Pilot of the BEMPU Device for Reduction in Hypothermia and Infection Related Neonatal Mortality and Morbidity in Rajasthan

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This pilot was done in partnership with NHM Rajasthan and the WISH Foundation

Report Presented by BEMPU Health

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Contents

1. Executive Summary 1
2. Background 2
3. NHM Rajasthan Pilot 4
4. Methodology 7
5. Results 8
6. Conclusion 20
7. List of Appendices 21
Appendix A: Examples of Data Collection Tools 22
Appendix B: Roles and Responsibilities of Parties Involved 23

1. Executive Summary

Low-weight and premature babies often die or are injured due to hypothermia and late-treated infection. NHM Rajasthan identified the BEMPU Hypothermia Bracelet as an intervention to combat these deaths and illnesses. This novel life-saving device monitors a newborn continuously for one month in the hospital and home setting. If the baby is hypothermic, the device sounds an alarm enabling the parents to warm with Kangaroo Mother Care (KMC) before severe hypothermia can cause death. If continuing to alarm despite warming the baby, the parents seek skilled care before an infection can become severe. The BEMPU Bracelet is one of the few devices that can be used in home setting to lower Neonatal Mortality Rate (NMR).

To demonstrate the effectiveness, NHM Rajasthan conducted a pilot with 386 low-weight babies in 10 facilities, 3 Sick Newborn Care Units (SNCUs) and 7 Primary Health Centers (PHCs) in Udaipur, Sagwara, and Dungarpur. Newborns less than 2.5 kg irrespective of gender and socio-economic status qualified for this study. 250 newborns were enrolled wearing the BEMPU bracelet and their families received standard discharge instructions and training on Kangaroo Mother Care (KMC). 136 newborns were enrolled in the control group and their families received the same standard of care discharge instructions and KMC training. Quantitative and qualitative data was collected during this study to determine the effectiveness of the BEMPU Bracelet in catching hypothermia, reducing infections in the home, and increase parent health-seeking behavior. Data collection took place every week for 4 full weeks; data for weeks 1-3 was collected over the phone and week 4 was done in person at the SNCU or PHC of enrollment.

BEMPU Group had a lower mortality rate by 8% and stronger compliance to KMC

The pilot results prove that the innovation is suitable for newborn care management in home-based settings. Feedback from mothers in the BEMPU group suggests that they performed more Kangaroo Care as a result of wearing the bracelet and had few difficulties complying. Feedback from doctors and nurses also suggest the device was acceptable for use in their clinics and would be further complemented with programs for KMC.The mortality rate in the BEMPU group was 6% compared with a mortality rate of 14% in the control group; this could be from increased KMC or early detection of infection in the homes.

2. Background

a. Problem: Low-weight babies dying in homes.

1 in 3 babies born in India is Low Birth Weight

These babies are at the highest risk of hypothermia

Neonatal hypothermia and infection are among the top causes of newborn death and illness in low-resource settings, especially in LBW and pre-term infants[1]. Newborns with hypothermia can experience consequences like hypoglycemia, hypoxia, and poor weight gain. As a result they have to be readmitted to SNCU, and also face a greater likelihood of death. Newborn infection is one of the largest causes of mortality; hypothermia is an early symptom of infection in LBW babies, and offers a channel for early detection. Morbidities and mortalities related to hypothermia can largely be prevented by performing regular KMC, or through medical intervention if detected early.

In Rajasthan, as per the 2013 Annual Health Survey (AHS) data, 36.3% (37.6% rural, 32.6% urban) of babies are born with LBW. Conversion into number shows its massiveness which is equal to approximately 608,000 babies per year who are LBW, and who are at high risk for hypothermia and other infections. Timely intervention with these newborns has greater scope to bring down the Rajasthan's NMR which is 37 per 1000 in 2012-13, as per AHS data.

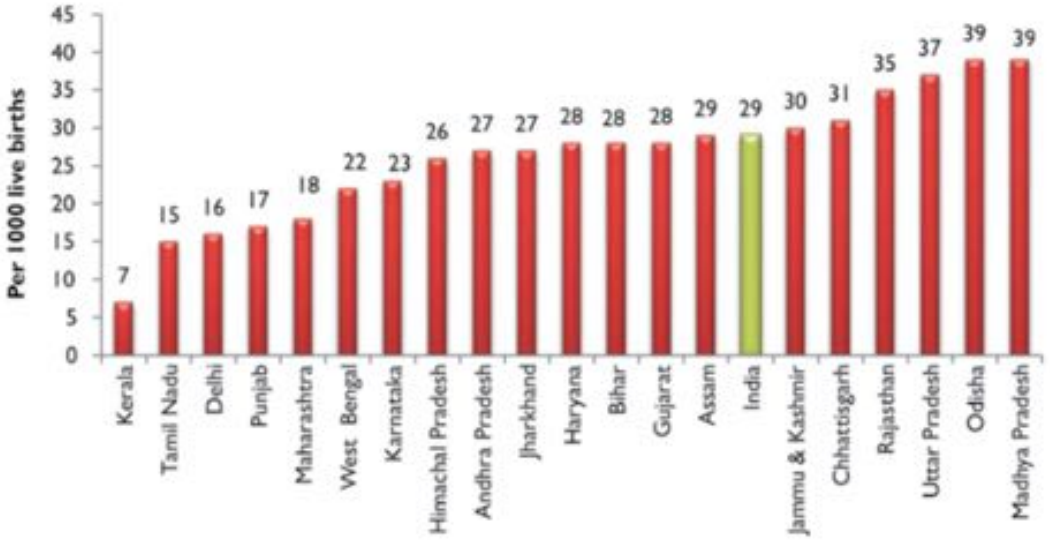


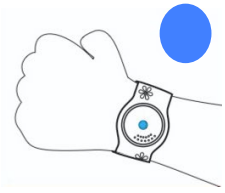
Figure 1 – NMR Rates for India. Graph retrieved from NFHS-3, India 2005-06.

[1] Lunze, Karsten et al. "The Global Burden of Neonatal Hypothermia: Systematic Review of a Major Challenge for Newborn Survival." BMC Medicine 11.1 (2013): 24. Print.

b. Proposed Solution: BEMPU

Preventing hypothermia and catching infections early can prevent death and complications in LBW newborns. Until recently, warmers and SNCU care have addressed these concerns in facility settings. However, it has been difficult to manage hypothermia and infection in the home setting.

NHM Rajasthan identified the BEMPU Hypothermia Bracelet as a potential solution to home based hypothermia management. The BEMPU Bracelet continuously monitors a newborn's temperature during the critical neonatal period. In the case of hypothermia, the device gives a simple audiovisual alarm to alert the parent to warm the baby through Kangaroo Care thereby preventing any harmful health consequences. If the device continues to beep despite warming, this implies the infant may have an infection and requires skilled intervention. The device empowers parents to take positive health seeking behaviors for their newborns.



BEMPU flashes a blue light when the baby is at a normal temperature

BEMPU flashes orange and alarms when the baby is hypothermic. The mother does kangaroo care.

Once the temperature returns to normal, BEMPU flashes blue again. Mothers do KMC to prevent future alarms.

BEMPU is a novel device used to catch hypothermia in the home

The bracelet works 24/7 for four full weeks, keeping the newborn continuously protected during the neonatal period. The device has been studied across India. Previous studies show that the BEMPU Bracelet is linked to:

- Increased weight gain and growth for the baby
- Increased compliance to Kangaroo Care for the mother and father
- Higher attendance rate for follow-up appointments by the parents

3. NHM Rajasthan Pilot

To understand the utility of BEMPU in NHM Rajasthan health facilities, a pilot was designed by LEHS/WISH and BEMPU Health and approved with NHM Rajasthan. The pilot was implemented in three NHM operated SNCUs, three NHM operated PHCs, and four WISH operated PHCs.

a. Objectives

The objectives of the pilot were the following:

1. To understand the effectiveness of the BEMPU Bracelet in reducing NMR and neonatal illness by monitoring: parent identification of danger signs; early referral management of hypothermia and infections; and key behaviors like KMC and weight gain in post discharge.
2. To assess the feasibility of integrating the BEMPU Bracelet into the government system.
3. To understand the community and health care provider's perception and acceptance of the BEMPU Bracelet by collecting feedback on the device from health professionals and caregivers such as SNCU nurses and doctors.

b. Pilot Design

The BEMPU Bracelet was issued to 250 critical babies (<2.5 kg) who were managed at SNCUs and PHCs in Udaipur and Sagwara. The device was issued to the baby prior to discharge from the center and then used at home for 4 continuous weeks. The results were compared to 136 newborns born in the control group SNCU and PHCs in Dungarpur. Every family (both control and experiment) received discharge instructions on hypothermia awareness and prevention, KMC, and swaddling techniques; the experimental group received additional instructions on the BEMPU Bracelet.

c. Location of Pilot:

The pilot was held in Udaipur and Dungarpur districts of Rajasthan. Locations were selected because of their high prevalence of LBW newborns, Udaipur is 46.60% and Dungarpur is 40.80% compared to Rajasthan's state average of 36.30%; high neonatal mortality rates, Udaipur and Dungarpur have a rate of 41 per 1,000 births compared to Rajasthan's state average of 37 per 1,000. The study split centers into BEMPU centers and Control centers. In order to ensure newborns from all geographies and socio-economic classes were enrolled a smaller SNCU, Sagwara, which is inside the Dungarpur district, was added to the BEMPU Group. The pilot also included 7 PHCs throughout both districts.

Level	BEMPU Group (250 Babies)	Control Group (136 Babies)
SNCU	Udaipur SNCU Sagwara SNCU	Dungarpur SNCU
PHC	Bikrani PHC Malwa Ka Chhora PHC Mandwa Richha PHC Mamer PHC	Ramgarh PHC Nithawa PHC

d. Inclusion and Exclusion Criteria for the BEMPU Pilot

Inclusion:

- Weight at discharge below 2500 gms.
- Baby is able to maintain temperature without radiant warmers.
- Baby is stable (normal capillary filling time strong peripheral pulses).
- Primary illness, if any, has resolved.
- Mother is confident of taking care of the baby at home, baby breast-feeds well.
- Parent willing to participate.
- Parent is able to come to follow-up at 4 weeks.
- Parent has a mobile phone at which they can be reached.

Exclusion:

- Newborn is not clinically stable.
- Newborn who is Leaving Against Medical Advice (LAMA).
- Newborn is discharged with a complication known to impact its ability to gain weight, or which can put newborn at a higher disposition for infection or death (down's syndrome, metabolic, genetic disorders, etc).
- Newborns being referred to higher centers.

e. Execution

Newborns were enrolled in the study by SNCU and PHC nurses, site data entry operators (DEOs), and BEMPU Staff. Parents of newborns enrolled in the study received three follow-up phone calls to collect information on: health status of newborn; KMC compliance; and status of BEMPU Bracelet (if applicable). Parents also received a reminder call before their 4-week follow-up appointment. If parents did not answer the phone, their ASHA was to be called to gather follow-up data (however due to logistical constraints, this did not practically happen). At the 4th follow-up appointment, parents submitted their patient diary and doctors took final anthropometric measurements. Doctors and nurses completed a feedback form once all follow-ups were complete.

Nurses were provided incentives to enroll newborns in the pilot. DEOs were provided incentives to perform all follow-up phone calls. The DEOs were asked to give 5 calls per newborn on the following days: day 3 to remind of study, day 7 to collect 1 week follow-up data, day 14 to collect 2 week follow-up data, day 21 to collect 3 week follow-up data, and day 27 to remind parent come to week 4 follow-up appointment. If the parents do not come for 28th day follow-up, DEOs will give one more reminder call. DEOs were asked to email their excel sheets of data entry every Monday and Friday to WISH and BEMPU research teams. However, phone calls were not always successful due to unreachable numbers or parents not answering. Parents were provided an incentive/travel stipend for bringing their newborn to weekly follow-ups. All bracelets were originally to be collected by ASHAs on the last Home Based Newborn Care (HBNC) visit and returned to their respective health centers when the ASHA collected her incentive However due to logistical constraints this did not practically happen.

4. Methodology

a. Quantitative Data

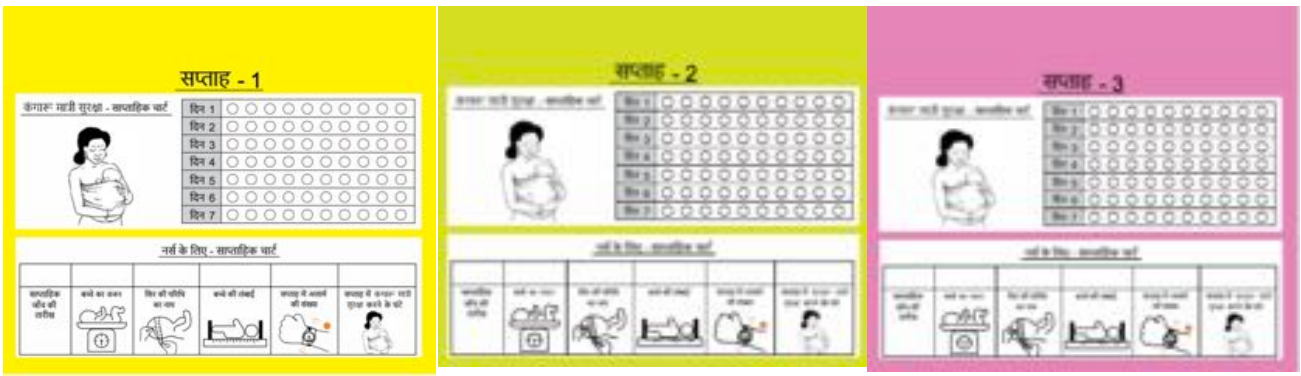
1. Survival rate
2. Follow-up rate
3. Readmission
4. Incidences of infection detection
5. Weight gain over duration of 4 weeks (per week)

b. Qualitative Data

1. Feedback on BEMPU Bracelet from appropriate health professionals including 3 Pediatric Department Heads at facility and community settings regarding its use and feasibility in the field.
2. Feedback from parents regarding their compliance to BEMPU Bracelet and understanding of newborn health.
3. Case studies of critical health issues identified for babies already discharged to the home setting.
4. Adherence to practices and behaviors of Kangaroo Mother Care (KMC).

c. Data Collection Tools

Parents were given take home diaries to monitor the hours of KMC performed every day for 4 weeks. If parents were unable to take their newborns to the SNCU or PHC for weekly follow-up appointments, but were able to see another health professional, anthropometric measurements were recorded in the diary and verified on final in person check-up. SNCUs and PHCs had hospital forms to collect data on: weight, length, head circumference, and hours of KMC. DEOs called parents weekly to collect data on: newborn status, hours of KMC, and weekly weight. See appendix for more examples of data collection tools.



5. Results

a. Quantitative Results

The training for the pilot took a total of 2 weeks. Trainings were held in SNCUs and PHCs with doctors, nurses, DEOs, and ASHAs. The purpose of the training was to ensure doctors, nurses, DEOs, and ASHAs understood: how the BEMPU Bracelet worked; how to properly gather and input data for the pilot; how to train families on the BEMPU Bracelet, KMC, and take home diaries; and how to properly send the data to LEHS/WISH and BEMPU Health teams for analysis. Enrolment began September 29th 2016 and ended January 10th 2017. Final data collection occurred the last week of February.

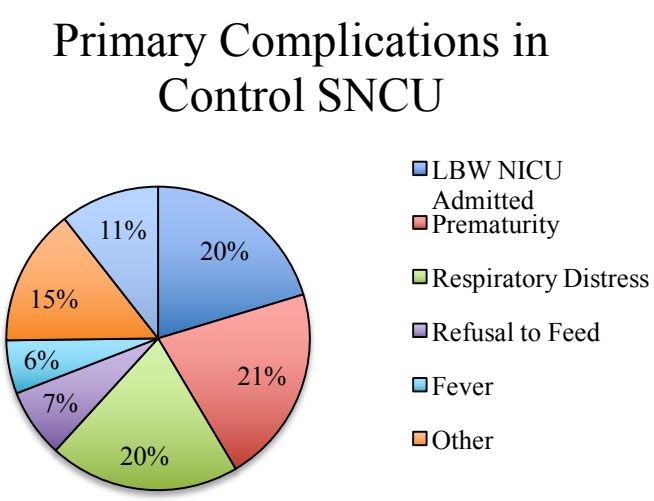
92% of BEMPU babies and 89% of the control babies were able to be contacted at 4 weeks.

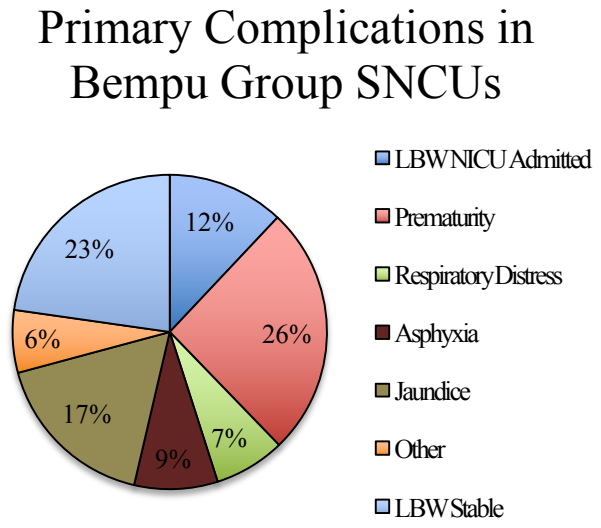
Enrolment & Follow-up: Total enrollment for the pilot was 386; 250 enrolled in the BEMPU group and 136 enrolled in the control group.

20 and 15 babies in the BEMPU and control group, respectively, were unreachable and therefore unable to complete the 4-week endpoint for death; therefore 92% and 89% of the newborns, respectively, were reached to confirm whether they were alive or deceased.

Parents were also requested to return to the center for follow up at 4 weeks for measurement of weight. The BEMPU group had 158 of the 250 enrolled complete the study; however only 144 completed returned for for the weight check-up within the 4-week time frame giving an in-hospital follow-up rate of 63.2%. The control group had 66 of the 136 enrolled complete an in-hospital follow up complete the study, however only 56 of these occurred within the 4-week time frame giving a rate of 42%. Before the pilot began, we were told the follow-up rate was close to 0%, therefore we expected a large loss to follow-up. Both groups were had the same weekly calling schedule and were given incentives to come to follow-up appointments. A significant portion of parents did not return for follow-up despite the follow-up calls and incentives. This was largely because the distance to travel was often significant as the district hospitals cater to a large geographic area.

Admission Profile: Udaipur, Sagwara, and Dungarpur SNCUs were able to provide profiles of newborns enrolled in the study. Newborns from PHCs did not have profiles recorded. In the control SNCU, the largest primary conditions of newborns enrolled were: prematurity (26 newborns), LBW NICU Admitted (25 newborns), and respiratory distress (25 newborns). In the BEMPU Group the largest primary conditions of newborns enrolled were: prematurity (60 newborns), jaundice (40 newborns), and LBW (28 newborns). The following graphs show primary conditions of SNCUs newborns enrolled in the studies.





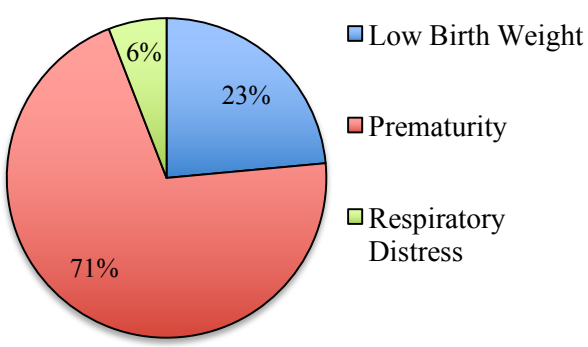
Newborns from the two groups had similar profiles at the time of enrollment in the study:

	Control			BEMPU		
	N	Average	SD	N	Average	SD
Birth Weight (kgs)	132	1.94	0.43	243	1.87	0.38
Discharge Weight (kgs)	132	1.88	0.41	243	1.89	0.37
Gestational Age (weeks)	94	35.2	3.1	74	35	2.8
Gender (% male)	131	52.94%	-	243	52.8	-

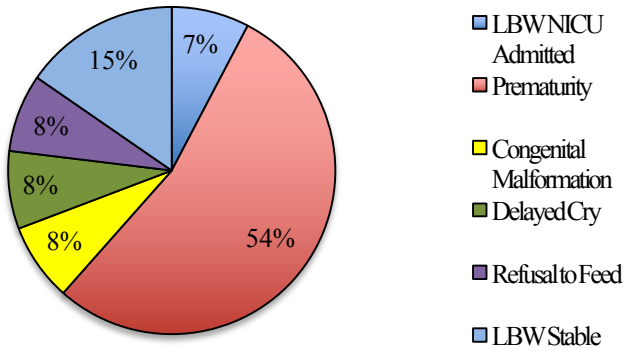
Total number of newborns enrolled = 136 in control and 250 in BEMPU, however not every newborn enrolled had all information captured

Death Rate: The BEMPU group observed a lower death rate at 6%, while the control group had a rate of 14% (p=0.013). Death data was collected by the DEOs, during visits to the facility, and also verified by phone calls by the project execution team when newborns did not come to follow-up appointments.

Primary Complications in Newborns who Died after Discharge from Control SNCU

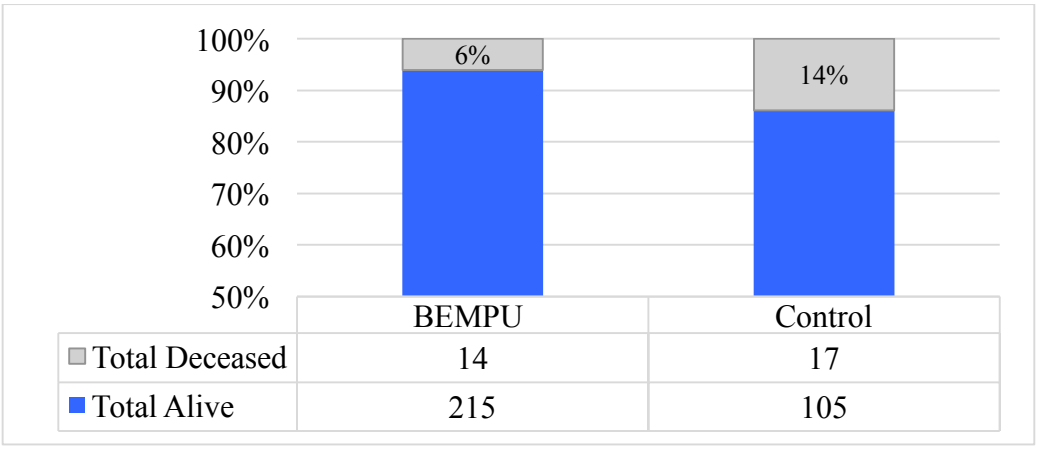


Primary Complications in Newborns who Die After Discharge from Bempu SNCU



Newborns who were enrolled at a SNCU were given a primary condition during enrollment. Many of the newborns who died were born premature. The following graphs break down primary complications of newborns in all SNCUs who died after discharge.

Babies Alive and Deceased after 4 weeks



**There are 20 and 15 babies that were unreachable in the BEMPU and Control Group, respectively*

Weight Gain: There were 144 and 56 newborns from the BEMPU and Control group, respectively, who completed the study in the 4-week timeframe; however, only 128 and 44 data sheets were used in the study analysis. The reason data sheets were excluded from the weight gain analysis include data sheets were illegible, data sheets were not filled correctly, or data was obviously falsified. Newborns coming were measured for weight at each follow-up appointment at every center. Weight gain was calculated as:

$$\frac{\text{(Weight at 4 weeks – Weight at Discharge)}}{\text{(Total Number of Days Between Discharge and 4}^{th}\text{ week Follow-Up)}}$$

The weight gain does not show a significant difference between the two groups in mean or median.

	Average Weight Gained (grams/day)			
	N	Mean	Median	SD
BEMPU	128	24.4	24.2	11.6
Control	44	26.5	24.6	13.8

The data for weight gain was difficult to gather and not standardized between centers and nurses. Some newborns were weighed with their clothes on, some nurses rounded information to the nearest half kg, and some centers did not have proper scales.

b. Qualitative Results

Qualitative results were captured through case studies with parents, doctors, and staff nurses. Parents were interviewed on KMC compliance, reasons for readmission (when applicable), and reasons for death (when applicable). Doctors and staff nurses were asked for their feedback on BEMPU and how it can be integrated into the health systems. Qualitative data shows positive feedback from doctors and nurses; promotion of KMC compliance and newborn weight gain; increase of early detection in the home and weekly follow-up rates; and reduction in neonatal mortality rates.

Parent Feedback:

Interview 1: KMC to Prevent Alarming

Location: Karada Village, Sagwara

"BEMPU showed a red light many times a day, especially in the early morning hours. I used to do KMC so that BEMPU will not show a red light."

Background: Mother01 is 23 years old with degree in commerce; Father01 lives and works in Bombay as bank manager. Mother01 lives with her mother and sister. This is their first child. Mother regularly went to prenatal checkups with her Anganwaadi and delivered in a hospital.

BEMPU Use: Mother remember instructions for: purpose of BEMPU, how to use BEMPU, and proper KMC technique. Mother performed KMC regularly and every time BEMPU showed a red light. "BEMPU showed a red light many times a day, especially in the early morning hours. I used to do KMC so that BEMPU will not show a red light."

Result: The baby gained 1.44 kgs in 4 weeks; the discharge weight was 2.40 and 4th week weight was 3.84 kgs. The baby had no hospital readmissions and is currently healthy. The mother performed KMC every time BEMPU alarmed and otherwise. When asked, the mother showed health care workers the correct process of KMC. The mother did not know anyone in the family could perform KMC.

Interview 2: BEMPU Promotes KMC
Location: Nai Village, Udaipur

Background: The mother is 25 years old and studied until 10th standard. The father is a mason and works in Udaipur city. This is their first child.

BEMPU Use: Mother remembers instructions for: hypothermia awareness, importance of cleanliness and breastfeeding, and BEMPU use. "BEMPU beeped in the night and early morning hours. Whenever it beeped I did KMC. I was told that my baby can get cold easily and needs warmth."

"BEMPU beeped in the night and early morning hours. Whenever it beeped I did KMC. I was told that my baby can get cold easily and needs warmth."

Result: The baby gained 1.25 kgs in 4 weeks; the discharge weight was 2.40 kgs and the 4th week was 3.65 kgs. The baby had no hospital readmissions and is currently healthy. When asked, the mother showed health care workers an incorrect process of KMC. The mother performed KMC while she and her baby were wearing clothes. Health workers corrected her KMC.

Interview 3: BEMPU Encourages Kangaroo Family Care
Location: Thoor Village, Udaipur

Background: The mother is 21 years old and the husband is 29 years old and works as a farmer. The parents live with the father's family in a large house on the outskirts of Udaipur. This is their first child. The baby was born prematurely and with low birth weight. The baby suffered from pneumonia and was treated in the Udaipur SNCU for 8 days.

BEMPU Use: Both parents understood how to use BEMPU and knew if it ever alarmed they were to perform KMC for 1 hour and throughout the day. The father, mother and grandmother performed KMC on the baby day and night. "The BEMPU Bracelet was extremely helpful in maintaining the baby's temperature. We all took turns in performing KMC regularly.

"The BEMPU Bracelet was extremely helpful in maintaining the baby's temperature. We all took turns in performing KMC regularly."

Result: The baby gained 1.06 kgs in 4 weeks; the discharge weight was 1.91 kgs and the 4th week weight was 2.97 kgs. Family members performed KMC for 1 hour every time the bracelet alarmed and also if the bracelet did not alarm.

"[BEMPU]'s beeping alerted me to the baby's temperature and enabled me to perform KMC for my child. The alarm worried me and I would do KMC to stop the beeping."

Interview 4: Increased Compliance to KMC
Location: Sagwara

Background: The mother is a 23-year-old housewife and the father is a farmer. The mother is well educated and has completed her ANM training. They have a 3-year-old daughter. This is the couples' second child. The baby was born via caesarean delivery and weighed 2.3 kgs. The baby was admitted to the SNCU with jaundice and discharged a week later with the BEMPU Bracelet.

Bempu Use: The mother understood how to use and the importance of BEMPU. She breastfed and performed KMC after every alert and throughout the day. "It's beeping alerted me to the baby's temperature and enabled me to perform KMC for my child. The alarm worried me and I would do KMC to stop the beeping."

Result: The baby gained 1.5 kgs in 4 weeks; the discharge weight was 2.3 kgs and the 4th week weight was 3.8 kgs. When asked, the mother was able to show the correct technique for performing KMC. The baby is currently healthy and was not readmitted during the study.

Interview 5: BEMPU catches Infection in the Home
Location: Khuntwara Village, Sagwara

BEMPU catches infection in the home – mother brings newborn to hospital.

Background: The mother and father are farmers and live with the father's family. The mother gave birth to twin girls, both were low birth weight. They have a 3-year-old son; this is the couple's second and third child.

BEMPU Use: The mother understood how to use BEMPU and performed KMC every time the Bracelet beeped and otherwise. "*BEMPU helped me in performing KMC.*" During the 2nd week of the study, the bracelet continued to keep alarm for one of the twins despite KMC. The mother brought both twins to the hospital and the twin with the beeping Bracelet was diagnosed with septicemia and readmitted.

Result: One twin was readmitted to the hospital for septicemia. Little weight gain was noticed for both twins. The mother was trained to continue KMC and breastfeeding for her twin girls.

Interview 6: Bracelet Alarmed But No Time Given to Baby
Location: Akehpur Village, Sagwara

Background: The mother is 26-year-old housewife and the father works in a nearby town. This is their 6th child; the baby was born with a twin, but the twin sister died immediately after birth. Both parents want a boy child and referred to their daughters as 'problems'.

BEMPU Use: The mother was aware of hypothermia and the importance of KMC. She was instructed on BEMPU instructions and knew how to use it, protect it from water, and perform KMC every time the bracelet alarmed. Despite knowing the use and need for BEMPU, the mother did not perform KMC.

Result: The baby did not gain any weight in 4 weeks since discharge. The discharge was 1.30 kgs and the 4th week weight was 1.29. The baby was brought to the hospital 4 times in 2 months and when the interview took place the baby had a cough and fast breathing. When asked to perform KMC, the mother did not know the right process.

"BEMPU used to beep, I have so much work, I cannot attend the baby all the time. Buy I breastfeed her and take her to the hospital as much as possible."

Doctor Feedback:

Feedback 1: Dr. Pradeep Meena, Udaipur SNCU in charge – Facilitates KMC and Catching Infection Early

"The BEMPU Hypothermia Bracelet has been demonstrated at the SNCU facility in Udaipur District Hospital since October 2016. It has been observed that the Bracelet is a good device for early detection of hypothermia and infections in infants; it is also an excellent facilitator of Kangaroo Mother Care (KMC). The in-built alarm acts as a timely reminder to caregivers to provide regular KMC to infants. If an infant's temperature is maintained, with proper breast-feeding and KMC, an infant gains weight. Overall, the bracelet is useful in reinforcing home-based newborn care at the community level, thereby reducing neo-natal mortality. It also has been observed that the pilot of the Bracelet has ensured an improvement in facility-based follow-ups.

"However there is an urgent need to strengthen processes to ensure that the importance of KMC is effectively communicated to mothers of infants, many of whom are unaware of the correct method of performing KMC. The Bracelet's impact on Hypothermia related issues with infants will be maximized only if good KMC practices are adopted by caregivers.

"It has been observed that the Bracelet's life is for 1 month. As follow-ups rarely take place on time, it is suggested that the battery life of the device may be extended to ensure completion of follow-ups. Further, the device can be part of a complete package for home based new born care which can include the product and processes like counseling on good KMC practices, for better health outcomes for neonates."

Feedback 2: Dr. Sunny Maheshwari, Udaipur Resident Paediatrician – Improve KMC and Follow-Ups with Rural Mothers

"The BEMPU Hypothermia Bracelet is a good device that easily enables rural women to ascertain the requirement for Kangaroo Mother Care (KMC). Thus, the device facilitates decision making and encourages good KMC practices and breastfeeding. We have observed that several mothers have displayed increased awareness of the dangers of hypothermia and KMC due to using the Bracelet. Further, the requirement of weekly follow-ups has assisted us in closely tracking weight gain and change in weight of LBW infants. This will enable improvement in NMR at the facility.

"However, one of the biggest challenges continues to be effective communication of KMC practices to mothers and family members, many of whom do not perform KMC in a proper manner. A possible solution may be employing visual tools to impart knowledge of KMC practices to new mothers, such methods may prove to be far more impactful means of communication.

"Overall, the Bracelet is useful in reducing incidents of hypothermia and infections in infants and may be recommended as an essential tool for home based new born care. However, it is suggested that for maximum impact, the duration/battery life of the device may be extended beyond 28 days."

Feedback 3: Dr. Rajendra Adhikari, Sagwara Head of Department, Paediatrics – Community Accepted Intervention

"The BEMPU Bracelet is a useful device for early identification and management of Hypothermia in infants. During the study, we have observed that it has been received well and accepted by the community. The device will be successful in the public health system if cost benefit and cost effectiveness is prioritized. The life/battery of the device may also be enhanced as weight gain may not be significant within just one month."

Feedback 4: Dr. Pradhyumna Jain, Sagwara Resident Paediatrician – Useful in Detecting Hypothermia

"The BEMPU Bracelet is useful in detecting hypothermia. It is recommended that the device can also be used to detect infection."

Health Staff Feedback:

Feedback 1: Mr. Praful, Ms. Meenaxi, & Ms. Nirmala, Udaipur Staff Nurses – Excellent Device for All LBW Babies

"The Bracelet is an excellent device that gives timely alarms and alerts mothers to the dangers of hypothermia and infection. Based on observations over the past few weeks, it can be definitely prescribed for all babies having birth weights below 2.5 Kgs.

"However a major challenge that we face is in counseling mothers on KMC. It has been observed that some mothers are not amenable to the idea of KMC and are unable to comply due to circumstances out of their control. For example, mothers in the general ward are reluctant to undress and perform KMC in the open due to lack of privacy. It is recommended that if BEMPU can provide a gown/sling for mothers' along with the Bracelet as a package, it may facilitate privacy and enable mothers to better perform KMC.

"It is also recommended that the life of the Bracelet may be extended beyond 30 days to enable completion of follow-ups."

Feedback 2: Ms. Indhira Jhala and Mr. Pramod Pandya, Sagwara Staff Nurse - Can be Used on All LBW Babies

"When we first found out about BEMPU, we were interested to work on the study. The device is good for detection of hypothermia and can be used on all low birth weight babies. However, it is recommended that the Bracelet's strap be made far more adjustable, whether by means of a buckle or otherwise, to ensure that the sensor touches the infant's skin at all times.

"We observed several challenges during the study in counseling on KMC and ensuring follow-ups. There is difficulty in ensuring that KMC is practiced regularly by mothers. Visual tools such as distribution of posters on KMC to mothers may help in addressing this issue. Also, families often don't prioritize the health of newborns and as a result, do not come forward for regular follow-ups despite reminders. The issuance of incentives to families for regular follow-up may assist in improving this situation.

"It is also recommended that the Bracelet may be issued to babies in the PNC Ward itself as it can be monitored at the facility during the initial days"

Verbal Autopsies:
During the study 31 babies died; 17 in the BEMPU group and 14 in the control group. A subgroup of the parents and families were interviewed for verbal autopsies.

BEMPU Group:
RIC04, Female – Mother did not want a female child and fed her less
The baby was born a twin, with a male brother. Nurses at the PHC reported that the mother was unhappy with a female child and was reluctant to breastfeed the girl baby. The baby was born low birth weight (1.6 kgs) and much smaller than her twin brother. The mother reported the bracelet for her girl baby beeping more frequently than the bracelet on her boy baby. On December 2nd the bracelet beeped for hours and the mother performed KMC. The baby died during KMC and PHCs staff diagnosed the cause of death to be pneumonia.

SGA002, Female – BEMPU Alerted ASHA Worker, but Baby and Mother Were Too Far Gone

BEMPU issued frequent alarms causing family to call local ASHA

The baby was born prematurely (7 months) and low birth weight (1.5 kgs). The mother was severely anemic (Hb-8) and underweight (49Kg). The mother was given blood transfusions after she had given birth. The baby was discharged from the Sagwara SNCU with the BEMPU Bracelet on September 26th, 2016. On October 7th, 2016 the BEMPU Bracelet was alarming continuously, causing the grandparents to call the local ASHA. The ASHA came at once and discovered the baby and mother to be in life-threatening conditions; the baby was having difficulty breathing and the mother was experience convulsions, fits, and full body swelling. The ASHA called for an ambulance, but the newborn had died before the ambulance reached. The mother died a week later. The BEMPU Bracelet issued timely alerts, however, the mother's health was so deteriorated after childbirth, she was unable to provide basic care to her child and herself.

SGA020, Male – Mother Provided KMC, But It Did Not Save Baby
The baby was born prematurely (8 months) and low birth weight (1.35kgs). The mother was anemic and underweight. The baby was discharged on October 28th, 2016 at 3:00 pm from the Sagwara SNCU. BEMPU started to alarm at 6:00 PM and the mother performed KMC until the bracelet stopped beeping. The bracelet alarmed again at 9:00 pm and the mother performed KMC until the beeping stopped. Around midnight on October 29th, 2016 the baby began to have hiccups and died. There is no known cause of death.

UDP53, Male and UDP54, Male – Mother readmitted newborns after bracelet continuously beeped, but both died
The twins were born low birth weight (1.6 and 1.7 kgs) and were not taking breastfeeding. Eight days after birth, the bracelets alarmed continuously despite KMC. The mother readmitted her twins to the hospital. Shortly after admission they died.

CONTROL Group:

DGP032 and DGP033, Male (twins) – Mother Unable to Care for Twins After Giving Birth, Family Members Not Empowered to Assist in Child Care

The twin babies were born low birth weight (1.7 kgs and 2.2 kgs) and with jaundice. The mother was anemic at the time of birth and very weak; she was unable to breastfeed. Because the mother was unable to breastfed, her mother-in-law fed the twins cows milk. The newborns appeared to be healthy and had no problems in their bowel movements and urination. One month after discharge the twins experienced difficulty breathing, the mother reports feeling a drop in their temperature before their death. The deaths occurred suddenly and the parents were did not receive an official cause of death. The mother's illness prevented her from providing care to her babies and family member appeared to be unaware of the fact they could have assisted in kangaroo care.

DGP067

The baby was born prematurely and low birth weight (1.5 kgs). The baby developed discharge and a redness around the umbilical cord. The baby was not taking breastfeeding and became very lethargic. The baby died in the home.

DGP106

The baby was born prematurely and low birth weight (1.3 kgs). The baby stayed in the NICU for 5 days and was then discharged home. The baby died the second day home. The mother said her baby had a fever and difficulty breathing.

6. Conclusion

The results of the NHM Rajasthan Pilot of the Bempu Hypothermia Alert Device show: positive feedback from doctors and nurses; promotion of KMC compliance for the newborn; cases of early detection of complications in the home, improvement in and rates of attendance for follow-up appointment; and an observed reduction in neonatal mortality. However, the pilot has also highlighted structural issues in newborn and maternal health. The significant challenge lies in the dissemination of education to newly discharged parents. BEMPU improved parent health-seeking behavior, but will reach its greatest impact when paired with educational services.

The BEMPU Bracelet is necessary innovation to reduce NMR

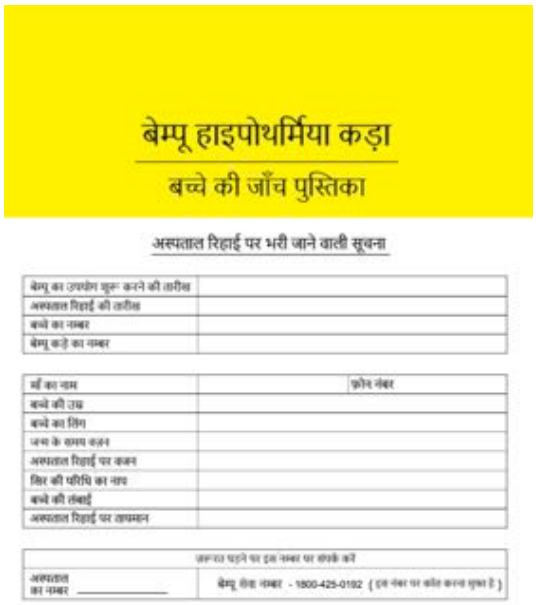
7. List of Appendices

Appendix A: Examples of Data Collection Tools

Appendix B: Roles and Responsibilities of Parties Involved

Appendix A: Examples of Data Collection Tools

A patient diary was designed for ease of data collection. Below are excerpts from the booklet.



बेम्पू हाइपोथर्मिया कड़ा

बच्चे की जाँच पुस्तिका

अस्पताल रिहाई पर भरी जाने वाली सूचना

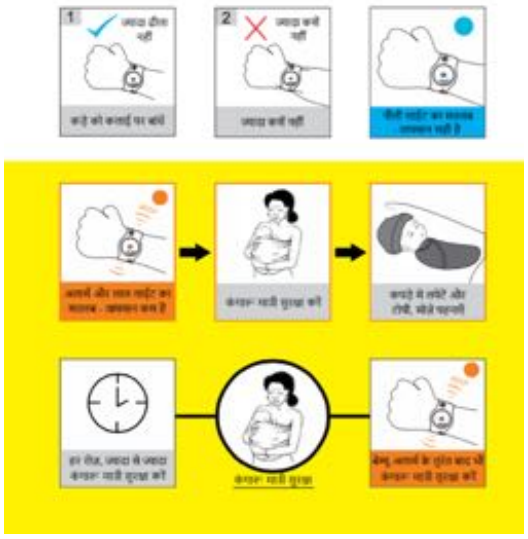
बेम्पू का उपयोग शुरू करने की तारीख	
अस्पताल रिहाई की तारीख	
बच्चे का नम्बर	
बेम्पू कड़े का नम्बर	

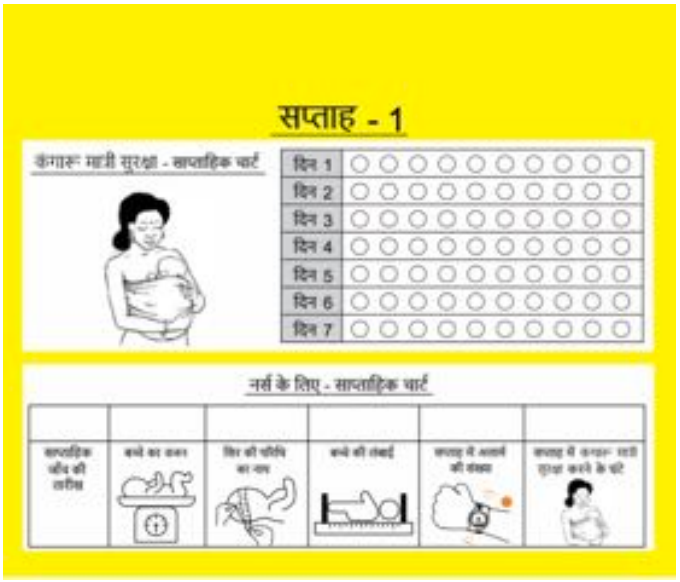
माँ का नाम		फ़ोन नंबर
बच्चे की उम्र		
बच्चे का लिंग		
जन्म के समय वज़न		
अस्पताल रिहाई पर वज़न		
सिर की परिधि का नाप		
बच्चे की लंबाई		
अस्पताल रिहाई पर तापमान		

अस्पताल का नम्बर _____	बेम्पू सेवा नम्बर - 1800-425-0102 (इस नंबर पर कॉल करना मुफ़्त है)

नर्स के लिए ट्रेनिंग के निर्देश

- ☐ 1. हाइपोथर्मिया की जानकारी दें
- ☐ 2. बेम्पू कड़ा उपयोग करने की जानकारी दें - चित्र 1 और 2 देखें
- ☐ 3. नीली लाइट का मतलब बताएं
- ☐ 4. अलार्म और लाल लाइट का मतलब बताएं
- ☐ 5. कंगारू मात्री सुरक्षा ओर कपड़े मे लपेटने का निर्देश दें
- ☐ 6. कड़े को लगातार 1 महीने के लिए उपयोग करने की निर्देश
- ☐ 7. कड़े को हर दिन साफ करने का निर्देश दें
- ☐ 8. कड़े को पानी से बचाने का निर्देश दें
- ☐ 9. कंगारू मात्री सुरक्षा पुस्तिका भरना सिखाँए





Appendix B: Roles and Responsibilities of Parties Involved

To execute the project, NHM Rajasthan, WISH, and BEMPU Health worked together to do following activities:

1. **NHM Rajasthan**
   a. Provide baseline data
   b. Provide human resource support and logistic support for training of staff and data collection from SNCU and PHC.
   c. Assist in follow-ups to collect data for recruited newborns.
   d. Provide necessary approvals for conducting the study, including but not limited to letters of support.

2. **WISH**
   a. Provide technical support for training on-ground staff for conducting the study.
   b. Selecting PHCs to be involved
   c. Assist follow-ups to collect data for recruited newborns.
   d. Assist in providing necessary approvals for conducting the study.
   e. Oversee quality of data collection
   f. Assist in analysis and report preparation
   g. Assist in coordinating activities with Rajasthan NHM.

3. **BEMPU Health**
   a. Provide training for the use of the BEMPU device.
   b. Develop communication and training material, develop key indicators for monitoring and tracking the feasibility implementation project.
   c. Assist in evidence monitoring with data entry operators
   d. Provide 250 BEMPU devices to be deployed in the field.

Contact Information

For more information on the report or to use BEMPU in your government centers, please contact the BEMPU Team

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