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Int J Gynaecol Obstet. 2013 September ; 122(3): 230–233. doi:10.1016/j.ijgo.2013.04.008.**A multi-country study of the “intrapartum stillbirth and early neonatal death indicator” in hospitals in low-resource settings****Robert L. Goldenberg^{a,*}, Elizabeth M. McClure^b, Bhala Kodkany^c, Gilbert Wembodinga^d, Omrana Pasha^e, Fabian Esamai^f, Antoinette Tshetu^d, Archana Patel^g, Hillary Mabaye^f, Shivaparasad Goudar^c, Sarah Saleem^e, Manjushri Waikar^g, Ana Langer^h, Carl L. Boseⁱ, Craig E. Rubens^j, Linda L. Wright^k, Janet Moore^b, and Ann Blanc^l**^aDepartment of Obstetrics and Gynecology, Columbia University, New York, USA^bDepartment of Social, Statistical and Environmental Sciences, Research Triangle Institute, Durham, USA^cDepartment of Obstetrics, Karnataka Lingayat Education Society's Jawaharlal Nehru Medical College, Belgaum, India^dSchool of Public Health, Kinshasa, Democratic Republic of Congo^eDepartment of Community Health Sciences, Aga Khan University, Karachi, Pakistan^fDepartment of Pediatrics, Moi University, Eldoret, Kenya^gLata Medical Research Foundation, Nagpur, India^hDepartment of Global Health and Population, Harvard School of Public Health, Boston, USAⁱDepartment of Pediatrics, University of North Carolina at Chapel Hill, Chapel Hill, USA^jGlobal Alliance for Prevention of Preterm Birth and Stillbirth, Seattle Children's Hospital, Seattle, USA^kEunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, USA^lPopulation Council, New York, USA**Abstract****Objective**—To determine the feasibility of introducing a simple indicator of quality of obstetric and neonatal care and to determine the proportion of potentially avoidable perinatal deaths in hospitals in low-income countries.**Methods**—Between September 1, 2011, and February 29, 2012, data were collected from women who had a term pregnancy and were admitted to the labor ward of 1 of 6 hospitals in 4 low-income countries. Fetal heart tones on admission were monitored, and demographic and birth data were recorded.**Results**—Data were obtained for 3555 women and 3593 neonates (including twins). The doptone was used on 97% of women admitted. The overall perinatal mortality rate was 34 deaths per 1000^{*}Corresponding author: Robert L. Goldenberg, Department of Obstetrics and Gynecology, Columbia University College of Medicine, New York, NY, 10032 USA. Tel.: +1 212 305 1521; fax: +1 919 647 4160. rlg88@columbia.edu.**Conflict of interest**

The authors have no conflicts of interest.

deliveries. Of the perinatal deaths, 40%–45% occurred in the hospital and were potentially preventable by better hospital care.

Conclusion—The results demonstrated that it is possible to accurately determine fetal viability on admission via a doptone. Implementation of doptone use, coupled with a concise data record, might form the basis of a low-cost and sustainable program to monitor and evaluate efforts to improve quality of care and ultimately might to help to reduce the in-hospital component of perinatal mortality in low-income countries.

Keywords

Doptone; Fetal heart tones; Hospital-based perinatal mortality; Neonatal mortality; Perinatal mortality; Stillbirth

1. Introduction

It is estimated that, every year, approximately 300 000 pregnant women, 3 million third-trimester fetuses, and 4 million neonates die worldwide, mostly in low-income countries [1,2]. Half of these deliveries occur at home [3], and it is thought that moving these deliveries from home or lower-level clinics to a hospital would substantially improve these outcomes. A recent study from India seems to challenge this hypothesis, however, especially in areas where the quality of hospital care is poor [4].

As a result, the WHO, United Nations Population Fund (UNFPA), and other organizations are seeking a simple measure of quality of hospital care. Ideally, this metric should be based on easily and reliably collected data by which pregnancy outcomes can be compared within and across institutions over time. Stillbirth and neonatal mortality rates have been the measures most commonly used for this purpose; however, the difficulty with both measures is that an unknown portion of mortality occurs both before hospital admission and after hospital discharge. Mortality inside the hospital is directly influenced by the quality of care in the hospital and provides a potentially powerful measure of care quality, whereas mortality in the household or community is less likely to be influenced by the quality of the hospital care.

In 2007, Fauveau [5] described the “intrapartum stillbirth and early neonatal death indicator.” This measurement, which was considered to be quantifiable at the facility level, was intended as a proxy for the quality of obstetric and newborn care provided at birth by attendants. Specifically, the “intrapartum and very early newborn death rate” was constructed with a numerator comprising the sum of intrapartum stillbirths (restricted to those with fetal heart beats perceived at admission in labor) and very early newborn deaths (within the first 24 hours of life), and a denominator comprising all deliveries for a given facility in a year. In the original description, to focus on those fetuses or neonates with the highest likelihood of survival, it was suggested that the “indicator” should be restricted to neonates with a birth weight of 2500 g or more.

Representatives of several agencies including the WHO, Centers for Disease Control and Prevention, the National Institute of Child Health and Human Development (NICHD) funded Global Network for Women’s and Children’s Health Research (Global Network), the Maternal Health Task Force at EngenderHealth, the Bill & Melinda Gates Foundation-funded Global Alliance to Prevent Preterm birth and Stillbirth (GAPPS) and UNFPA met in 2011 and recommended a pilot study to evaluate this indicator. The NICHD Global Network—a consortium of US and low-income country institutions funded by NICHD and the Bill & Melinda Gates Foundation that conducts research aimed at improving women’s and children’s health in low-income settings [6]—undertook the study.

The aim of the study was to address 4 specific research questions by introducing use of a doptone—an inexpensive (US \$30) electronic fetal heart tone (FHT) amplifier—to determine fetal viability on maternal admission, together with collection of a brief data record focused on fetal or neonatal status. The first question addressed was whether hospitals use a doptone consistently. The second was to determine the perinatal mortality rate (PMR) for women with FHTs detected on admission as compared with those with no FHTs heard on admission, and therefore to assess the percentage of deaths occurring in the hospital setting. The third was to examine the outcome among women with no FHTs heard on admission. The last was to evaluate whether the results were significantly different when the sample was restricted to neonates with a birth weight of 2500 g or more.

2. Materials and methods

The present study, which was overseen by a Global Network research investigator, was conducted among women with a term pregnancy who were admitted to the labor ward of 1 of 6 Global Network site hospitals between September 1, 2011, and February 29, 2012. The 6 hospitals were located in Karachi, Pakistan; Belgaum, India; Eldoret, Kenya; Kinshasa, Democratic Republic of Congo (DRC); and Nagpur, India (2 hospitals). Institutional review board approval was granted at each Global Network site and by the Research Triangle Institute, Durham, NC, USA. Each woman provided informed consent to use data collected from her medical record.

The hospital settings ranged from urban (Karachi, Kinshasa, Nagpur) to semi-urban (Belgaum, India) to rural (Western Province near Eldoret, Kenya). Each hospital had a minimum of 1000 annual deliveries (ranging from 6300 in Kinshasa to 1100 in Belgaum). All facilities were mid-level public or government hospitals and accepted maternal and neonatal referrals, but were not major tertiary hospitals. Each hospital had either a physician or nurse available 24 hours a day. In addition, each hospital had the capability to provide cesarean delivery and neonatal care with the exception of Kinshasa, which referred women for cesarean delivery if needed. Newborns were followed up until discharge, which usually happened within 24 hours of deliveries.

Each hospital was given 2 doptones (Sonoline B Fetal Doppler, Lake Bluff, IL, USA) and the staff, including physicians, midwives, and nurses, were given a single demonstration regarding their use by a project supervisor.

The aim was to collect data from a minimum of 500 consecutive admissions of women with a term pregnancy to the labor ward of each hospital over at least a 3-month period. At each facility, hospital staff screened and enrolled consecutive women presenting for delivery; however, a few women screened were in false labor and their data were excluded from analyses.

A simple 1-page form was used to record basic maternal demographics, data about doptone use, fetal heart rate status on admission, birth weight, gestational age, and neonatal viability at discharge. In addition, a descriptive survey assessed the health providers' perceptions of using a doptone as recommended for the study.

The recorded data were entered at each site and transmitted to the Global Network Data Coordinating Center (Research Triangle Institute, Durham, NC, USA) for analysis via SAS version 9.2 (SAS Institute, Cary, NC, USA). Data analyses included descriptive statistics and PMRs.

3. Results

During the study period, some hospitals recruited considerably more than 500 women; as a result, data were obtained for 3555 women and, with twins, 3593 neonates. Thus, the average enrollment was 590 women per hospital.

Across all of the study sites, the doptone was used on admission to obtain FHTs among 97.0% of women. In 2.2% of admissions, a doptone was not used but the staff member used another method to obtain the FHTs; in 0.8% of admissions, the FHTs were not monitored. Regardless of the method used, FHTs were heard in 97.6% of the women admitted and not heard in 1.8%. For another 0.5% of women, the staff person was unsure whether FHTs were present or not (data not shown). Responses from the survey showed that none of the staff at any of the hospitals reported difficulty using the doptone or collecting or recording project-related data. At several of the hospitals, however, it was noted that at times the staff were too busy to use the doptone or that some women were too close to delivery on arrival to listen to heart tones.

Among the 3593 deliveries including twins, there were 121 deaths (including stillbirths and neonatal deaths before discharge), resulting in an overall PMR of 34 per 1000 deliveries (Table 1). First, we examined the 3448 cases with FHTs heard on admission (Table 1); among these, there were 45 in-hospital perinatal deaths, giving an in-hospital PMR of 13 per 1000 deliveries. Comparison of this rate with the total PMR of 34 per 1000 deliveries indicates that approximately 40% of the perinatal mortality occurred in-hospital. Of the 45 in-hospital deaths, signs of life (defined as having 1 or more of the following at birth: movement, breathing, or heart rate) were apparent at delivery for 26 (58%), which were therefore classified as neonatal deaths. Nineteen (42%) were stillbirths. Of these, 3 were macerated and may represent FHTs heard in error, whereas 16 were non-macerated stillbirths.

Of the 65 fetuses for whom FHTs were not heard on admission, 4 neonates were discharged alive and another 3 died before discharge. These probably represent cases where FHTs were present on admission but missed. Therefore, if the absence of FHTs by doptone is considered a positive test for stillbirth, there were a small number of false-positive results.

Among the 80 women for whom FHTs were not monitored or were missing, or the results were uncertain (Table 1), there were 15 perinatal deaths, giving a PMR of 187 per 1000 deliveries. Of these deaths, 4 were macerated stillbirths, 5 were fresh stillbirths, and 6 were neonatal deaths. If the doptone had been used or used correctly in these cases, it is likely that between 5 and 10 would have had FHTs on admission. If these are added to the 45 cases of perinatal mortality with FHTs detected on admission, then up to 55 of the 121 deaths (45%) occurred in-hospital and would have been included as part of the intrapartum indicator.

When the analyses were restricted to neonates that weighed 2500 g or more at delivery, as defined by Fauveau's original description of this indicator [5], the PMR was 22 per 1000 deliveries. There was a similar proportion of in-hospital deaths (43%), giving an indicator value of 9.4 per 1000 deliveries (Table 1).

4. Discussion

Several low-income countries have adopted the goal of achieving 100% of deliveries in healthcare facilities, and in many countries an increasing number of births are taking place in facilities. Nevertheless, improvements in perinatal outcomes are not always observed with increasing facility deliveries: poor quality obstetric and neonatal care seems to explain at least part of this failure [7]. Reasons for the poor quality care are many, and include poorly

trained and inadequate staff, delays in treatment, and failure to use effective treatments even if available. Lawn et al. [8] concluded that one-third of stillbirths are related to intrapartum asphyxia, whereas one-fourth of neonatal deaths are also preceded by intrapartum asphyxia. Most asphyxia-related deaths are preventable by appropriate obstetric care and neonatal resuscitation.

Documentation of FHTs on admission in labor is important for at least 2 reasons. First, the absence of FHTs identifies fetuses that are already dead such that a plan for safe delivery can be made. Second, the presence of FHTs identifies fetuses that are viable on admission and that with appropriate care should be discharged alive as a neonate. Because FHTs can be hard to hear and might be missed when using a stethoscope—especially if the equipment is poor or the staff are not well trained—an FHT amplifier (doptone) was used to improve detection in the present study. Using the doptone, the hospital staff had a high degree of accuracy in detecting stillbirths by the absence of FHTs. Nevertheless, there were clearly a few misclassified cases when FHTs were not detected for live fetuses and when the fetus was apparently dead but FHTs were reported. In the present pilot study, only minimal training was provided for using the doptone and especially for distinguishing fetal from maternal heart sounds. It is likely that some or all of the misclassification would be eliminated with better training.

In the hospitals in which the study took place, the data showed an average PMR prior to neonatal discharge of 34 per 1000 deliveries. This rate is within the range of what might be expected for hospital deliveries in a low-income country [9,10]. FHTs were detected for approximately 45% of the total perinatal deaths (stillbirths plus neonatal deaths prior to discharge), and therefore, as per the indicator, occurred in-hospital. These deaths are potentially preventable and many of these neonates might have been discharged alive with appropriate care during labor, delivery, and the early newborn period. This observation is particularly relevant to newborns weighing more than 2500 g because, with appropriate care, nearly all of these fetuses or newborns should survive, and mortality among lower birth weight neonates, which is often due to complications of prematurity, would not influence the outcome. To date, no studies have determined the most appropriate lower birth weight cutoff for the indicator, but it seems clear that in order to compare similar newborns the same lower birth-weight cutoff should be used.

The present preliminary data were obtained from a pilot study conducted with minimal support and must be considered within that context. Although an effort was made to include multiple hospitals from several countries, the present data still represent a relatively small convenience sample. Thus, further research is needed to confirm this finding across a broader range of facilities, settings, cultures, care-provider skill level, and post-introduction study duration.

Training both in the use of the doptone and in data collection was limited and clearly could have been improved. Nevertheless, the present analysis suggests that, among the perinatal deaths that were recorded before discharge in these hospitals, just over half occurred prior to hospital admission and are unlikely to be preventable by any change in hospital management or quality of care. Regarding the perinatal deaths of fetuses with FHTs that were alive on admission, 42% died before delivery, and 58% were born alive and died in the neonatal period. Many of these fetuses or neonates should have survived with appropriate intrapartum and neonatal care. We therefore believe that the use of this indicator, as implemented in the study with a doptone and a concise data record, might form the basis of a low-cost and sustainable program to monitor and evaluate efforts to improve quality of care and ultimately might help to reduce the in-hospital component of perinatal mortality in low-income countries.

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Table 1

Fetal heart tone status at admission and perinatal mortality ^a

FHT on admission ^b	Total fetuses	Alive at discharge	Macerated stillbirth	Fresh stillbirth	Neonatal death before discharge	Perinatal death ^c	Perinatal mortality rate ^d
All fetuses							
Total	3593	3472	33	53	35	121	34/1000
Present	3448 (96.0)	3403	3	16	26	45	13/1000
Absent	65 (1.8)	4	26	32	3	61	938/1000
Unknown	80 (2.2)	65	4	5	6	15	187/1000
Fetuses < 2500 g							
Total	3050	2983	17	32	18	67	22/1000
Present	2969 (97.3)	2941	1	13	14	28	9.4/1000
Absent	36 (1.2)	2	14	18	2	34	944/1000
Unknown	45 (1.5)	40	2	1	2	5	111/1000

^a Values are given as number or number (percentage) unless stated otherwise.

^b Fetal heart tones (FHTs) were determined by any method. Unknown includes not monitored and indeterminate cases.

^c Perinatal mortality included all stillbirths or neonatal deaths before hospital discharge.

^d Number of deaths per 1000 deliveries.