

Strengthening Fetal Heart Rate Monitoring during Labor with a Standard Handheld Doppler – Implementation Experience from India

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Abstract

Background: India's neonatal and perinatal mortality is among the highest in the world. Intrapartum-related conditions contribute to a significant proportion of neonatal deaths and stillbirths. Fetal heart rate monitoring, a recommended norm to assess fetal well-being, is not practiced as per standard guidelines in public health facilities. A standardized Doppler along with training on fetal heart rate monitoring was implemented across different levels of healthcare in three states. **Methods:** Facilities were selected purposively to implement the Doppler. Baseline data for 3 months were collected. Interviews of health providers and observation of labor were conducted quarterly. Data were analyzed through a comparison of baseline and intervention on a number of delivery and monitoring indicators. **Results:** Among 22,579 total deliveries, monitoring frequency increased along with increase in detection of abnormal fetal heart rate (FHR) while cesarean section and stillbirths reduced slightly. Cases never monitored reduced in the District Hospitals (7.98–2.07, $P < 0.01$) and in Community Health Centers (14.7–1.67, $P < 0.001$). Stillbirth rate reduced at the medical college (3.6–1.1, $P < 0.001$). Interviews with providers revealed acceptance of the device due to its reliable readings. **Conclusion:** The Doppler demonstrates acceptability and serves as a useful aid to improve intrapartum FHR monitoring.

Keywords: Aspirational districts, Doppler, fetal heart rate monitoring, India, LaQshya, maternal health, newborn health

INTRODUCTION

The perinatal mortality rate in India is high at 26 per 1000 live birth.^[1] Risk factors such as maternal infection, preterm birth and birth asphyxia contribute to early neonatal and perinatal mortality.^[2,3] Intrapartum fetal heart rate (FHR) monitoring is a global practice to assess fetal well-being during childbirth.^[4] Abnormality in FHR like severe variability, bradycardia, and tachycardia during labor is associated with fetal hypoxia and adverse perinatal outcomes. However, practice of FHR monitoring is suboptimal in low resource settings where there are challenges of availability of HR, poor knowledge and inadequate resources in terms of monitoring devices.^[5] Considering the need for improved monitoring during labor in public healthcare facilities the project, a technical support partner of Government of India, implemented a standard hand held Doppler, with key design advantages, under LaQshya (National Labour Room Quality improvement initiative) platform. The intervention was implemented at various levels of healthcare facilities with

minimal support. The minimalistic support premised on that an evidence-based reliable, effective, and proven technology shall require minimal handholding.

The CEA-certified and FDA-approved “Moyo” handheld Doppler device selected was found to address several constraints in FHR monitoring and in earlier trials had generated evidence of its reliability and utility to detect abnormal FHR.^[6-8] The study was conducted to assess the reliability, robustness, and acceptability of the device and improve monitoring of FHR in public health settings.

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How to cite this article: Bajpayee D, Sarin E, Dastidar SG, Chandra S, Mohanty JS, Bisht N, *et al.* Strengthening fetal heart rate monitoring during labor with a standard handheld doppler – implementation experience from India. *Indian J Community Med* 2022;47:405-9.

Received: 25-05-21, **Revision:** 12-11-21, **Accepted:** 23-11-21, **Published:** 10-10-22

Access this article online

Quick Response Code:



Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.ijcm_818_21

METHODS

Seven facilities from aspirational districts across three states were selected purposively based on delivery load and convenience. Three levels of care were represented by Medical College, District Hospital (DH) and FRU-CHC [Table 1].

Identified facilities were assessed on FHR monitoring practices using record review, provider Knowledge, and observation of skills and practices. Labor room register, case sheets, and partographs were reviewed for frequency of FHR monitoring and detection of abnormal FHR. Structured questionnaires were used to assess knowledge and challenges faced. Direct Observation further consolidated information on the practice of FHR monitoring in labor.

The implementation started with facility-based training of service providers on FHR monitoring protocols and hands-on practice on device. SBA guidelines for intermittent FHR monitoring, every half an hour in active first stage of labor and every 5 min in the second stage of labor were reiterated. An optimum number of devices were provided to each facility based on its delivery load and number of labor tables.

Two quarterly assessments were done by interviewing 3–4 service providers and observing 3–4 labor cases, selected purposively, per facility to assess current FHR monitoring practice and challenges. 1–2 postnatal women from each facility were also interviewed on their experience.

Data were collected monthly on the frequency of FHR monitoring and detection of abnormal FHR. Based on 95% confidence level and plus-minus 8 confidence interval and total number of deliveries per facility level, the number of sample of case sheets reviewed was: Medical College –120, DH –100 and CHC-50. Additional data were collected from January 2020 on pregnant woman getting admitted in an advanced stage of labor and the neonatal outcome of cases detected with abnormal FHR (FHR <120, >160 bpm).

Key monitoring indicators tracked

- % Cases where FHR never monitored
- % Cases where FHR monitored >4 times
- % Abnormal FHR detected
- % Fresh stillbirths.

For analysis, baseline practices were compared with intervention practices. *T*-test was conducted to test significant

difference in the two time periods. Qualitative information from quarterly assessment were compiled and analyzed through content analysis.

Mentoring visits by project consultants were regularly conducted for handholding of service providers, troubleshooting for device, and reinforcing documentation practices.

RESULTS

A total of 22,579 women delivered during the intervention period. The baseline period covered a total of 7310 deliveries. The number of C-sections totaled 4562 (20%) in intervention period which is a slight reduction from baseline figure of 1625 (22%). A slight reduction was seen in the stillbirth rate [Table 2]. Abnormal FHR detected was higher and monitoring frequency increased [Table 2].

The outcomes of FHR monitoring are presented for various levels of facility. Percentage increase in cases detected with abnormal FHR was significantly high in both CHC and DHs. A significant decrease in stillbirth was seen in Medical College from 3.6% to 1.12%. Asphyxia cases were almost equal during baseline and intervention at CHC and DH. At Medical College, however, there was an increase in asphyxia cases [Table 3]. Cases never monitored decreased significantly in CHC and DHs, whereas in Medical College, the number of cases never monitored were low from the start. Frequent monitoring of FHR (>4 times) had a significant increase in DHs [Table 4].

We derived additional data on 4430 deliveries. A total of 26% of women delivered within 1 h of admission, the highest was in Uttarakhand (45%). Abnormal FHR was found in 451 cases (10.2%). C section was conducted in 44% of the cases and 30% had normal delivery [Figure 1]. Almost a quarter of the cases (23.3%) resulted in birth asphyxia with no deaths reported.

Qualitative assessment

Baseline interviews highlighted poor FHR documentation. Both stethoscope and Dopplers were used but challenges were reported in their usage. Challenges in stethoscope included low audibility and difficulty in locating FHS. Challenges in Doppler were fluctuating readings, battery replacement, and storage. Observation found only 7 out of 27 labor cases were

Table 1: Intervention sites

State	Facility	Level	Average monthly delivery load (2018-2019)
Jharkhand	RIMS	Medical college	730
	Chaibasa DH	District hospital	176
	Ratu	CHC	200
Uttarakhand	Haridwar DH	District hospital	450
	Mangalore	CHC	103
Odisha	Kandhmal DH	District hospital	302
	Baliguda	SDH	111

RIMS: Rajendra Institute of Medical Sciences, DH: District Hospital, CHC: Community Health Centre, SDH: Sub Divisional Hospital

Table 2: Overall C-section, abnormal FHR, stillbirth and monitoring frequency during baseline and intervention

Outcomes	Intervention total delivery (22,579), n (%)	Baseline total delivery (7310), n (%)	P (t-test)
C-section	4562 (20)	1625 (22)	0.332
Stillbirth	289 (1.3)	148 (2)	0.037*
Asphyxia	1517 (6.7)	440 (6)	0.279
Indicators	Intervention sample case sheets (12,213), n (%)	Baseline case sheets (7310), n (%)	P (t-test)
Abnormal FHR	895 (7.3)	254 (3.5)	0.019*
Monitored >4 times	2698 (22.1)	1124 (15.2)	0.025*
Monitored 3-4 times	2008 (16.4)	898 (12.3)	0.3121
Never monitored	420 (3.4)	559 (7.6)	0.0005***

*<0.05, **<0.01, ***<0.001. FHR: Fetal heart rate

Table 3: Comparison of abnormal fetal heart rate, stillbirth, and asphyxia during baseline and intervention by type of facility

Health facility	Baseline		Intervention		P (t-test)
	Mean (%)	SE	Mean (%)	SE	
Abnormal FHR detected					
Medical college	14.85	4.90	14.46	1.05	NS
District hospital	5.94	1.39	10.78	1.20	0.023
Community health center	3.61	1.00	6.66	0.81	0.033
Stillbirth					
Medical college	3.60	1.09	1.12	0.15	0.0001
District hospital	2.18	0.84	1.70	0.24	NS
Community health center	1.08	0.29	1.05	0.16	NS
Asphyxia					
Medical college	7.93	1.74	12.67	0.74	0.005
District hospital	5.89	1.74	5.21	0.54	NS
Community health center	5.55	1.07	5.97	0.64	0.064

NS: Not significant, FHR: Fetal heart rate, SE: Standard error

Table 4: Comparison of monitoring frequency during baseline and intervention by type of facility

Health facility	Baseline		Intervention		P (t-test)
	Mean (%)	SE	Mean (%)	SE	
Never monitored					
Medical college	1.54	0.58	0.76	0.58	NS
District hospital	7.98	2.44	2.7	0.76	0.004
Community health center	14.72	3.35	1.67	0.48	0.000
Monitored >4 times					
Medical college	29.6	3.70	31.27	2.07	NS
District hospital	13.23	2.36	27.22	3.78	0.03
Community health center	32.19	2.76	38.08	2.62	NS

SE: Standard error

monitored as per protocol in the first stage while none were monitored as per protocol in the second stage. Quarterly assessments revealed the majority of providers using Moyo Doppler which they found gave reliable readings. At the last quarterly assessment, 48% of cases were observed to be monitored at 30 min. Among 28 beneficiaries, 23% who had the device strapped on reported that they were able to walk around, squat, and sit easily. Of the multipara pregnant woman, majority reported the experience was better than before as they could hear the heartbeat of the baby and felt reassured.

DISCUSSION

Our findings highlight that the frequency of FHR monitoring increased during the intervention. Detection of abnormal FHR increased in the same period indicating the criticality of monitoring at frequent intervals. The increase in detection of abnormal FHR through directly correlated to increased frequency of FHR monitoring could also be on account of the decision support algorithm in the device for raising an alarm on record of persistent abnormal FHR. Reduction of stillbirth rate from 2% to 1.3% observed at the Medical College reiterates that trained HR is equally important as technological intervention.

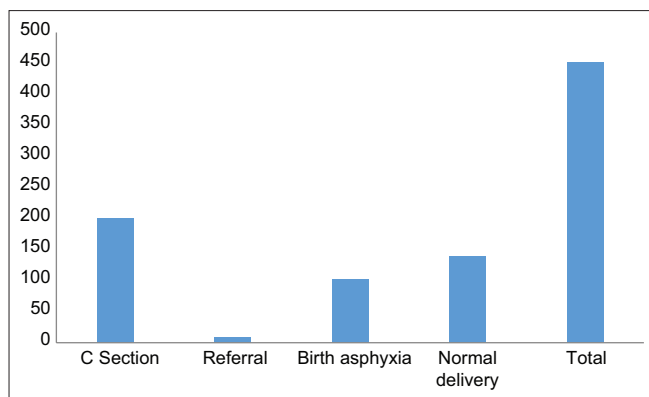


Figure 1: Outcomes of cases with abnormal fetal heart rate ($n = 451$)

Studies have cited various detection rates of abnormal FHR ranging from 3% to 8% of total deliveries using Doppler.^[5,9,10] In our intervention percent rates for detection of abnormal FHR during labor varied across facility levels. The high percent seen in medical college could be on account of it being a tertiary facility where more women with complications get admitted. While studies point to an increase in C section rates with use of continuous electronic fetal monitoring^[11,12] as well as intermittent monitoring^[13] even among low-risk women,^[11] the C section rates we saw marginally reduced which suggests that unnecessary interventions did not result from increased detection of abnormal FHR.

We found that CHCs started with a better monitoring record than DHs and medical colleges. It could be because DH and medical college have a higher load of patients, which reduced monitoring frequency. It could also be due to many of the women showing up at higher centers in advanced stages of labor. However, the introduction of a standardized Doppler saw a larger significant difference in cases never monitored. It could be an effect of the Doppler or the intervention itself which focused on frequent monitoring and had a training component along with monitoring and supervision throughout implementation. Similarly, monitoring more than four times was significantly higher in intervention period at DH may be due to the presence of optimal number of staffs at DH level. Number of device and number of staffs both are equally important to increase the frequency of monitoring. At CHC, staff is less and at medical college case load is more. In Medical College asphyxia rates increased in the subgroup of pregnant women identified with abnormal FHR. This could be an effect of frequent monitoring and training along with added focus on the intervention and on improved documentation and recording.

Mothers expressed reassurance on account of hearing the fetal heartbeat during continuous monitoring with device. In a similar initiative in Liberia, the majority of mothers found listening to heartbeat of their unborn baby a positive experience.^[14] The device helped the women to be mobile and upright during labor even while being regularly monitored for

FHR. A quantitative assessment done in Tanzania showed, 28.3% of women who labored in bed expressing that they actually wanted to be mobile^[15] and a study from south India reiterated that encouraging women to ambulate during first stage of labor was effective in improving labor outcomes.^[16] The decision to use the device for continuous or intermittent monitoring was left to the clinical decision maker.

Reliability of FHR readings through the Moyo was vouched by most providers. The Moyo provided stable readings, reduced the time taken in locating FHS, and on account of the alarm function boosted confidence in diagnosis. This is consistent with a study where professionals preferred a device which gives reliable results so that they are certain of their decisions.^[17] Initial training too may have contributed to the health providers' ready acceptance. Future roll out of the device has already been proposed by 2 of the 3 participating states.

Although regular troubleshooting helped in addressing technical challenges, the issue of loss of volume in few devices after being used for some time, is being looked into during the development of the next version of device.

The effectiveness of device and conclusion being drawn should be considered in the light of the following limitations. The implementation has been conducted in seven facilities and device' durability might vary when scaled up across the state. Further, the study was not powered to assess the impact of improved monitoring on perinatal outcomes and this would need further detailed evaluation in larger cohort. Documentation practices were not uniform across the intervention sites.

CONCLUSION

Strengthening of FHR monitoring and Partograph use are already part of the national LaQshya program and have been included in the Rapid Quality Improvement cycles at facilities. A standard fetal doppler device is likely to improve FHR monitoring because it is a reliable and easy to use.

Declarations

Ethics approval and consent to participate

We obtained permission from the Maternal and Child Division of the MoHFW, state National Health Mission and facility in charges. We used publicly available data and therefore we did not seek ethical approval. However, anonymity and patients' and clinicians' rights were respected. Informed consent forms were used to obtain consent before interviewing the patients or the clinicians.

Availability of data and materials

Data will be made available on request.

Acknowledgments

We express our gratitude to the State Governments of Odisha, Jharkhand and Uttarakhand, the state National Health Mission, and the Maternal and Child Health Division, MoHFW. We acknowledge Dr Rachana Patel for conducting some of the

analysis. Our sincere gratitude to the participants- facility service providers and the pregnant women without whom this intervention could not have been implemented.

Financial support and sponsorship

This work was made possible by the support of the American people through the United States Agency for International Development under the terms of Cooperative Agreement Number AID 386 A 14 00001. The contents of this paper represent the views of the authors and do not reflect the views of the US Government.

Conflicts of interest

There are no conflicts of interest.

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