0.0)	5 (6.3)
How difficult did you find it to apply CHX to your baby's nabhi? **					
Very difficult	1 (0.6)	1 (0.6)	0 (0.0)	1 (1.1)	0 (0.0)
Difficult	4 (2.3)	4 (2.5)	0 (0.0)	2 (2.1)	2 (2.5)
Somewhat difficult	20 (11.5)	20 (12.5)	0 (0.0)	9 (9.6)	11 (13.8)
Slightly difficult	4 (2.3)	4 (2.5)	0 (0.0)	2 (2.1)	2 (2.5)
Not difficult	136 (78.2)	130 (81.3)	6 (42.9)	79 (84.0)	57 (71.3)
Don't know	9 (5.2)	1 (0.6)	8 (57.1)	1 (1.1)	8 (10.0)
Do you think it is difficult to apply CHX on the cord when it has become stiff? **					
Very difficult	1 (0.6)	1 (0.6)	0 (0.0)	1 (1.1)	0 (0.0)
Difficult	8 (4.6)	7 (4.4)	1 (7.1)	6 (6.4)	2 (2.5)
Somewhat difficult	19 (10.9)	18 (11.3)	1 (7.1)	14 (14.9)	5 (6.3)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Slightly difficult	3 (1.7)	2 (1.3)	1 (7.1)	2 (2.1)	1 (1.3)
Not difficult	109 (62.6)	107 (66.9)	2 (14.3)	62 (66.0)	47 (58.8)
Don't know	34 (19.5)	25 (15.6)	9 (64.3)	9 (9.6)	25 (31.3)
In your opinion, is the price of CHX too high, high, just right....?					
Too high	11 (3.7)	6 (3.8)	5 (3.6)	3 (3.1)	8 (4.0)
High	35 (11.7)	21 (13.1)	14 (10.1)	13 (13.4)	22 (10.9)
Just right	41 (13.7)	29 (18.1)	12 (8.6)	16 (16.5)	25 (12.4)
Low	150 (50.2)	88 (55.0)	62 (44.6)	51 (52.6)	99 (49.0)
Too low	7 (2.3)	4 (2.5)	3 (2.2)	3 (3.1)	4 (2.0)
Don't know	55 (18.4)	12 (7.5)	43 (30.9)	11 (11.3)	44 (21.8)
How difficult do you think it is to obtain a free bottle of CHX?					
Very difficult	4 (1.3)	2 (1.3)	2 (1.4)	2 (2.1)	2 (1.0)
Difficult	19 (6.4)	8 (5.0)	11 (7.9)	5 (5.2)	14 (6.9)
Somewhat difficult	48 (16.1)	29 (18.1)	19 (13.7)	18 (18.6)	30 (14.9)
Slightly difficult	19 (6.4)	6 (3.8)	13 (9.4)	2 (2.1)	17 (8.4)
Not difficult	169 (56.5)	110 (68.8)	59 (42.5)	65 (67.0)	104 (51.5)
Don't know	40 (13.4)	5 (3.1)	35 (25.2)	5 (5.2)	35 (17.3)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
In your opinion, is the price of CDK too high, high, just right....?					
Too high	7 (2.3)	5 (3.1)	2 (1.4)	3 (3.1)	4 (2.0)
High	33 (11.0)	20 (12.5)	13 (9.4)	12 (12.4)	21 (10.4)
Just right	44 (14.7)	30 (18.8)	14 (10.1)	20 (20.6)	24 (11.9)
Low	147 (49.2)	84 (52.5)	63 (45.3)	49 (50.5)	98 (48.5)
Too low	4 (1.3)	2 (1.3)	2 (1.4)	3 (3.1)	1 (0.5)
Don't know	64 (21.4)	19 (11.9)	45 (32.4)	10 (10.3)	54 (26.7)
How difficult do you think it is to obtain a free CDK?					
Very difficult	2 (0.7)	2 (1.3)	0 (0.0)	2 (2.1)	0 (0.0)
Difficult	18 (6.0)	8 (5.0)	10 (7.2)	7 (7.2)	11 (5.5)
Somewhat difficult	53 (17.7)	27 (16.9)	26 (18.7)	14 (14.4)	39 (19.3)
Slightly difficult	20 (6.7)	9 (5.6)	11 (7.9)	5 (5.2)	15 (7.4)
Not difficult	158 (52.8)	105 (65.6)	53 (38.1)	63 (65.0)	95 (47.0)
Don't know	48 (16.1)	9 (5.6)	39 (28.1)	6 (6.2)	42 (20.8)
Did the dhonni remind you to apply CHX after cutting the cord?					
Yes	59 (19.7)	56 (35.0)	3 (2.2)	45 (46.4)	14 (6.9)
No	237 (79.3)	103 (64.4)	134 (96.4)	51 (52.6)	186 (92.1)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Don't remember	3 (1.0)	1 (0.6)	2 (1.4)	1 (1.0)	2 (1.0)
Did any of your family members remind you to apply CHX after cutting the cord?					
Yes	56 (18.7)	54 (33.8)	2 (1.4)	36 (37.1)	20 (9.9)
No	242 (80.9)	106 (66.3)	136 (97.8)	61 (62.9)	181 (89.6)
Don't remember	1 (0.3)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.5)
Did someone who attended a community meeting remind you to apply CHX (for subsequent applications)?					
Yes	31 (10.4)	26 (16.3)	5 (3.6)	18 (18.6)	13 (6.4)
No	265 (88.6)	132 (82.5)	133 (95.7)	79 (81.4)	186 (92.1)
Don't remember	3 (1.0)	2 (1.3)	1 (0.7)	0 (0.0)	3 (1.5)
How much does the instruction sheet help to correctly apply CHX?					
Helped a lot	60 (20.1)	53 (33.1)	7 (5.0)	27 (27.8)	33 (16.3)
Helped	86 (28.8)	64 (40.0)	22 (15.8)	38 (39.2)	48 (23.8)
Helped somewhat	30 (10.0)	23 (14.4)	7 (5.0)	16 (16.5)	14 (6.9)
Helped very little	2 (0.7)	1 (0.6)	1 (0.7)	1 (1.0)	1 (0.5)
Did not help	2 (0.7)	0 (0.0)	2 (1.4)	0 (0.0)	2 (1.0)
Didn't see/read it	119 (39.8)	19 (11.9)	100 (71.9)	15 (15.5)	104 (51.5)
How much does the leaflet help to correctly apply CHX?					
Helped a lot	45 (15.1)	38 (23.8)	7 (5.0)	22 (22.7)	23 (11.4)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Helped	84 (28.1)	59 (36.9)	25 (18.0)	38 (39.2)	46 (22.7)
Helped somewhat	27 (9.0)	18 (11.3)	9 (6.5)	9 (9.3)	18 (8.9)
Helped very little	1 (0.3)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.5)
Did not help	4 (1.3)	1 (0.6)	3 (2.2)	1 (1.0)	3 (1.9)
Didn't see/read it	138 (46.2)	44 (27.5)	94 (67.6)	27 (27.8)	111 (55.0)
How much does the poster help to learn about CHX and where to obtain it?					
Helped a lot	41 (13.7)	33 (20.6)	8 (5.8)	14 (14.4)	27 (13.4)
Helped	83 (27.8)	57 (35.6)	26 (18.7)	36 (37.1)	47 (23.3)
Helped somewhat	26 (8.7)	18 (11.3)	8 (5.8)	13 (13.4)	13 (6.4)
Helped very little	2 (0.7)	2 (1.3)	0 (0.0)	0 (0.0)	2 (1.0)
Did not help	1 (0.3)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.5)
Didn't see/read it	146 (48.8)	50 (31.3)	96 (69.1)	34 (35.1)	112 (55.5)
How much does the sticker help to learn about CHX and where to obtain it?					
Helped a lot	27 (9.0)	23 (14.4)	4 (2.9)	13 (13.4)	14 (6.9)
Helped	82 (27.4)	54 (33.8)	28 (20.1)	36 (37.1)	46 (22.8)
Helped somewhat	22 (7.4)	16 (10.0)	6 (4.3)	8 (8.3)	14 (6.9)
Helped very little	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

	Overall (n=299)	Used CHX (n=160)	Did not use CHX (n=139)	Used CDK (n=97)	Did not use CDK (n=202)
Did not help	2 (0.7)	0 (0.0)	2 (1.4)	0 (0.0)	2 (1.0)
Didn't see/read it	166 (55.5)	67 (41.9)	99 (71.2)	40 (41.2)	126 (62.4)
How confident did you feel that you could apply the CHX correctly on your own?					
Very confident	48 (16.1)	45 (28.1)	3 (2.2)	23 (23.7)	25 (12.4)
Confident	95 (31.8)	82 (51.3)	13 (9.4)	52 (53.6)	43 (21.3)
Somewhat confident	19 (6.4)	12 (7.5)	7 (5.0)	9 (9.3)	10 (5.0)
Slightly confident	6 (2.0)	4 (2.5)	2 (1.4)	1 (1.0)	5 (2.5)
Not confident at all	3 (1.0)	1 (0.6)	2 (1.4)	1 (1.0)	2 (1.0)
Don't know	128 (42.8)	16 (10.0)	112 (80.6)	11 (11.3)	117 (57.9)
Do you think someone else needs to explain to you how to apply CHX, or does the instruction leaflet provide sufficient explanation?					
Yes, needs to be explained always	37 (12.4)	15 (9.4)	22 (15.8)	11 (11.3)	26 (12.9)
Yes, need to be explained sometimes	75 (25.1)	42 (26.3)	33 (23.7)	24 (24.7)	51 (25.3)
No, never has to be explained	187 (62.5)	103 (64.4)	84 (60.4)	62 (63.9)	125 (61.9)

** Those collected CHX

Willingness to pay**Willingness to pay for CHX and/or CDK by source of CHX/CDK***

	Overall	Wealth Quintiles					Collected CHX/CDK from							
		1 st (bottom)	2nd	3rd	4th	5 th (top)	Projahmo HC	FWC	EPI Health assistant	FWA	TBA	Pharmacy	Others	
Among families who collected CHX														
Paid for CHX	80 (46.0)	17 (42.5)	16 (44.4)	20 (47.6)	13 (41.9)	14 (56.0)	1 (20.0)	2 (5.3)	7 (13.2)	1 (16.7)	61 (98.4)	8 (88.9)	0 (0.0)	
Amount paid mean±sd median(range)	47.6±12.3 45,(18,75)	45.3±15.0 45(20,75)	47.8±11.7 45(18,70)	49.6±10.3 45(35,70)	44.1±10.1 45(25,63)	51.0±13.9 45(22,70)	40.0±0.0 40(40,40)	41.0±8.5 41(35,47)	37.4±7.6 35(27,45)	45.0±0.0 45(45,45)	49.8±12.2 45(18,75)	42.6±12.6 45(20,63)	-	
Total	174	40	36	42	31	25	5	38	53	6	62	9	1	
Among families who collected CDK														
Paid for CDK	69 (44.8)	16 (40.0)	12 (38.7)	18 (48.7)	13 (48.2)	10 (52.6)	0 (0.0)	2 (6.1)	11 (21.2)	0 (0.0)	50 (96.2)	6 (85.7)	-	
Total	154	40	31	37	27	19	6	33	52	4	52	7	-	
Among all families (all live birth)														
Willing to pay for CHX	276 (92.3)	63 (98.4)	50 (89.3)	56 (87.5)	65 (97.0)	42 (87.5)	4 (80.0)	37 (97.4)	43 (81.1)	5 (83.3)	57 (91.9)	8 (88.9)	1 (100.0)	
Maximum willing to pay for CHX mean±sd median(range)	38.4±13.7 40(4,90)	37.4±14.1 40(10,70)	38.2±13.1 45(10,70)	39.6±12.3 45(12,70)	38.0±14.9 45(4,90)	39.4±14.1 40(10,90)	37.5±18.5 45(10,50)	37.7±15.2 37.5(10,70)	39.9±10.0 45(15,60)	48.0±12.5 45(40,70)	40.2±11.0 45(18,70)	36.3±14.6 45(10,50)	25.0±0. 0 25(25,2 5)	
Willing to pay for CDK	216 (82.2)	47 (73.4)	39 (69.6)	44 (68.8)	52 (77.6)	34 (70.8)	5 (100.0)	34 (89.5)	43 (81.1)	6 (100.0)	11 (17.7)	5 (55.6)	1 (100.0)	
Maximum willing to pay for CDK mean±sd median(range)	31.8±19.9 20(10,100)	32.9±19.4 30(10,80)	30.1±18.5 20(10,90)	30.5±17.9 20(15,99)	32.0±21.2 22(10,100)	33.9±23.2 20(10,100)	23.5±11.5 20(10,43)	36.3±22.2 27.5(10,99)	29.8±15.5 25(10,70)	34.3±24.1 25(17,70)	45.0±35.4 45(20,70)	50.0±0.0 50(50,50)	-	
Total	299	64	56	64	67	48	5	38	53	6	62	9	1	

Appendix 2: Figures

Instructions used for the liquid/cotton ball product in Phase 1

নবজাতকের নাতী/নাতীতে ক্লোরহেক্সিডিন লাগানোর ধাপ



নবজাতকের নাভী/নাড়ীতে ক্লোরহেক্সিডিন লাগানোর ধাপ



১ ২ ৩ ৪ ৫ ৬ ৭


জন্মের ১ম দিন হতে দিনে ১ বার করে পর পর ৭ দিন ক্লোরহেক্সিডিন লাগান

নাড়ী কাটার সাথে সাথে ক্লোরহেক্সিডিন লাগান

নবজাতকের নাড়ীতে ক্লোরহেক্সিডিন লাগানোর নিয়ম

১. সাবান এবং পানি দিয়ে হাত ধুয়ে নিন
২. পুরো নবজাতককে নাকি খেপার জন্য ব্যস্ট্রিক্স কাপড় সবসময় সতর্কতার ক্রমটুকু সঠিকের দিন
৩. ক্লোরহেক্সিডিন বোতলকে তুলে খোলার পর একে টুকরা তুলা নিন এবং তুলাটিকে বোতলের মুখে ধরে ছুঁতে ছুঁতে ঐষধ লাগিয়ে নিন
৪. বোতলটি খুলে সঠিকের মুখে
৫. বোতল তুলা দিয়ে চেষ্টে চেষ্টে কাপড়মাঝে নাড়ীর গোড়ায় ও পুরো নাড়ীতে (যদি ঐষধ লাগানো)
৬. প্রথম তুলাটি বোতল দিয়ে আঁকোনি তুলা নিন। আঁশের মধ্যে করে তুলাটি ঐষধ দিয়ে ভিজিয়ে নিন। জেজানো তুলা দিয়ে আঁকোনাভাবে নাড়ীর আগায় ক্লোরহেক্সিডিন লাগান। যদি নাড়ী শুষ্ক হয়ে আসে তখন তুলা দিয়ে চারপাশে ও দ্বিতীয় তুলা দিয়ে নাড়ীর মাঝখানে ঐষধ লাগাতে হবে
৭. ঐষধ দিয়ে নাড়ী পরিষ্কার করার পর নাড়ীর গোড়ায় তুলা ঐষধ লাগানি শুষ্ক থাকে না
৮. ঐষধ লাগানোর পর শাকসবজি পরিষ্কার করা শুষ্ক করে হাতে হাতে রাখতে হবে
৯. বাসভার করা তুলা ফেলতে দিন এবং সাবান - পানি দিয়ে আঁধার হাত ধুয়ে নিন।


Instructions for the nozzle bottle product promoted in Phase 2




Application
Apply once daily starting from the day of birth until the baby's 7th day.
Apply chlorhexidine immediately after cutting the cord.

4% Chlorhexidine Solution


Antiseptic solution for the umbilical cord and umbilicus

- 

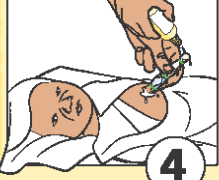
1

Wash your hands with drinking water and soap, before and after applying the chlorhexidine solution.
Do not dry hands after washing.
- 


2

Squeeze the bottle to apply the chlorhexidine solution to the base of the umbilical cord.
- 

3

Squeeze the bottle to apply the chlorhexidine solution to the stump of the umbilical cord.
- 

4

Squeeze the bottle to apply the chlorhexidine solution to the tip of the umbilical cord.
Make sure that the entire umbilical cord is soaked.
Do not clean off any solution from umbilical cord or umbilicus after application.
- 

5

Continue applying the chlorhexidine solution to the umbilicus after cord separation

Precaution
Do not touch your eyes during application.
Keep in dry and cool place, away from light.
Keep away from children.

Conceptual model for factors limiting effective coverage of the CHX intervention

