

## **Newborn Thermal Care Practices in Rural India: A Community-based Program to Prevent and Improve Recognition and Management of Hypothermia**

**Report due date:**

31 March 2007 (End-of-project survey data collection was completed in December 2006; verbal autopsy data collection will be completed in March 2007).

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This study was a collaborative effort of King George Medical University and the Department of International Health, Bloomberg School of Public Health, Johns Hopkins University

**Location(s) of the project (Country/Site):**

Shivgarh Block, Rae Bareli District, Uttar Pradesh, India

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**Project Timeframe:**

May 2003 – December 2006; data analysis is ongoing

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**Attachments:** The following attached DRAFT project documents further describe various aspects of the program (Please note that these are DRAFT documents, not for distribution):

### ***Original Proposal***

#### ***Publications***

- Introduction of community based skin to skin care in rural Uttar Pradesh, India. J Perinatol 2006;26:597-604.
- Perceived Morbidities and Healthcare Utilization for Neonatal Health in Rural Uttar Pradesh, India: Effects of a Behavior-Change Communication Intervention. PhD Dissertation, Jeff Willis, 2006.
- Validation of accuracy and community acceptance of the BIRTHweigh III scale for categorizing newborn weight in rural India, J Perinatol 2007; in press.
- Feasibility of community neonatal death audits in rural Uttar Pradesh, India. J Perinatol 2007; in press.
- Additional manuscripts submitted (not attached to this report)
  - Hypothermia: Review of pathophysiology, burden and strategies for management
  - Neonatal health program management in a resource constrained setting in rural India.
  - Community perceptions of birth weight in rural Uttar Pradesh, India.

#### ***Program Management***

- Neonatal health program management in a resource-constrained setting in rural India; Administrative protocols; Finance manual; Vehicle management policy; Induction guidelines; Library management; Recruitment guidelines; Separation policy; Guest management policy; Human resources KGMU-JHU personnel manual

#### ***Formative/Qualitative Research, Baseline Findings***

- Essential newborn care program: Pregnancy and newborn care practices in Shivgarh
- Baseline report of home-based essential newborn care
- Essential newborn care project, Shivgarh, India: Pregnancy and newborn care practices in Shivgarh
- A qualitative study on understanding the perception regarding weight and weighing of the baby in Shivgarh, India

#### ***Program Processes***

- Saksham, towards self reliance
- Participatory approach to improve newborn care and prevent neonatal hypothermia in Shivgarh, India
- Essential newborn care program/behavior change and communication
- Developing a BCC Strategy Using Formative Research Findings in Shivgarh, India

#### ***Training***

- Supervisor's Training Module on Essential home-based newborn care
  - Community Health workers' training module on essential home-based newborn care
- Study instruments (available on request)

# Executive Summary

## Rationale and Setting

India accounts for 27% of global neonatal deaths, and 30% of neonatal mortality in India occurs in the state of Uttar Pradesh (UP). Thus, nearly 10% of all global neonatal deaths take place in this state of India. The characteristics of this part of India are very similar to several other Indian states as well as large sections of Bangladesh, southern Nepal and Pakistan.

Millennium Development Goal-4 for child survival cannot be met without substantial reductions in neonatal mortality. Since the majority of births and neonatal deaths take place at home, away from the reach of skilled providers, innovative community-based approaches are urgently needed to bring substantial improvement in newborn survival in India.

Recent studies have demonstrated the potential impact of packages of maternal and neonatal care on neonatal mortality. Based on modeling of limited empirical data, *The Lancet* Neonatal Survival Series suggested that 18-32% of neonatal mortality could be averted through high (90%) coverage of a package of preventive family and community neonatal care. This study in Shivgarh was designed to test the impact of such a simple, evidence-based package of preventive care provided by families and communities.

## Objectives

The overall purpose of this field study was to evaluate the impact of family and community interventions based on community mobilization and behavior-change models and theories aimed to promote evidence-based, preventive, essential newborn care (ENC) on 1) key newborn care practices, 2) neonatal morbidity, 3) care-seeking for newborn illness, 4) cost and equity, and 5) neonatal mortality.

We also aimed to evaluate the impact of the program on prevention, early recognition and management of neonatal hypothermia, including the utility and acceptability of skin-to-skin care in the community.

## Specific objectives

- Determine domiciliary care knowledge, attitudes and practices regarding essential newborn care, with a focus on newborn thermal control.
- Develop behavior change communications to promote preventive essential newborn care, including prevention, early recognition and effective management of newborn hypothermia.
- Evaluate impact and cost-effectiveness of education/behavior change communications (BCC) delivered by Community Health Workers and Community Health Promoters/Change Agents on essential newborn care practices, including care-seeking; prevalence, recognition and management of hypothermia, including adaptation, safety and utility of skin to skin care (STSC); and neonatal morbidity and mortality.
- Evaluate acceptability, compliance, safety and process of introduction of STSC.

- Describe the association of use of STSC with improved essential newborn care practices, including breastfeeding, prevention and management of hypothermia and reduced risk for mortality and infections.
- Evaluate the feasibility and acceptability of using LCT *ThermoSpot* device in rural communities to enhance mothers' recognition and management of neonatal hypothermia.
- Determine the influence of the neonatal hypothermia indicator (*ThermoSpot*) on recognition of and response to newborn hypothermia and health-seeking behavior of the caregivers.
- Develop algorithms for recognition and management of hypothermia to inform neonatal IMCI and verbal autopsy protocols.
- Gain insight into the potential roles of various cadres of workers in providing neonatal health services at the community level, and inform the development of models of community-based essential newborn care.

## Methods

This was a population-based, cluster randomized, controlled trial of the impact of a preventive package of family and community care. The trial was based on:

- Careful formative research to understand the socio-cultural-economic constructs that underlie newborn care and decision-making for care in the community.
- Development of newborn care communications based on principles of community participation, mobilization and empowerment.
- Promotion of evidence-based essential newborn care practices, targeting behaviors that address key causes of neonatal mortality and that are amenable to change.

The intervention approach adopted was:

- Community mobilization through social-mapping and community meetings by a community mobilizer to gain trust, access, approval, support and subsequent community ownership for newborn care based on cultural appropriateness, respect and empowerment.
- Develop and provide, in a conversational way, culturally appropriate BCC.
- Community-based workers (*Saksham Sahayak*) deliver BCC messages to pregnant women, their family members and neighbors, and key community stake-holders through home visitations, two in the antenatal period and two in the early postnatal period (days 0 and 2/3).
- Develop and progressively transfer intervention responsibilities to community volunteers (*Saksham Karta*) and a community governing board.

## Intervention package

Based on the formative research and review of global literature on interventions for improving neonatal health and survival, the following package of key interventions was selected for implementation:

- Birth preparedness
- Clean delivery, clean cord and skin care

- Immediate wiping, drying and keeping the baby warm
- Breastfeeding promotion
- Skin-to-skin care

## Study design

Three study arms were devised:

- 1) *Comparison clusters*: Usual services provided by the government and by other organizations working in the area. No special education in newborn care.
- 2) *Intervention-I clusters*: Community mobilization and behavior change communications to promote essential newborn care, including thermal care.
- 3) *Intervention-II clusters*: Community mobilization and behavior change communications to promote essential newborn care, including thermal care, facilitated by use of *ThermoSpot* as a device to aid in early recognition of newborn hypothermia.

The cluster unit for randomization of the intervention trial was the *Gram Sabha* (major villages and associated hamlets; 39 within the study area). Thirteen *Gram Sabhas* were cluster randomized to each of the three intervention arms.

## Data collection

Data collection was performed independently of the program implementation team. A number of surveys were administered, including

- Baseline surveys of household demographics and socioeconomic status; household knowledge, attitudes, practices and competencies regarding essential newborn care; maternal and newborn hypothermia, and neonatal and maternal mortality
- Prospective surveys of antenatal, intrapartum and postnatal care practices, care-seeking and cost of neonatal care
- End-of-project surveys of household knowledge, attitudes, practices and competencies in maternal and newborn care
- Verbal autopsy

## Results

- Formative research and program design and planning was completed during May to December 2003.
- Activities within the *Saur* (the birth room where the mother and newborn are confined after birth to protect them) are critical to newborn survival, and an understanding of roles and responsibilities of caretakers who have access to the *Saur* during the period of confinement was critical to the formulation of effective intervention strategies.
- Family and community members play the key roles in newborn care.
- In general, the formal health system is disengaged from newborn care.
- Hypothermia affected most normal and low birth weight newborns in the colder months of the year.
- In nearly half (42%) of the cases of newborn hypothermia, the mothers was even colder than her infant.

- Essential, preventive newborn care practices such as early initiation of breastfeeding, delayed bathing, and skin-to-skin care were rapidly and almost universally adopted within months of program initiation.
- Neonatal mortality was reduced by approximately half within one and one-half years.

## Conclusions and Discussion

- Newborns in rural Uttar Pradesh are at risk of developing hypothermia across all seasons, although the risk is highest during the winter.
- Hypothermia is highly prevalent among both normal weight and low birth weight newborns, across all seasons but particularly in winter, in the community in rural India, and in more than 40% of cases, lower temperature of the mother than the hypothermic baby may limit her ability to warm the baby through skin-to-skin contact.
- In this low-resource environment, low ambient temperature is an overwhelming risk factor for hypothermia.
- Low ambient and maternal temperatures must be considered and addressed in strategies to implement KMC in the community as an effective intervention for newborn thermal control.
- Innovative, community-driven solutions may be the key to achieving thermal control through KMC in resource poor settings
- Skin-to-skin care emerges as a spontaneous and natural response to informed choice for thermal care in resource poor domiciliary settings if addressed through appropriate cultural paradigms.
- Lateral transfer of knowledge from health workers to caregivers that avoids conflict with deep-rooted social and cultural values, and the provision of messages that strike a cord with their existing understanding for newborn care and maternal instincts, empowers them to embrace change with increased spontaneity and confidence.
- A minimal package of preventive essential newborn care can significantly reduce neonatal mortality in a low-resource, high mortality area in a relatively short period of time (i.e., 18 months for initiation of program implementation, 2 years from coming into the community *de novo*). This validates the findings and strategy for implementing newborn health programs proposed by *The Lancet* Neonatal Survival Series.
- Some behavior change (e.g., skin-to-skin care) requires both antenatal and an early postnatal visit to reinforce. We believe that this is reflected in the lack of adoption of this practice in the comparison area.
- Behavior change can occur rapidly (i.e., within a period of a few months of initiation of a BCC program).
- The power of the community is under-appreciated and under-utilized in public health.
- The newborn is an apolitical, non-controversial point of convergence for the community and for continuum of care.
- Community mobilization and behavior change communications appear to act together to stimulate the adoption of evidence-based newborn care practices, leading to reduced neonatal mortality.
- In high mortality settings with poorly functioning health systems, initial emphasis on promotion of evidence-based family and community essential newborn care can rapidly improve care practices and substantially lower neonatal mortality, but

community demand requires simultaneous attention to clinical care for maternal and newborn complications.

### ***Overall conclusions***

- In a resource-poor area of rural India, a simple, low-cost package of essential newborn care delivered through a culturally sensitive community mobilization and behavior change communication program by community-based health workers and volunteers improved key newborn care practices and reduced neonatal mortality in half within one year.
- Working together with communities through community mobilization and behavior change communications in a manner which avoided conflict with deep-rooted social and cultural values and roles stimulated the adoption of evidence-based newborn care practices, leading to a rapid reduction in neonatal mortality despite scarce resources.
- In high mortality settings with a poorly functioning health system, initial emphasis on evidence-based family and community care can rapidly improve newborn care practices and substantially lower neonatal mortality, however, community demand also requires simultaneous attention to development of capacity for clinical care for maternal and newborn complications.

# FINAL REPORT

## Rationale and Setting

The overall purpose of this field study was to evaluate the impact of educational interventions based on community mobilization and behavior-change models and theories aimed to promote evidence-based, preventive, essential newborn care (ENC) on 1) key newborn care practices, 2) care-seeking for newborn illness, 3) neonatal morbidity and 4) neonatal mortality. We also aimed to evaluate the impact of the program on prevention, early recognition and management of neonatal hypothermia, including the utility and acceptability of skin-to-skin care in the community.

### **Why Uttar Pradesh, India?**

India accounts for 27% of global neonatal deaths, and 30% of neonatal mortality in India occurs in the state of Uttar Pradesh (UP). Thus, nearly 10% of all global neonatal deaths take place in this state of India.

UP, where this study took place, lies in the Gangetic plains of Northern India. The characteristics of this part of India are very similar to other BIMARU Indian states (i.e., Bihar, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Rajasthan, Orissa [5]) as well as large sections of Bangladesh, southern Nepal and Pakistan. UP is the most populous state in India with a population of 166,052,859 (2001 Census of India), an increase of almost 26% since 1991. Like the rest of India, gains in infant survival in UP have stagnated since the mid 1990s. Even prior to the 1990s, however, gains in neonatal survival were not keeping pace with those during the post-neonatal period. Thus, the neonatal mortality rate in UP is now 54/1000 live births, higher than the national average (43/1000, SOWN 2001), and neonatal deaths comprise approximately 60% of infant mortality [5]. The neonatal mortality rate in rural UP is even higher, estimated at 66/1000 live births (NFHS-II).

Of the neonatal deaths, approximately two-thirds occur in the first week of life. The principal causes of these deaths are infections and birth asphyxia, although little data is available on cause-specific mortality, especially at the community level. Most (85%) deliveries take place at home, and only one out of every five is attended by trained staff; traditional birth attendants (TBAs) (33%), and relatives and neighbors (47%) assist the other deliveries [5]. Three-fourths (74%) of all deliveries are conducted in the mother's own home and 10% are conducted in a parent's home.

### ***Shivgarh Block***

This study took place in Shivgarh Block of Raebareli District of Uttar Pradesh, India, which has a population of 110,100. To select the site, we talked with representatives of multiple non-governmental organizations as well as governmental officials, reviewed area maps and conducted multiple exploratory visits to various locations in Uttar Pradesh. The study area was selected based on its high mortality rate, rural location with poor access to quality health services, and few prior programs or research projects (Table 1). Thus, the local infrastructure in Shivgarh to support the study was created entirely by the project team. This was our first project in this area – thus, there was no project office in Shivgarh and the project site was identified and mapped for the first time by our team. In addition, there were no Anganwadi

workers in this area at the time the study began. Our Lucknow office was also started anew, and it served two other new projects in addition to this one.

Thus, this project serves as a demonstration of what can be accomplished when moving into an entirely new area with little to no other program activity and no research infrastructure whatsoever.

### **Why preventive, essential newborn care?**

Millennium Development Goal-4 for child survival cannot be met without substantial reductions in neonatal mortality (Lawn JE et al., 2005). Since the majority of births and neonatal deaths take place at home, away from the reach of skilled providers, innovative community-based approaches are urgently needed to bring substantial improvement in newborn survival in India.

**Table 1. Characteristics of the study site (data from our baseline survey)**

<b>General</b>	
Economy	Agrarian, rural
Literacy†	M = 61%, F = 37%
NMR	62/1000 live births
ANC* >1	3.5%
Delivery within the home	88%
Skilled birth attendance‡	18.5%

†Ability to read and write with understanding.

\*An antenatal visit which included weight and blood pressure measurement and abdominal examination.

‡Delivery by a physician, nurse or nurse-midwife.

Recent studies have demonstrated the potential impact of packages of maternal and neonatal care (reviewed in Bhutta ZA et al. 2005; Darmstadt GL et al. 2005) on neonatal mortality. Based on modeling of limited empirical data, *The Lancet* Neonatal Survival Series suggested that 18-32% of neonatal mortality could be averted though high (90%) coverage of a package of preventive family and community neonatal care (Darmstadt GL et al., 2005).

This study in Shivgarh was designed to test the impact of such a simple, evidence-based package of preventive care provided by families and communities.

### **Why an emphasis on hypothermia?**

As part of the package of interventions that we sought to provide, we placed some emphasis on prevention, recognition and management of hypothermia, given the lack of community-based information on hypothermia (Bhutta ZA et al. 2005).

The newborn baby loses heat more easily and regulates body temperature less efficiently than a child or an adult. A hypothermic baby (body temperature <36.4 °C), especially if small or sick, is at increased risk of developing health problems and of dying (Ellis et al., 1996; Tafari 1985; Stanley et al., 1978; Morley 1960). The risk is higher in low birth weight (LBW) babies and assumes

importance in India where an estimated 33% of babies are born LBW. In fact, India has the largest number of LBW infants in absolute numbers of any country. Prevalence rates of hypothermia in developing countries have been reported at upwards of 50% in studies from Nepal (Johanson et al., 1992; Mullany et al., 2006), Malawi (Christensson et al., 1988), Ethiopia (Tarafi 1985), and Zimbabwe (Kambarami et al., 2002) and in a village-based study in India, 38% of the neonates were found to be hypothermic based on a single temperature reading taken within the first 24 h after birth (Kumar et al., 1998).

Evidence suggests that it is difficult for mothers to detect slight changes in body temperature simply by touch, but it appears to be possible for them to detect moderate or severe changes, i.e., 47% of mothers could detect moderate hypothermia (Kumar et al., 1998). Most families in developing country communities are unlikely to possess a thermometer, particularly a low reading one, and touch may be the only method of assessment available to them. Therefore, mothers' ability to monitor for early signs in addition to preventing and managing hypothermia is essential for her newborn baby, especially in the first days of life when risk of hypothermia is greatest.

## Objectives

- Determine domiciliary care knowledge, attitudes and practices regarding essential newborn care, with a focus on newborn thermal control.
- Develop behavior change communications to promote preventive essential newborn care, including prevention, early recognition and effective management of newborn hypothermia.
- Evaluate impact and cost-effectiveness of education/behavior change communications (BCC) delivered by Community Health Workers and Community Health Promoters/Change Agents on essential newborn care practices, including care-seeking; prevalence, recognition and management of hypothermia, including adaptation, safety and utility of skin to skin care (STSC); and neonatal morbidity and mortality.
- Evaluate acceptability, compliance, safety and process of introduction of STSC.
- Describe the association of use of STSC with improved essential newborn care practices, including breastfeeding, prevention and management of hypothermia and reduced risk for mortality and infections.
- Evaluate the feasibility and acceptability of using LCT *ThermoSpot* device in rural communities to enhance mothers' recognition and management of neonatal hypothermia.
- Determine the influence of the neonatal hypothermia indicator (*ThermoSpot*) on recognition of and response to newborn hypothermia and health-seeking behavior of the caregivers.
- Develop algorithms for recognition and management of hypothermia to inform neonatal IMCI and verbal autopsy protocols.
- Gain insight into the potential roles of various cadres of workers in providing neonatal health services at the community level, and inform the development of models of community-based essential newborn care.

## Methods

### Intervention design

#### *Ethical approval*

Prior to engaging in contact with human subject, ethical approval for this study was obtained locally from the King George Medical College Institutional Review Board, and from the Johns Hopkins Bloomberg School of Public Health Committee on Human Research.

#### *Data and Safety Monitoring Board (DSMB)*

A DSMB was established for the primary purpose of ensuring human subjects protection. The members of the DSMB were Dr Sundar Rao (Chairman, Retired, CMC Vellore), Dr A.K. Deorari (AIIMS), Dr A.K. Jana (CMC Vellore), Dr Jorge E. Tolosa (Oregon Health Sciences University).

#### *Formative research*

The intervention strategy and BCC package was developed during May to December 2003 based on formative research (May - August 2003) and trials of improved practices (TIPS) leading to refinement in the intervention strategy (September – December 2003). The approach to community mobilization and development of BCC messages is documented in attached files, and focused on:

- Careful formative research to understand the socio-cultural-economic constructs that underlie newborn care and decision-making for care in the community.
- Development of newborn care communications based on principles of community participation, mobilization and empowerment.
- Promotion of evidence-based essential newborn care practices, targeting behaviors that address key causes of neonatal mortality and that are amenable to change.

The intervention approach adopted was:

- Community mobilization through social-mapping and community meetings by a community mobilizer to gain trust, access, approval, support and subsequent community ownership for newborn care based on cultural appropriateness, respect and empowerment.
- Develop and provide, in a conversational way, culturally appropriate BCC.
- Community-based workers (*Saksham Sahayak*) deliver BCC messages to pregnant women, their family members and neighbors, and key community stake-holders through home visitations in the antenatal and early postnatal period.
- Develop and progressively transfer intervention responsibilities to community volunteers (*Saksham Karta*).

Initial formative research consisted of:

- In-depth interviews (n = 83) with a variety of community stakeholders in newborn care, including mothers, fathers, mothers-in-law, TBAs, Anganwadi workers, Auxiliary Nurse Midwives (ANMs), *Joala Chap* doctors (unqualified medical practitioners), *Domins* (lowest-caste women who cut the umbilical cord and provide initial oil massage), *Nauns* (low-caste women who provide early maternal and

newborn care, particularly oil massage), Pandits, and key influential community members.

- Focus group discussions (n = 8) with various groups of caregivers.
- Direct observations (n = 2) of delivery and immediate newborn care.
- Body mapping (n = 4) to understand perceptions of pregnancy, delivery and illness.

The formative research sampling frame included the entire Shivgarh Block. Purposeful sampling was done, stratified by Primary Health Center zone, ANM Sub-center zone, religion and caste. Interviews were conducted until saturation of information was achieved.

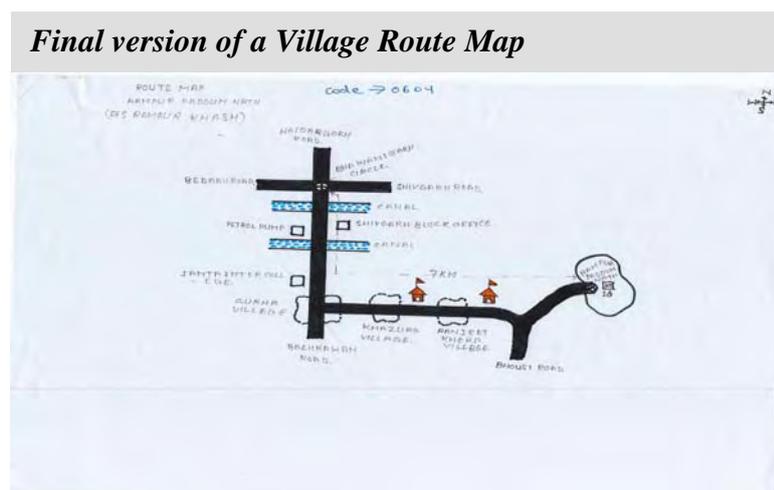
Further details of the approach to qualitative formative research, and findings, are provided in project documents attached to this report (see section, Formative/Qualitative Research, Baseline Findings).

### ***Community mapping***

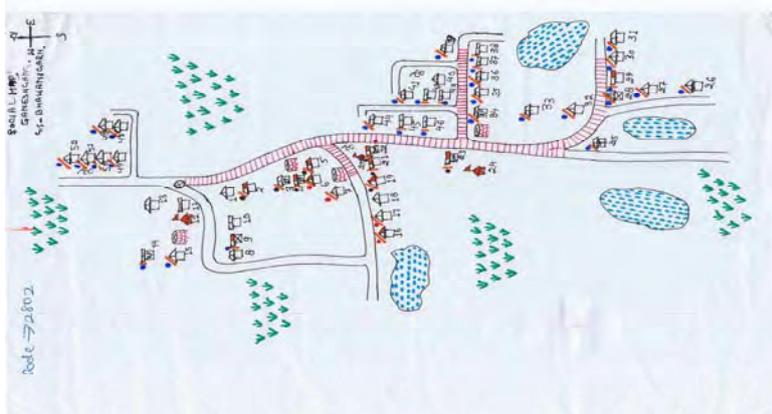
The initial phase of community mobilization involved mapping of the entire community (i.e., determination of GPS coordinates of all community structures, natural resources, households, key influential community members, health care providers, etc), and household member listing for all of Shivgarh Block. This was done simultaneously with the conduct of formative research. Community mapping, enumeration and listing served as a means for identifying community resources that may be utilized to benefit neonatal health, and for planning community mobilization meetings and home visitation for implementation of the intervention. It also provided the basis for tracking vital events.

A Route Map and a Social Map (Figure 1) of each of the 303 villages and hamlets in the project area were made as follows:

**Figure 1. Village Maps**



## Final version of a Village Location/Social Map



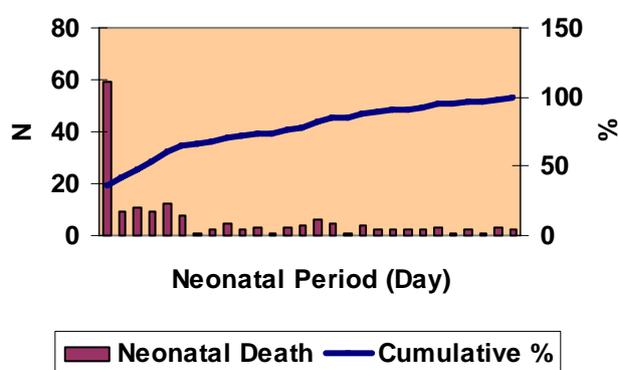
### Baseline survey

Before intervention implementation began, a household baseline survey was administered to 18,989 households in the entire study area to establish at baseline:

- Household demographics and socio-economic status
- Maternal and newborn care practices
- Neonatal mortality rate (Figure 2)

A draft baseline report is attached to this report (see Baseline report of home-based essential newborn care).

**Figure 2. Timing of neonatal deaths in Shivgarh (from baseline retrospective data)**



The timing of neonatal deaths in Shivgarh suggests that since approximately 65% of deaths take place in the first week of life, intervention during the antenatal, intrapartum, and early postnatal periods is critical. This had an important impact on the study design, including the timing of visits and the elements of the intervention package.

### ***Intervention package***

Based on the formative research and review of global literature on interventions for improving neonatal health and survival, the following package of key interventions was selected for implementation:

- Birth preparedness
- Clean delivery, clean cord and skin care
- Immediate wiping, drying and keeping the baby warm
- Breastfeeding promotion
- Skin-to-skin care
  - An example of a BCC message, for promotion of skin-to-skin care is as follows: “Mango is kept in the hay to enable it to ripen, likewise if the newborn baby is attached to the chest of Mom then the chances of proper growth increases.”

The development and content of the BCC messages designed to convey the importance of these practices and to encourage their adoption are documented in project reports attached to this report (see section, Program Processes).

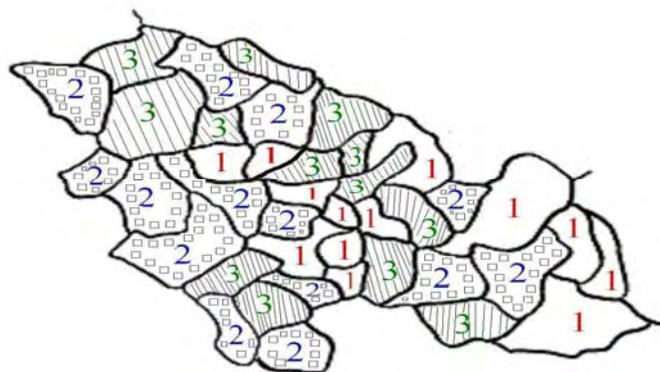
### ***Study design***

Three study arms were devised:

- 4) *Comparison clusters*: Usual services provided by the government and by other organizations working in the area. No special education in newborn care.
- 5) *Intervention-I clusters*: Community mobilization and behavior change communications to promote essential newborn care, including thermal care.
- 6) *Intervention-II clusters*: Community mobilization and behavior change communications to promote essential newborn care, including thermal care, facilitated by use of *ThermoSpot* as a device to aid in early recognition of newborn hypothermia.

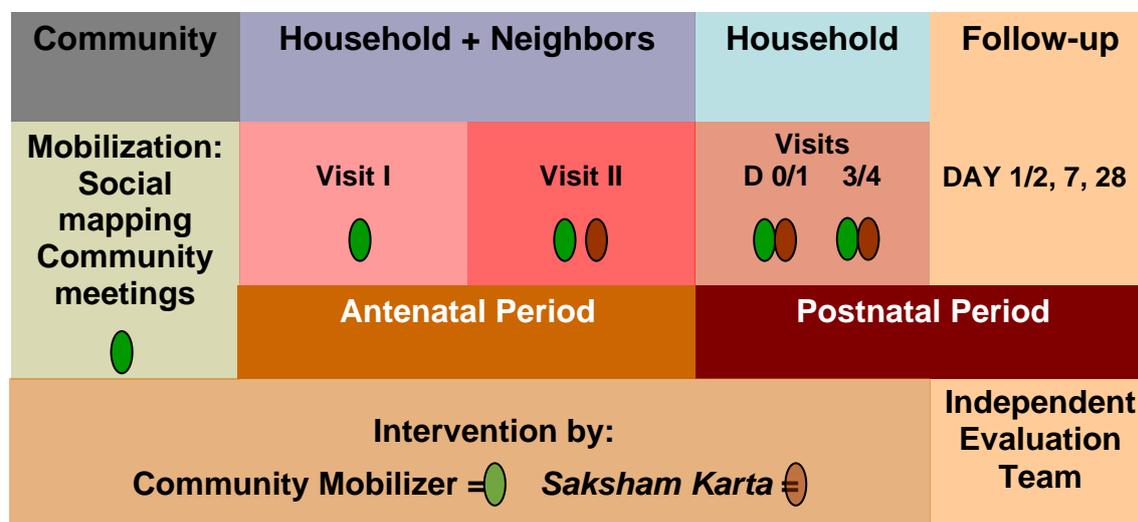
The cluster unit for randomization of the intervention trial was the *Gram Sabha* (major villages and associated hamlets; 39 within the study area). Thirteen *Gram Sabhas* were randomly allocated to each of the three intervention arms, as follows (Figure 3):

**Figure 3. Shivgarh block shown divided into cluster units assigned randomly to one of three study arms.**



The strategy for intervention is summarized in Figure 4, and elaborated below:

**Figure 4. Intervention Strategy**



### Program Implementation

In order to maintain the integrity of our evaluation of the program, strict separation of program implementation and data collection (i.e., evaluation) teams was maintained. The program and evaluation teams had separate offices on the project grounds in Shivgarh, and members of the teams were given strict instructions to refrain from sharing project information with members of the other team.

### Community surveillance

A community surveillance system was set up to identify all pregnant women in the study area. Careful formative research and continuous feedback through the project Monitoring Information System was utilized to design and continually improve the system. Expectant mothers who live in Shivgarh block and provided informed consent were registered. Pregnant women were identified by house-to-house contact every 3 months by the *Saksham Sahayak*.

### Training

*Saksham Sahayak*, who were selected from the local community, were trained in essential newborn care as described in the Training Manuals. On-the-job training was emphasized. Each *Saksham Sahayak* was responsible for community mobilization and household visits to promote essential newborn care in a population of approximately 3500. Increasingly, *Saksham Karta*, who are community volunteers who helped to promote the behavior change messages and helped new mothers practice skin-to-skin care, assumed responsibility for the interventions. The *Saksham Sahayak* increasingly played a supervisory role as the community members themselves took over the program implementation. This was by design, as a way to further develop and promote the feasibility, sustainability and scalability of the program.

Details of the training for supervisors and community health workers are provided in the project documents attached to this report (see section, Training).

## **Home visits**

### ***Antenatal visits***

Pregnant women were visited at home twice during the third trimester (Figure 3) by the *Saksham Sahayak* (and, increasingly over the course of the program, accompanied by the *Saksham Karta*, who first observed the home visits and then assumed a greater leadership role to promote the interventions in the village) who worked with the pregnant woman and other family and community members to plan for the birth and for newborn care. Each visit typically lasted for about 90 minutes and emphasized dialogue and negotiation.

### ***Birth notification***

A community birth notification system was set up to notify the *Saksham Sahayak* as soon as possible after the birth.

### ***Postnatal visits***

The *Saksham Sahayak* visited the family as soon as possible after notification of birth, typically on day 0 (i.e., the first day of life) and again on the third day of life, for a total of two postnatal visits. At each visit, BCC messages were reinforced. At the postnatal visits, instruction and practice was also provided on skin to skin care and breastfeeding. These visits were conducted in the *Saur*, the birthing room within the home where the mother and her newborn are kept for several days after birth.

## **Data Collection**

Several data collection instruments were administered at various times during the project (Table 2). These instruments are attached to the final report.

## **Sub-studies**

The infrastructure developed in Shivgarh through this project enabled the study team to address a number of other key questions regarding neonatal healthcare in a low resource setting. Additional sub-studies nested within the main trial included:

- Quantitative validation and qualitative assessment of the utility of the BIRTHweigh III newborn weighing scale
- Mini-logger study to examine relationships between maternal and newborn body temperature, particularly in the context of skin-to-skin care, and the impact of thermal care practices on newborn body temperature
- Feasibility of and strategies for community neonatal death audit
- Care-seeking and cost for preventive and curative newborn care
- Role of private providers (e.g., *Joala Chap* doctors) in newborn care
- Perceptions of low birth weight

**Table 2. Summary of Data Collection Activities**

Data Collection Activity	Time frame		No. of respondents
	From	To	
Mapping of Villages	20-Jul-03	15-Sep-03	4530 (303 maps)
Listing of Households	20-Jul-03	15-Sep-03	4530 (18989 HH)
Baseline SES: Assessment of socio-economic status	12-Nov-03	4-Oct-04	18989
Baseline KAPC: Documentation of household knowledge, attitudes, practices and competencies regarding essential newborn care at the beginning of the project	24-May-04	12-Aug-04	1550
Pregnancy History (using DHS methodology)	18-Jul-03	31-Oct-06	11357
Day 1/2 Survey (Program evaluation): Document antenatal care, birth history, birth weight, early newborn care, maternal perception of temperature; measure newborn, maternal and room temperature	10-Jan-04	31-Oct-06	5982
Day 1/2 Survey (Thermospot): Document Thermospot readings, responses to Thermospot, perceptions of use	10-Jan-04	31-Oct-06	1702
Day 7 Survey (KMC/STSC): Documentation of use of skin to skin care and associated practices (e.g., thermal care, breastfeeding) during the first 7 days of life	1-Jan-05	31-Oct-06	3624
Day 28 Survey (Care seeking): Document perceptions of neonatal illness, care seeking for illness, perceptions of care received	13-Jan-05	31-Oct-06	3687
Minilogger: 24-hour continuous monitoring of maternal and newborn temperature in the home, and documentation of thermal care and essential newborn care activities through observation	2-Oct-04	31-Jan-07	546
End-of-Project KAPC Survey: Documentation of household knowledge, attitudes, practices and competencies regarding essential newborn care at the end of the project	12-Oct-05	20-Apr-06	3404
End-line Social Capital: Qualitative assessment of social capital in the study areas	12-Oct-05	20-Apr-06	3400
Neonatal Verbal Autopsy: Administer verbal autopsy questionnaire to families in the instance of all neonatal deaths	6-May-06	20-Sep-06	578
Maternal Verbal Autopsy: Administer verbal autopsy questionnaire to families in the instance of all maternal deaths	6-May-06	20-Sep-06	51
Vital Status: Verification of all maternal, neonatal and infant deaths and stillbirth through a follow-up home visit	10-Jan-04	31-Oct-06	9394
Costing Survey: Survey to determine the cost of providing essential and sick newborn care during the neonatal period	1-Jan-05	31-Oct-06	1668
Pregnancy Outcome Status	10-Jan-04	31-Jan-07	11357
End-line listing of households: Verification of household identity	10-Jan-04	31-Oct-06	19053
End-line HH & SES: Verification of household socio-economic status	10-Jan-04	31-Oct-06	19053

Explanatory Notes:

- The baseline KAPC was a resource intensive survey which sampled 1500 women who had delivered in the year 2003 (prior to the project). The maximum eligible was close to 3000 and therefore every 2<sup>nd</sup> woman was sampled for the survey.
- The endline KAPC was primarily meant to serve for the Case-control study
- The “pregnancy outcome status” differs from the “vital status” because vital status was verified by a follow-up home visitation, while the pregnancy outcome status was based on the Management Information System.

## Results

Program implementation began in January 2004, and, with the exception of the neonatal verbal autopsy study, was completed by December 2006. Table 4 summarizes the numbers of subjects enrolled in the study, including the various sub-studies / sub-components. Thus, it is premature at the time of preparation of this report (13 March 2007) to summarize the results of the study. However, preliminary analysis has provided some important information about the impact of the study. All results are preliminary, however, as data cleaning had not been completed at the time of the analyses that produced these results, and all results are unadjusted for demographic and socioeconomic factors, for baseline differences in rates, or for the effects of the cluster randomization.

### Characteristics of the study site

Key baseline characteristics of the study site are shown in Table 3.

<b>Table 3. General site characteristics</b>	
Economy	Agrarian, rural
Literacy	M = 61% ; F = 37%
NMR	62 / 1000 live births
ANC >1*	3.5%
Delivery within the home	88%
Skilled birth attendance	18.5%
<b>Care seeking (1st point of referral)</b>	
PHC/ANM	16% of households seek care
Unqualified Medical Practitioners	82% of households seek care

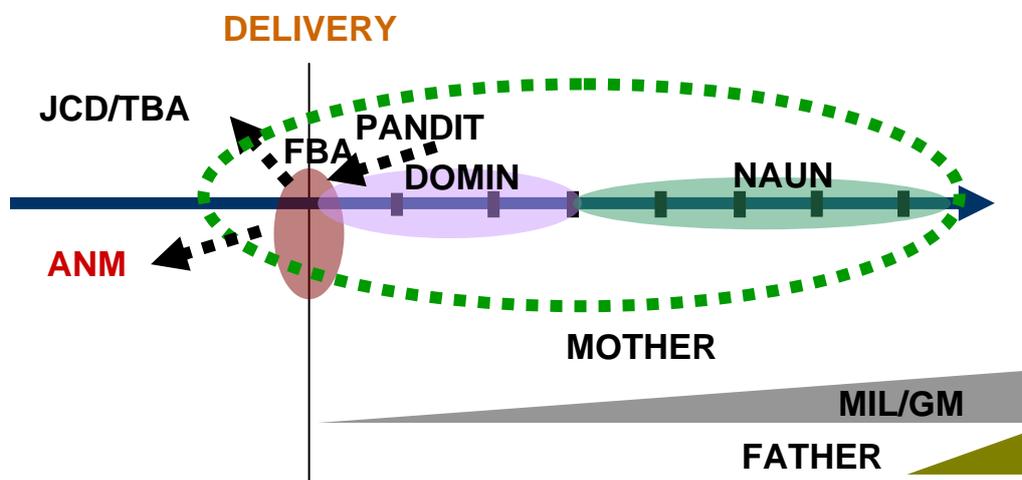
### Key qualitative findings

- The majority of the newborns (~90%) are delivered in the home; delivery is polluting and this perception has important implications for newborn and maternal care (e.g., avoiding use of scarce warm clothes that will need to be disposed off after the period of confinement)
- Mothers are confined within the *Saur* for 1 to 3 weeks after delivery
- There is a high level of role differentiation and specialization vis-à-vis early newborn care (Figure 5)
  - These roles are closely inter-woven with other traditional roles in the community
  - No other stage of life-cycle is witness to this advanced level of community involvement

Activities within the *Saur* (Figure 5) are critical to newborn survival, and an understanding of roles and responsibilities of caretakers who have access to the *Saur* during the period of confinement is critical to the formulation of effective intervention strategies. Key care providers, in addition to the mother and mother-in-law, include:

- Pandit: Spiritual leader who advises the family on when to start breastfeeding.
- *Joala Chap* doctor: Unqualified medical practitioners, who are the primary providers of care for sick newborns. The families must leave the *Saur* to seek their care.
- Auxilliary Nurse Midwife: She provides care from the ANM Sub-center, and is rarely sought for care, even though her role theoretically includes skilled birth care. She does not have access to the *Saur*.
- *Domin*: Lowest caste woman who cuts the umbilical cord, cleans up after delivery, and initiates oil massage for the newborn and mother and visits the home daily for the first few days after delivery.
- *Naun*: Barber's wife, who takes over oil massage from the *Domin*.
- *Father*: In general, males, including the father, do not have access to the *Saur*. The father makes decisions regarding care-seeking outside the home and finances.

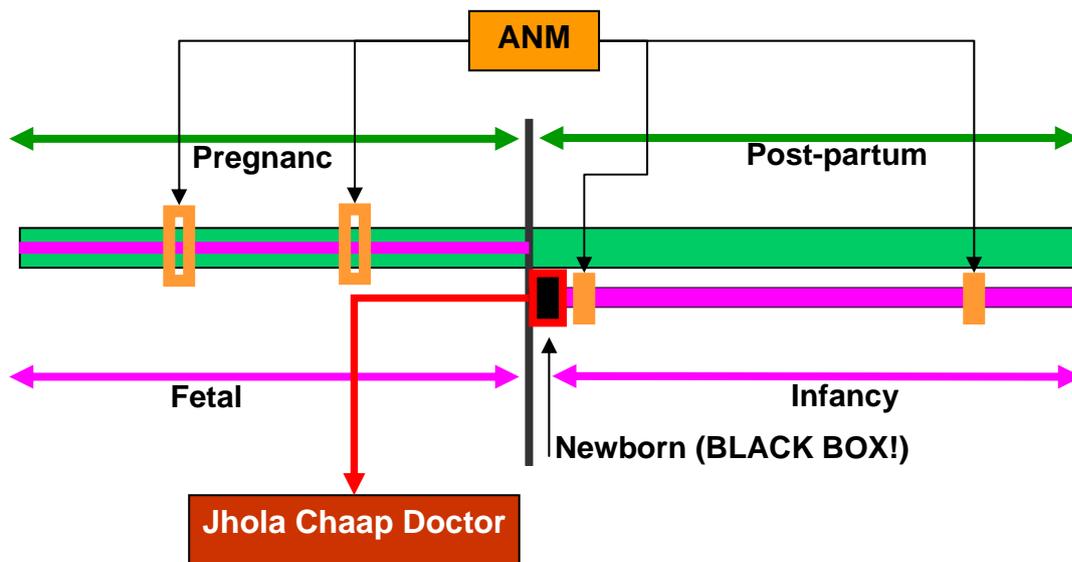
**Figure 5: Access of care providers to the *Saur* during the period of confinement**



### The health system

We also evaluated the role of the health system in newborn care (Figure 6). The ANM plays an important role in routine antenatal care and postnatal care, particularly immunization. However, postnatal care from the ANM typically is not sought until after the neonatal period. Thus, during the neonatal period, as noted above (Figure 5), the formal health system is largely disengaged from newborn care. Rather, family and community members play the key roles in newborn care (Figure 6).

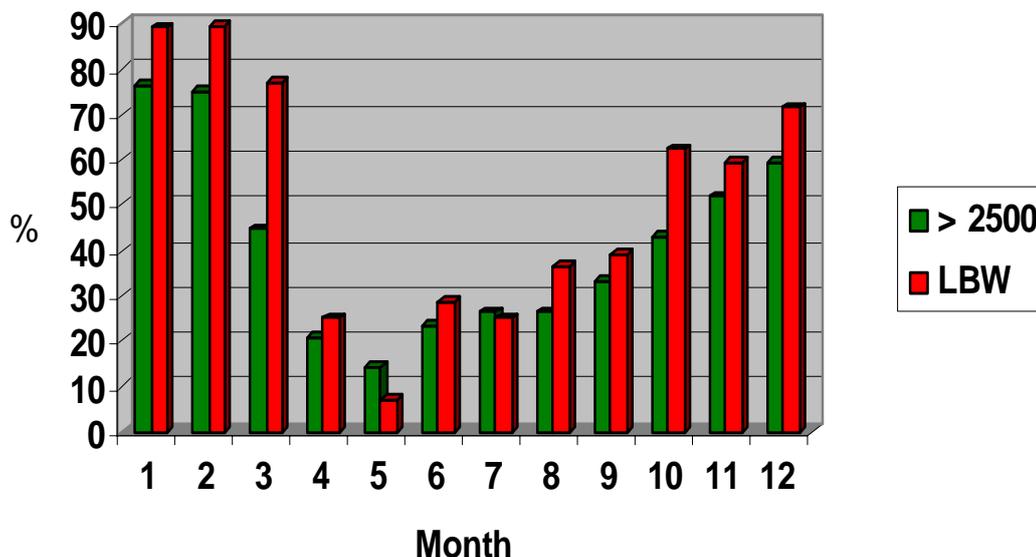
**Figure 6. Organization of newborn care within the formal health system in Shivgarh**



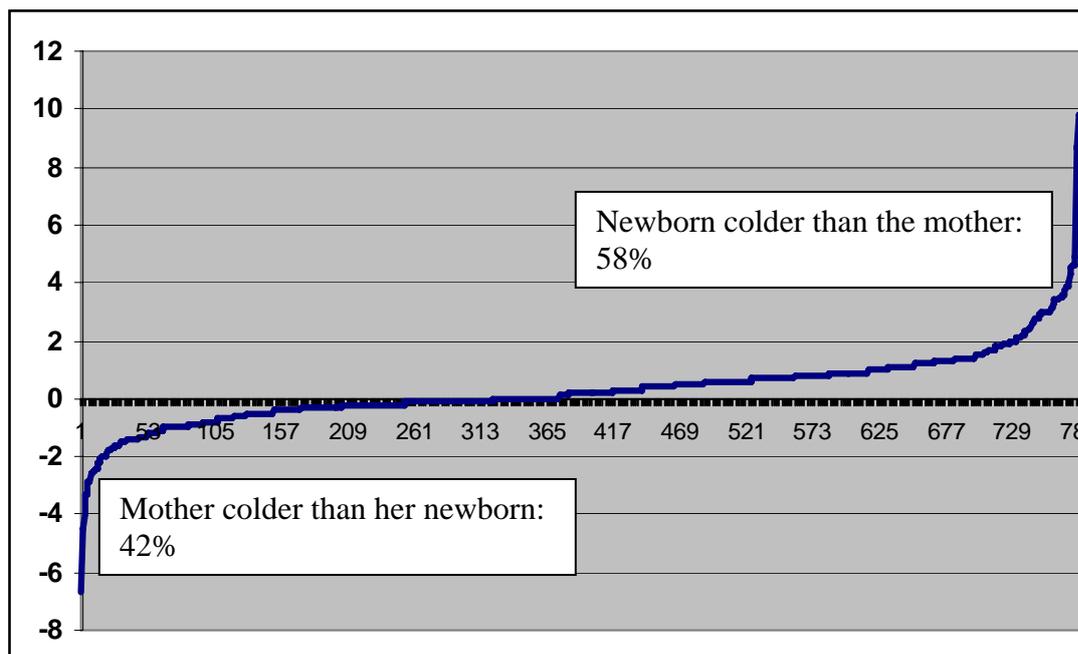
### Hypothermia

Hypothermia (body temperature  $< 36.4\text{ C}$ ) affected most newborns in the colder months of the year, and was a significant problem in both low birth weight and normal birth weight infants (Figure 5). Moreover, in nearly half (42%) of the cases of newborn hypothermia, the mothers was even colder than her infant (Figure 6). The impact of hypothermia on the ability of these mothers to warm their infants through providing skin-to-skin care was further investigated in the Mini-logger sub-study in which 24-hour, continuous mother-and-newborn temperature tracings and observations of behaviors, particularly thermal care practices, were recorded. The Mini-logger data has not yet been analyzed.

**Figure 5. Proportion of normal birth weight and low birth weight newborns in Shivgarh with body temperature  $< 36.4\text{C}$  by month**



**Figure 6. Temperature difference (Maternal temp minus newborn temp) of mother-newborn pairs in Shivgarh, ordered by the magnitude of the difference.**



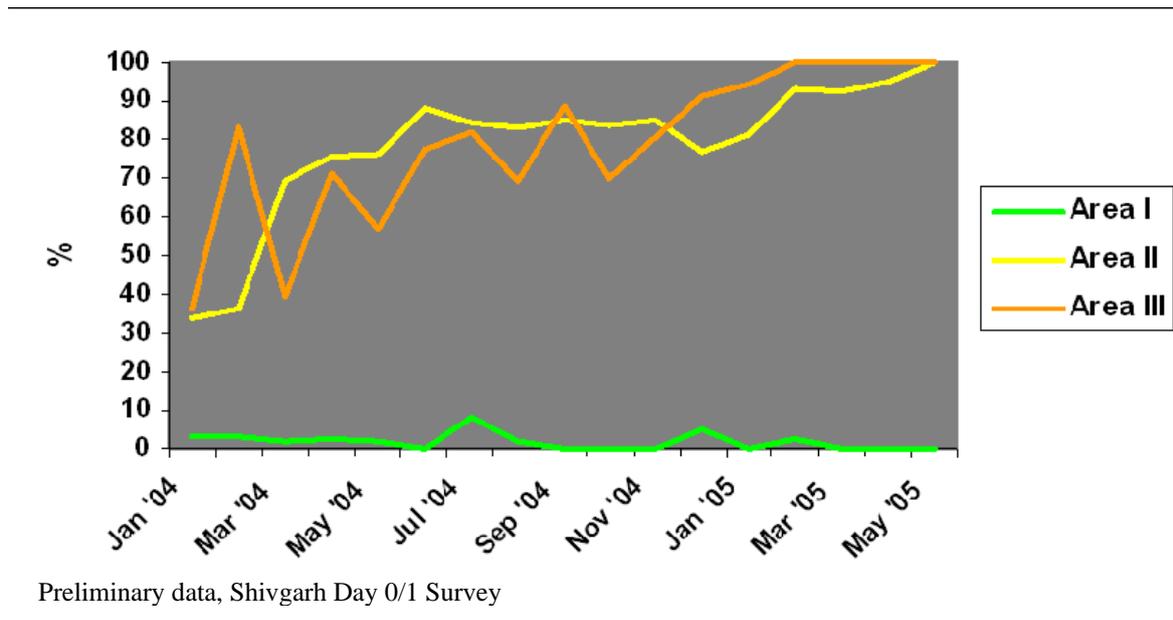
### Care practices

Remarkable changes in key practices associated with improved neonatal survival occurred early in the course of implementing the program (Figures 7-9).

#### *Skin-to-skin care*

A primary intervention promoted by the program was the adoption of skin-to-skin care. Within 3 months of project initiation, most mothers (i.e., > 50%) in both intervention groups accepted and practiced skin-to-skin care of their newborns. This practice was nearly universal (i.e., > 90%) in the intervention areas within 14 months (i.e., by February 2005). On the other hand, this practice was not adopted in the comparison area (i.e., acceptance remained only about 2-3%), suggesting that hearing about the practice was not enough; our qualitative research suggests that to adopt the practice required contact in the postnatal period with the *Saksham Sahayak* or *Saksham Karta*, who provided encouragement, demonstration, practice and trouble-shooting. Analysis of data from the STSC survey and from qualitative inquiries in the community will provide further insights into the acceptance of STSC; its association with other healthful practices such as breastfeeding, thermal care and delayed bathing; and lessons learned on how to most effectively promote STSC in the community. Preliminary analysis suggests that reasons for acceptance of STSC included: it prevents the baby from *Thanda bukhar* (hypothermia); the baby feels safer and the mother feels more capable of protecting her baby from evil spirits; and the baby is happier, startles less and is more relaxed while listening to the mother's heart beat. There were no perceived adverse effects. Barriers to adoption of STSC in the community included: "pollution" and presence of *litar* (vernix) on the newborn; potential disturbance of the cord, which some fear may hurt the baby; and weakness and postpartum pain of the mother. During hot summer months, some felt uncomfortable in the position.

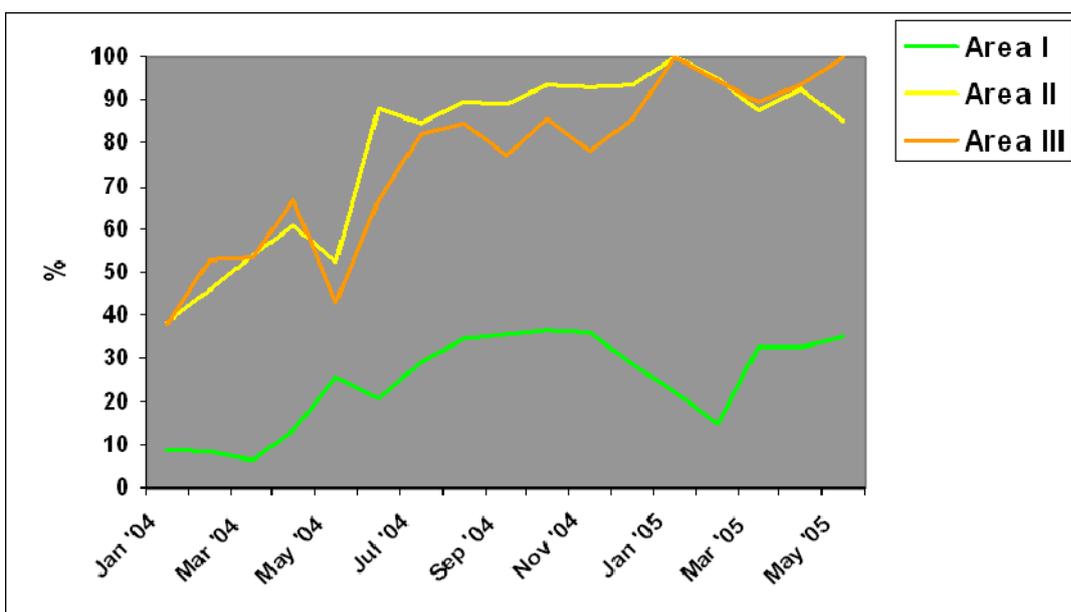
**Figure 7. Proportion of mothers who practiced skin to skin care.**



**Breastfeeding**

Initiation of breastfeeding on the first day of life increased substantially in both interventions arms in the first 6 months of implementation of the program (Figure 8). There was a slight increase in breastfeeding initiation in the comparison clusters, suggesting that, unlike for skin-to-skin care, there was some adoption of this improved practice among mothers in the comparison area who had no direct contact with health workers promoting the intervention through BCC (i.e., *Saksham Sahayak*).

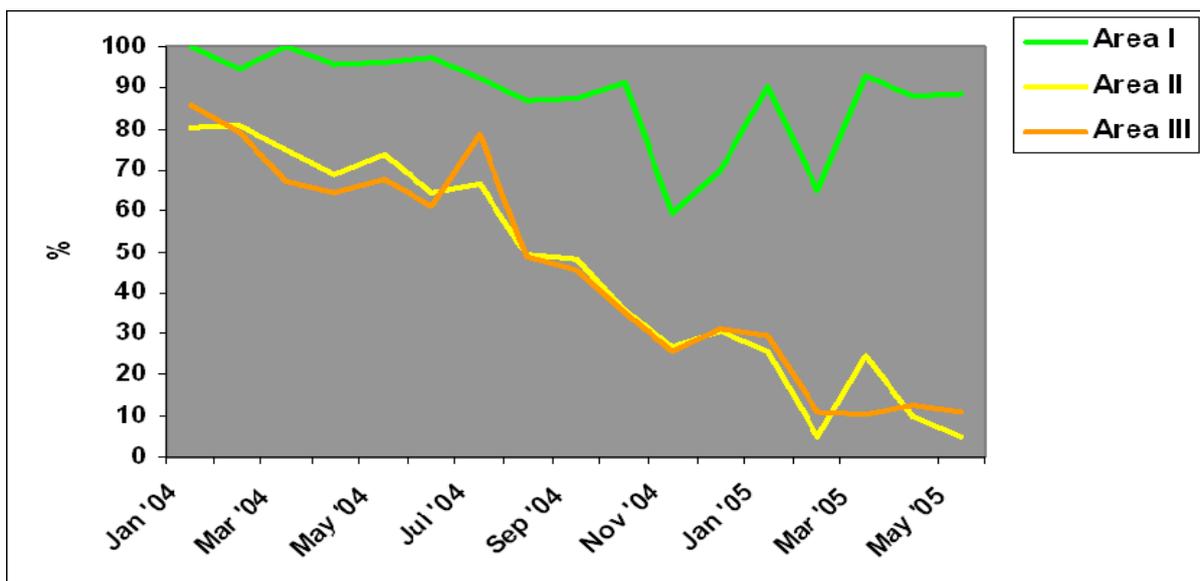
**Figure 8. Proportion of mothers in Shivgarh, by study arm, who initiated breastfeeding in the first 24 hours after giving birth.**



## Bathing

Delay in giving the newborn the first bath for at least the first day of life was promoted by the project. As with breastfeeding, there was substantial adoption of this practice in both intervention arms, as well as slight uptake in the comparison area. The process by which these practices are adopted in the comparison area in the absence of direct presence of the program in this area is a topic that is being studied, as this may provide important insights into program sustainability and scalability.

**Figure 9. Proportion of mothers in Shivgarh, by study arm, who delayed the first bath beyond the first day of life.**



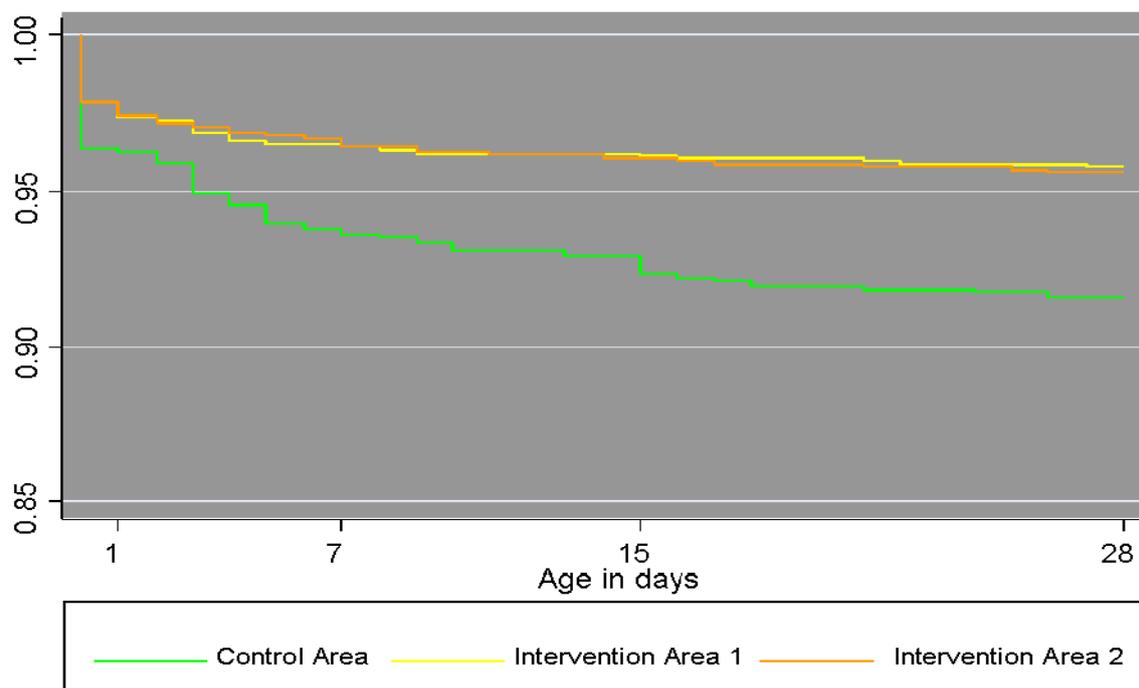
Changes in many other key maternal and newborn care practices are being analyzed and will be reported in the future in the peer-reviewed literature.

## Mortality

### *Neonatal mortality*

We measured neonatal mortality rates across the study arms at baseline, and then prospectively followed each newborn enrolled in the study for vital status at the end of the neonatal period. A verbal autopsy survey to ascertain cause of death will be completed in March 2007. Figure 10 shows the highly significant reduction in neonatal mortality that was observed in both interventions arms.

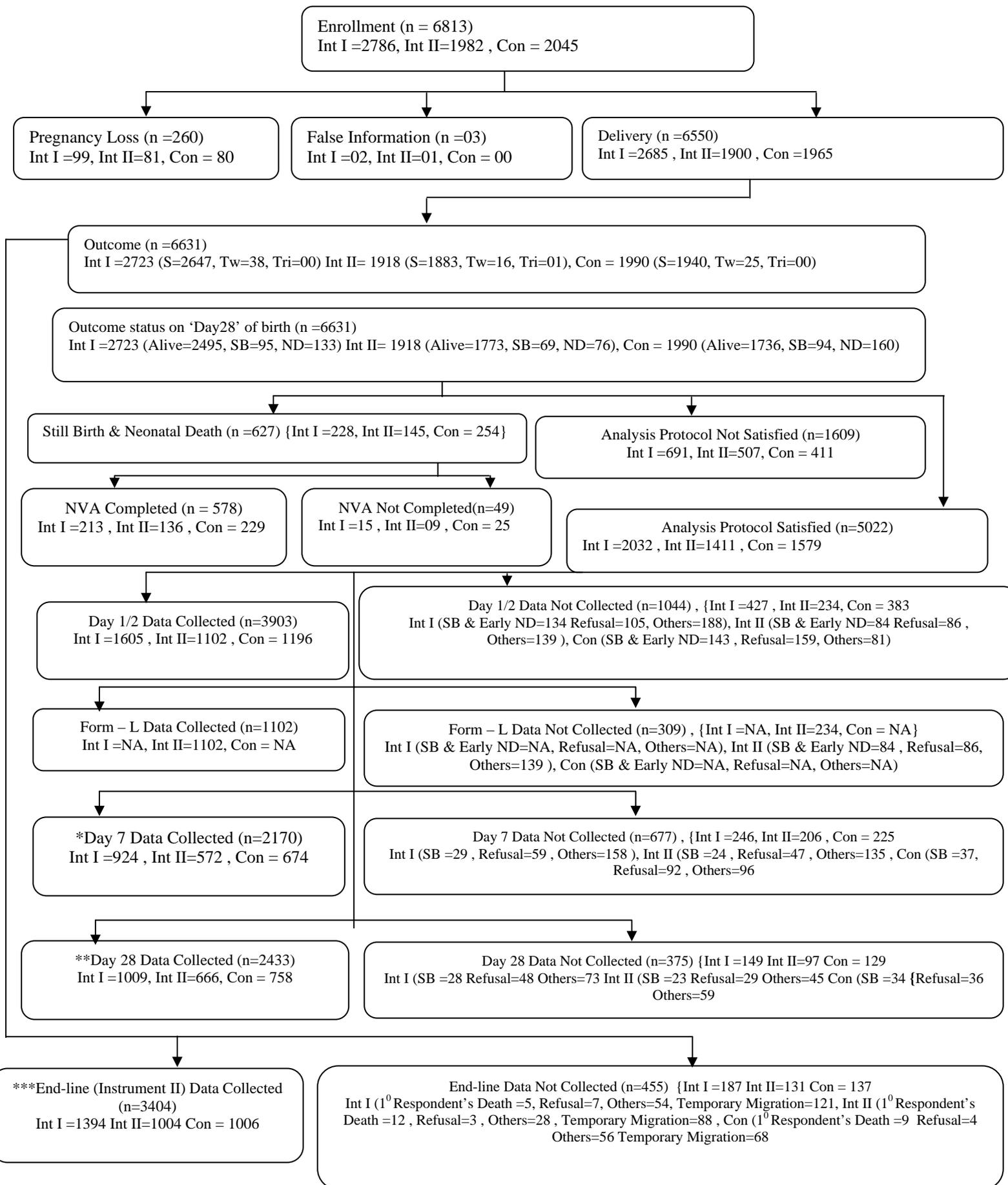
**Figure 10. Neonatal survival by study group in Shivgarh**

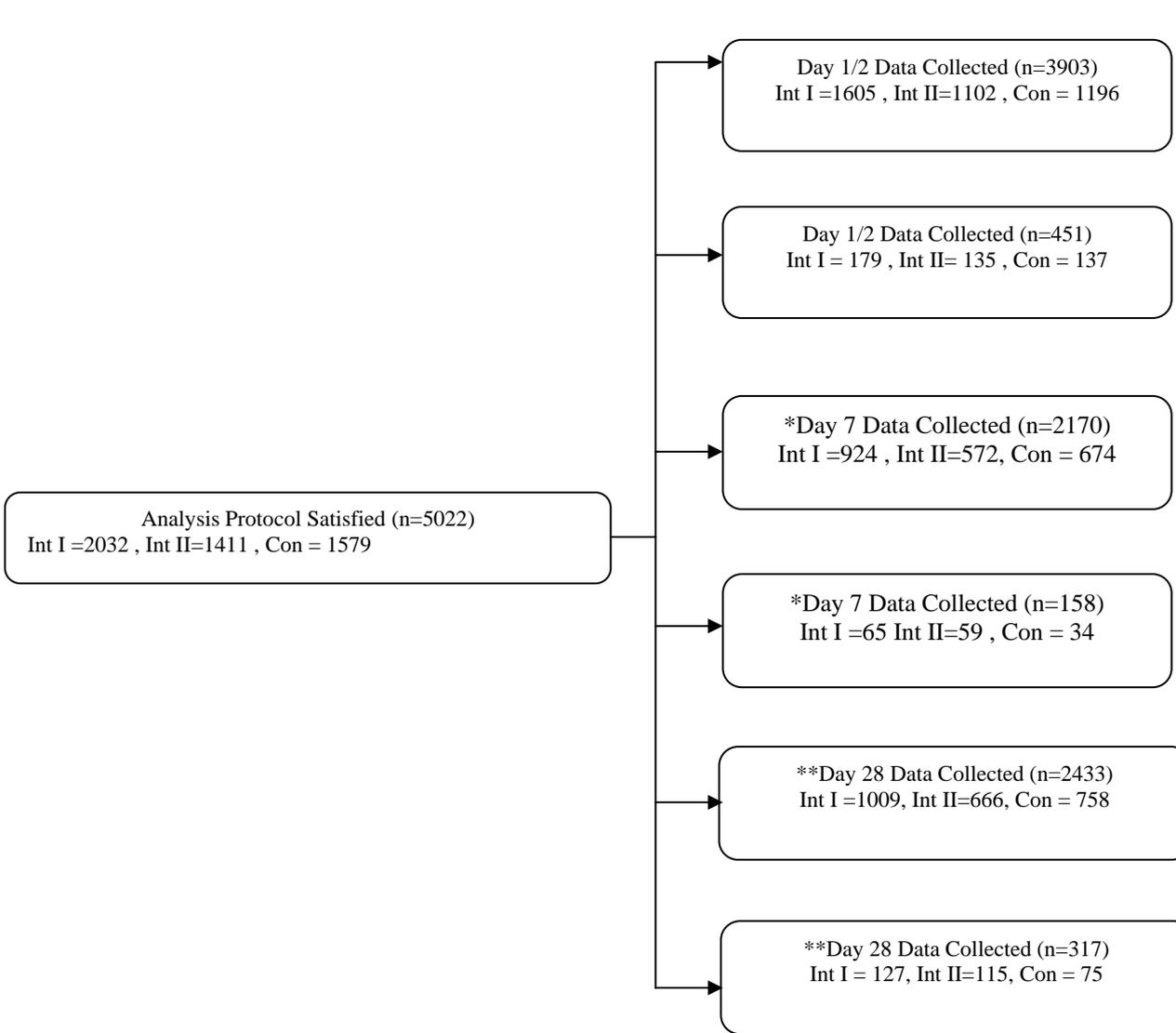
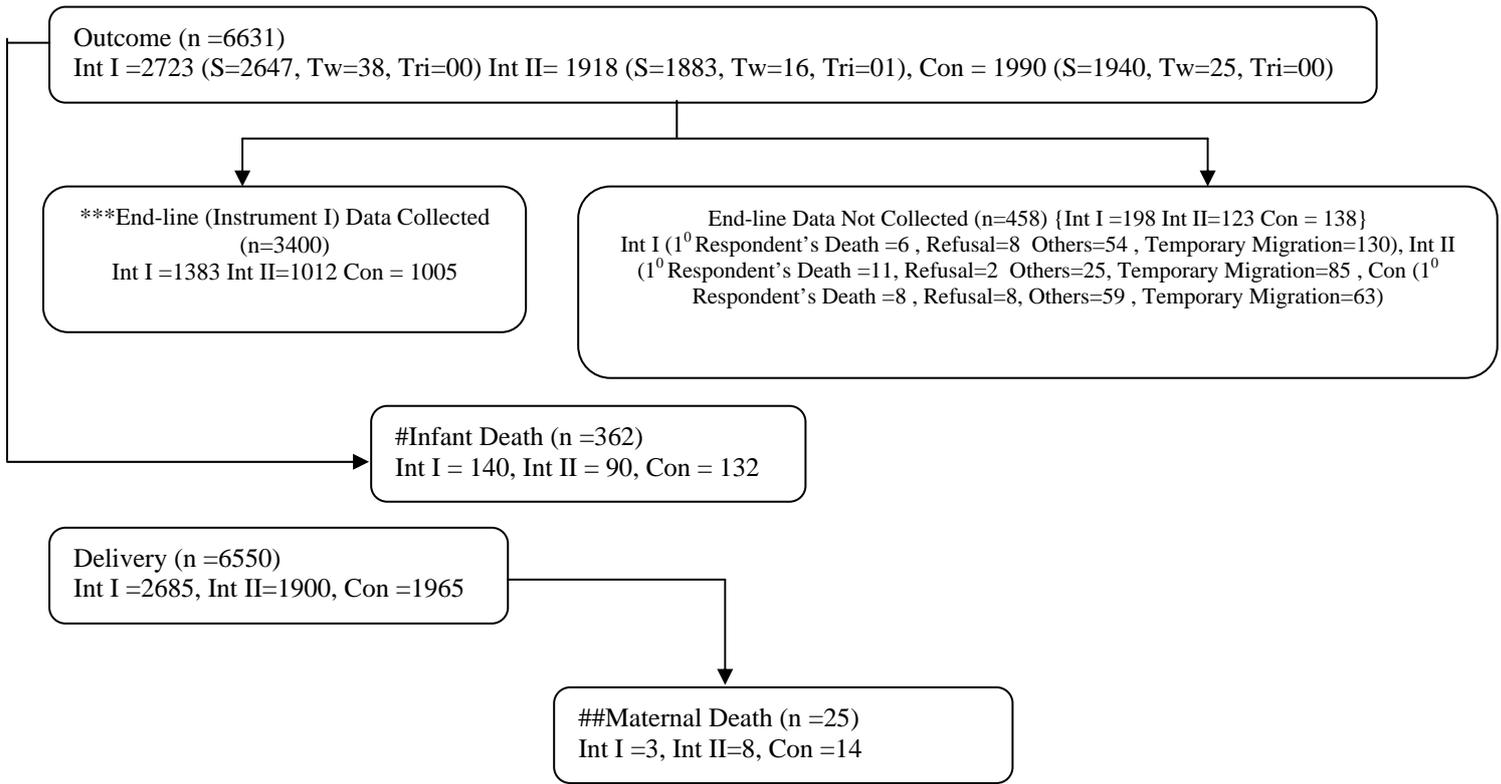


***Maternal mortality***

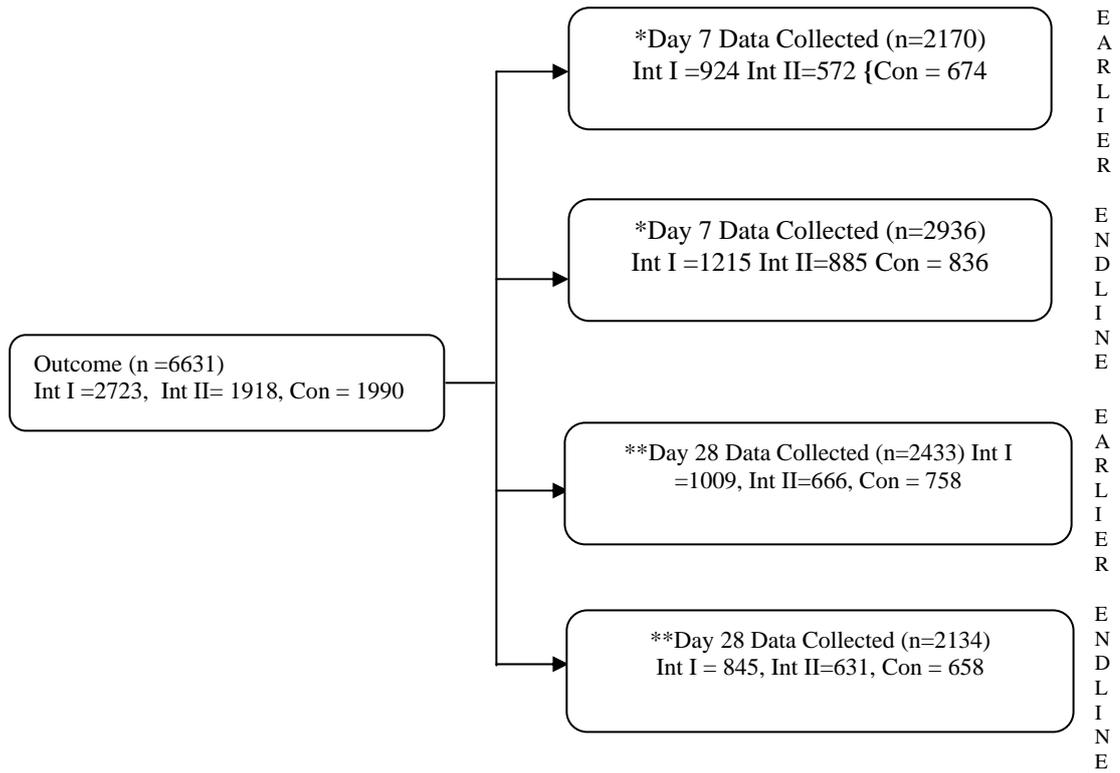
Maternal deaths in the study area have been recorded over the course of the study, and verbal autopsy has been completed for each maternal death. Preliminary analysis of data has been completed, however, results will be forthcoming in a peer-reviewed manuscript.

**Figure 4. Project Flow Chart (Complete for 10<sup>th</sup> January 2004 to 15 May 2006)**





EARLIER  
ENDLINE  
EARLIER  
ENDLINE  
EARLIER  
ENDLINE



Note:

- \* - Data collection process initiated from 01 – Jan – 2005 (n = 2,847)
- \*\* - Data collection process initiated from 13 – Jan – 2005 (n = 2, 776)
- \*\*\* - Data collected from those outcomes delivered on or before 15 – May – 2005
- # - Death count for those live births delivered on or before 15 – May – 2005
- ## - Death count up-to 90 days for those women enrolled till 15 – May – 2006

## Conclusions and Discussion

### Key Lessons Learned

Key conclusions will be formulated as data analysis proceeds. Moreover, process documentation for the project is extensive, and analysis and write-up of the lessons learned is forthcoming. However, a number of important principles are apparent now based on project learning, process documentation, and preliminary data analysis.

- Newborns in rural Uttar Pradesh are at risk of developing hypothermia across all seasons, although the risk is highest during the winter.
- Hypothermia is highly prevalent among both normal weight and low birth weight newborns, across all seasons but particularly in winter, in the community in rural India, and in more than 40% of cases, lower temperature of the mother than the hypothermic baby may limit her ability to warm the baby through skin-to-skin contact.
- In this low-resource environment, low ambient temperature is an overwhelming risk factor for hypothermia.
- Low ambient and maternal temperatures must be considered and addressed in strategies to implement KMC in the community as an effective intervention for newborn thermal control.
- Innovative, community-driven solutions may be the key to achieving thermal control through KMC in resource poor settings
- Skin-to-skin care emerges as a spontaneous and natural response to informed choice for thermal care in resource poor domiciliary settings if addressed through appropriate cultural paradigms.
- Lateral transfer of knowledge from health workers to caregivers that avoids conflict with deep-rooted social and cultural values, and the provision of messages that strike a cord with their existing understanding for newborn care and maternal instincts, empowers them to embrace change with increased spontaneity and confidence.
- A minimal package of preventive essential newborn care can significantly reduce neonatal mortality in a low-resource, high mortality area in a relatively short period of time (i.e., 18 months for initiation of program implementation, 2 years from coming into the community *de novo*). This validates the findings and strategy for implementing newborn health programs proposed by *The Lancet* Neonatal Survival Series.
- Some behavior change (e.g., skin-to-skin care) requires both antenatal and an early postnatal visit to reinforce. We believe that this is reflected in the lack of adoption of this practice in the comparison area.
- Behavior change can occur rapidly (i.e., within a period of a few months of initiation of a BCC program).
- The power of the community is under-appreciated and under-utilized in public health.
- The newborn is an apolitical, non-controversial point of convergence for the community and for continuum of care.
- Community mobilization and behavior change communications appear to act together to stimulate the adoption of evidence-based newborn care practices, leading to reduced neonatal mortality.
- In high mortality settings with poorly functioning health systems, initial emphasis on promotion of evidence-based family and community essential newborn care can

rapidly improve care practices and substantially lower neonatal mortality, but community demand requires simultaneous attention to clinical care for maternal and newborn complications.

### ***Overall conclusions***

- In a resource-poor area of rural India, a simple, low-cost package of essential newborn care delivered through a culturally sensitive community mobilization and behavior change communication program by community-based health workers and volunteers improved key newborn care practices and reduced neonatal mortality in half within one year.
- Working together with communities through community mobilization and behavior change communications in a manner which avoided conflict with deep-rooted social and cultural values and roles stimulated the adoption of evidence-based newborn care practices, leading to a rapid reduction in neonatal mortality despite scarce resources.
- In high mortality settings with a poorly functioning health system, initial emphasis on evidence-based family and community care can rapidly improve newborn care practices and substantially lower neonatal mortality, however, community demand also requires simultaneous attention to development of capacity for clinical care for maternal and newborn complications.

## **Sustainability and Scale**

The *Saksham Sahayak* developed a cadre of volunteers, the *Saksham Karta*, who complement their role within the villages. The *Saksham Karta* consist of mothers who have benefited from the intervention and influential members of the community who have a stake in newborn care and have volunteered to disseminate and support modification and adoption of behaviors by family members. There has been a gradual but consistent increase in the role of the *Saksham Karta* (volunteers) as primary providers of intervention, while the *Saksham Sahayak* increasing have played a supervisory role. Moreover, we have facilitated the formation of a community governing board, which meets at our project headquarters and is responsible for decisions regarding how to sustain and expand the intervention program in Shivgarh and surrounding areas..

Since the DSMB recommended that we expand the intervention program to the comparison clusters, we have been studying features of sustainability and scalability, and have been evaluating strategies for further adapting, simplifying, sustaining and expanding the intervention program locally. We feel that the site has an important role to play in conducting operations research to further broaden the intervention package to include maternal care and to link with the formal health system to provide care for sick newborns. We have particular strength in community processes, and feel that we can answer critical questions regarding how to take newborn care to greater scale through a process of community engagement, capacity building and participation. We are particularly interested in working with the government to demonstrate and evaluate the role of the ASHA worker in an integrated way within the health system.

We have taken up dialogue more intensively with local governmental (UP Health Systems Development Project, SIFPSA) and non-governmental institutions (Vistar program, Sure Start, NIPI). We aim to work closely with the government and other partners in an open dialogue regarding local needs, questions and bottlenecks, and determine in a participatory

process how our site can best be utilized to address key questions and constraints in neonatal health programming in Uttar Pradesh and in India more generally, and to demonstrate solutions.

## **Dissemination and Experience Transfer**

We are compiling a set of manuals on various aspects of the study (e.g., Formative Research, Community Mobilization, Behavior Change Communications, Project Management, Monitoring and Evaluation, Community-based Skin-to-Skin Care), drafts of many of which are appended to this report. We are also preparing a series of manuscripts for publication (see below). This will be complemented by a series of dissemination seminars to be held locally in Uttar Pradesh in collaboration with colleagues at KGMU, and will include officials of the Government of India (e.g., state Ministry of Health, Rural Health Mission), and various agencies (UN agencies, bilaterals) and organizations (non-governmental organizations). We anticipate that the dissemination sessions will address a number of important themes in neonatal health that are pertinent for the local context.

We have begun a process of frequent local engagement of the government of Uttar Pradesh and other stakeholders. We plan to hold a series of thematic seminars in which results related to a given subject are presented and discussed, and the implications for programming are explored. These seminars will be held as data is summarized on a given topic.

### **Demonstration / Site visits**

We feel that the Shivgarh site has an important role to play as a demonstration and ongoing learning site for the government and other agencies and organizations to see and experience the approach used to promote essential preventive newborn care. Increasingly, we are receiving requests for site visits, and have hosted a number of groups, including the Gates Foundation, USAID, SNL, INCLIN, NIPI (Norway-India bilateral child survival program), PATH (UP and Delhi offices), PneumoADIP, JHU (Office of the Dean), SEARCH and ICDDR, B. Upcoming visits are scheduled with: SIFPSA, JHU CCP, ITAP, UP-HSDP, Department of Program Monitoring and Evaluation, Government of UP, Principal Secretary Health-UP, President of National Public Health Foundation of India, UNICEF.

### **Presentations**

Indo-US (JHU) collaborations in neonatal health. India Chapter, Johns Hopkins Bloomberg School of Public Health Alumni Association, Delhi, India, December 7, 2006.

Shivgarh Experience: Lessons for NRHM; Team Leader: Recommendations for ASHA training. Norway India Partnership Meeting, State Stakeholders Workshop Group, Delhi, India, 4 October 2006.

Prevention and management of low birth weight: reflections from Shivgarh. Second Annual Workshop, MOther NewBorNet, New Delhi, India, 9-11 July 2006.

A community-based and community-driven essential newborn care program. Summer Institute Mini-University, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, 6 June 2006

Shivgarh: A community-based and community-driven essential newborn care program. UNICEF, Delhi, India, 25 May 2006.

Perceived morbidities and healthcare utilization for neonatal health in rural Uttar Pradesh, India: effects of a behavior-change communication intervention. Johns Hopkins University, Bloomberg School of Public Health, 9 April 2006.

Community neonatal death audits: a participatory process to mobilize and empower communities for collective action. Delta Omega Student Poster Competition, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, 17-24 Feb 2006.

Perceived Neonatal Morbidities in Rural Uttar Pradesh, India: Effects of a Behavior-Change Communication Intervention (Third Prize). Delta Omega Student Poster Competition, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, 17-24 Feb 2006.

Community mobilization and behavior change communications promote evidence-based essential newborn care practices and reduce neonatal mortality in Uttar Pradesh, India [poster]. Countdown to 2015: Tracking Progress in Child Survival, London, UK, 14 Dec 2005.

Update on new findings and priorities for international neonatal health research. Vermont Oxford Network Annual Meeting, Washington, DC, 3 Dec 2005.

Community-based newborn care program: the Indian experience. Asia Pacific Workshop on Continuum of Care for Maternal & Newborn Health, Bangkok, Thailand, 14-17 Nov 2005.

Lessons from implementation of skin-to-skin care in rural India for the development of strategies for community KMC. Global Forum for Health Research, Mumbai, India, 13 Sept 2005.

Community-driven essential newborn care in rural India. Global Health Council Annual Meeting, Washington DC, 2 June 2005.

Lessons learned from implementation of community-based skin-to-skin care in rural India. CORE Annual Meeting, West Point, New York, 20 April 2005.

Global neonatology: Saving Newborn Lives. Vermont Oxford Network Annual Meeting, Washington, DC, 11 Dec 2004.

Lessons from implementation of skin-to-skin care in rural India for the development of strategies for community KMC. First International Congress on Kangaroo Mother Care, Rio de Janeiro, Brazil, 9 Nov 2004.

Low ambient and maternal body temperature in rural Indian homes influences strategy to implement community-based KMC. First International Congress on Kangaroo Mother Care, Rio de Janeiro, Brazil, 9 Nov 2004.

Acceptance of community-based Skin-to-Skin care in rural India, First International Congress on Kangaroo Mother Care, Rio de Janeiro, Brazil, 9 Nov 2004.

Priorities for advancing newborn health and survival in South Asia. IndiaCLEN Annual Strategic Planning Meeting, Lucknow, India, 24 Sept 2003.

Global research priorities for advancing neonatal health. IndiaCLEN Neonatal Health Research Initiative Workshop, Lucknow, India, 21 Sept 2003.

Global experience (JHU and SNL) in neonatal health research in developing countries, IndiaCLEN Neonatal Health Research Initiative Workshop, Lucknow, India, 21 Sept 2003.

Advancing child survival through improved newborn health in developing countries. Department of International Health, Bloomberg School of Public Health, The Johns Hopkins University, Baltimore, MD, 24 Feb 2003.

## **Publications**

### ***Manuscripts in peer-reviewed journals***

Darmstadt GL, Kumar V, Yadav R, Singh V, Singh P, Mohanty S, Bharti N, Gupta S, Gupta A, Baqui AH, Santosham M. Introduction of community-based skin-to-skin care in rural Uttar Pradesh, India. *J Perinatol* 2006;26:597-604.

Darmstadt GL, Kumar V, Shearer J, Misra R, Mohanty S, Baqui AH, Coffey PS, Awasthi S, Singh JV, Santosham M. Validation of accuracy and community acceptance of the BIRTHweigh III scale for categorizing birth weigh in rural India. *J Perinatol*; in press.

Patel Z, Kumar V, Singh P, Yadav R, Singh V, Bharti N, Baqui AH, Santosham M, Darmstadt GL. Feasibility of community neonatal death audits in rural Uttar Pradesh, India. *J Perinatol*; in press.

### ***Manuscripts submitted for publication***

Darmstadt GL, Kumar V, Yadav R, Mehrotra H, Srivastava K, Gupta A, Sharma A, Shearer JC, Baqui AH, Santosham M. Community perceptions of birth weight in rural Uttar Pradesh, India.

Thomas A, Kumar V, Baqui AH, Awasthi S, Singh JV, Santosham M, Darmstadt GL. Neonatal health program management in a resource constrained setting in rural India.

### ***Priority manuscripts under preparation/planned (partial list)***

Several of the manuscripts noted below will be completed in 2007 with support from USAID-Washington.

- Community mobilization and behavior change communication promotes adoption of evidence-based newborn care practices and reduces neonatal mortality in Uttar Pradesh, India (main impact paper)
- Role of skin-to-skin care in improved neonatal care practices and reduced morbidity and mortality
- Timing of morbidity and mortality, and implications for intervention design

- Role of postnatal and antenatal visits
- Maternal care seeking and program effect on maternal mortality
- Hypothermia: A review of pathophysiology, burden and management strategies
- Role of private providers, e.g., *Joala Chap* doctors, in newborn care
- Risk factors for neonatal mortality (case-control study)
- Recognition of hypothermia by mothers and health workers
- Transfer of heat between mothers and other caregivers with newborns – the influence of skin-to-skin care and other thermal care interventions
- Undercounting of neonatal deaths and stillbirths by routine demographic surveillance in Uttar Pradesh, India
- Cost effectiveness of preventive essential newborn care
- Equity in changes in care practices and mortality
- Use of community health workers and community volunteers to promote essential newborn care
- Breastfeeding promotion
- Community mobilization – process and measurement
- Use of GPS to understand information transfer within the community
- Saur: Early post-partum confinement and implications for newborn care
- Community stake-holders for newborn care practices and implications for community-based strategies
- Gender differences in care-seeking for newborn illnesses in rural Uttar Pradesh, India
- Perceived neonatal morbidities in rural Uttar Pradesh, India: effects of a behavior-change communication intervention
- Healthcare utilization for neonatal illnesses in rural Uttar Pradesh, India: Effects of a behavior-change communication intervention
- Role of ThermoSpot in neonatal health care in rural Uttar Pradesh, India
- Spatial distribution (based on GPS) of morbidity and mortality and implications for intervention design
- Community surveillance for vital events
- Role of birth planning
- Concepts of body temperature, hot/cold