

Effect of a two-component intervention to change hospital practice from early to delayed umbilical cord clamping in the Peruvian Amazon

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ABSTRACT

Objective. To investigate the effect of a two-component intervention to change hospital practice with regard to the timing of umbilical cord clamping.

Methods. A pre-/post-study design was used to measure the effect of a two-component intervention on mean time to clamp the umbilical cord. The study took place at Hospital Iquitos “César Garayar García” in Iquitos, Peru. A total of 224 women were recruited from the hospital labor room: 112 pre-intervention, from 18 May–3 June 2009, and 112 post-intervention, from 6–20 July 2009. The intervention consisted of 1) a “best practice” three-day training workshop on birthing, and 2) a hospital directive. All deliveries were observed and the time between delivery of the first shoulder and clamping of the umbilical cord was measured with a digital stopwatch.

Results. The mean time between delivery and cord clamping before the intervention was 56.8 seconds (95% confidence interval [CI]: 51.0, 62.7). This increased to 169.8 seconds (95% CI: 153.8, 185.8) following the intervention. The difference in mean time to clamp remained significant in multivariate analyses ($\beta_{\text{adjusted}} = 113.2$ seconds, 95% CI: 96.6, 129.9).

Conclusions. Hospital policy and practice can be successfully changed from early to delayed umbilical cord clamping using a simple, two-component intervention.

Key words

Umbilical cord; labor; obstetric; health policy; developing countries; Peru.

The timing of umbilical cord clamping has recently undergone increased scien-

tific investigation. Although it was once thought that immediate clamping of the umbilical cord was necessary to prevent maternal postpartum hemorrhage (1, 2), this has been repeatedly shown to be false. It is now widely accepted that delayed umbilical cord clamping is most beneficial to the infant without incurring any risk to the mother (3–15). Allowing placental transfusion of blood to run to completion before clamping the umbili-

cal cord can provide the infant with an additional 15–20 mL of blood volume, increasing its total blood volume by an estimated 30% (16). This translates into an additional 30–50 mg of iron at birth (17, 18). Maximizing placental transfusion of blood usually takes approximately 3 minutes (19). The two meta-analyses conducted on this topic have found that waiting more than 1 minute to clamp the umbilical cord leads to

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higher hemoglobin levels, decreased risk of anemia, and higher ferritin levels in the first 6 months of life (4, 6).

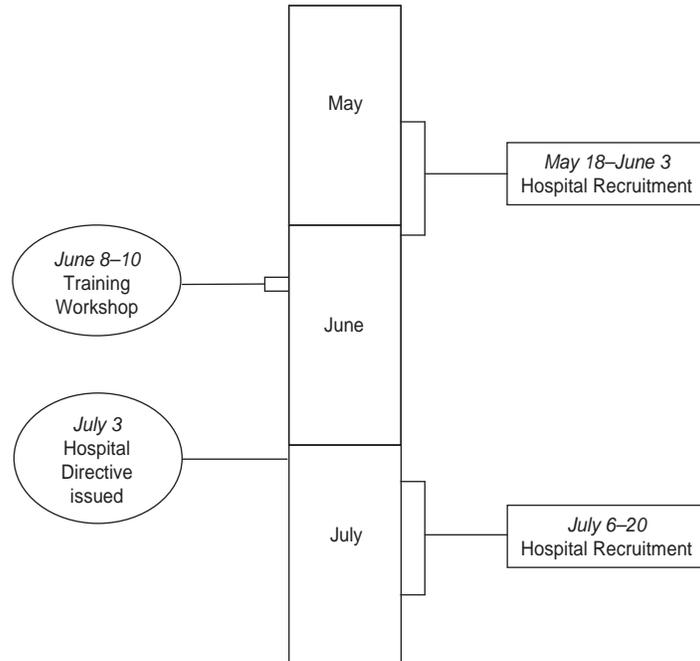
In 2007, the Pan American Health Organization (PAHO) released the following updated recommendations for the timing of umbilical cord clamping: “The optimal time to clamp the umbilical cord for all infants regardless of gestational age or fetal weight is when the circulation in the cord has ceased, and the cord is flat and pulseless (approximately 3 minutes or more after birth). After cord pulsations have ceased (approximately 3 minutes after delivery), clamp and cut the cord following strict hygienic techniques” (20, p. 5).

Delaying umbilical cord clamping is a cost-free intervention that has been demonstrated to be safe and effective in decreasing the risk of infant anemia. Poor communities struggle to combat anemia, as their ability to use other known effective interventions, such as iron supplementation, are limited by high costs and other difficulties. If successfully implemented, especially in poor areas of the world where the prevalence of infant anemia is high, delayed umbilical cord clamping could be an effective and sustainable means to improve child health and nutrition. While sufficient experimental evidence exists on the benefits of delayed cord clamping, a gap often exists between research and practice. Bridging the “know-do” gap, which refers to putting evidence-based research into practice, is an increasingly important field of research. No study has been conducted previously that has examined changing hospital policy from early to delayed umbilical cord clamping. To fill this gap, the objective of this study was to investigate the effect of a simple two-component intervention consisting of a three-day workshop and a hospital directive on changing hospital practice with regard to the timing of umbilical cord clamping.

MATERIALS AND METHODS

The host hospital for this study was the Hospital Iquitos “César Garayar García”—one of two public health facilities with an obstetrics and gynecology unit in the city of Iquitos in the Peruvian Amazon. The catchment area for this hospital includes Iquitos and its surrounding communities, which have an estimated total population of 406 000

FIGURE 1. Timeline for a study on changing hospital practice from early to delayed umbilical cord clamping (training, hospital directive, and pre- and post-intervention recruitment of women in labor), Iquitos, Peru, May–July 2009



(21). Approximately 5 000 births are recorded in this hospital annually.

A pre-/post-study design was used to document the effectiveness of a simple two-component intervention in changing hospital practice in the Department of Obstetrics and Gynecology of Hospital Iquitos. The goal of the intervention was to implement new national government guidelines for attendance at birth that included a change from early to delayed cord clamping. The study population was mother–infant pairs who had uncomplicated vaginal deliveries in the hospital. All women who arrived at the hospital in labor between 18 May–3 June 2009 (pre-intervention) and from 6–20 July 2009 (post-intervention) were approached to participate in the study (Figure 1). Inclusion criteria required that participants 1) not be scheduled for a cesarean section, 2) were residing in Iquitos or neighboring communities at the time of delivery and would continue to live there for at least four months after their delivery, and 3) gave written consent prior to entering the delivery room. Participants were excluded if they had an emergency cesarean section; their infant was 1) stillborn, 2) born with a tight nuchal cord that could not be unwrapped from his/her neck, or 3) had any congen-

ital abnormalities; or if mother and/or infant were transferred to another hospital before being discharged.

The hospital-level intervention consisted of two components: a three-day training workshop entitled “*Estandarización de habilidades clínicas básicas en salud materno-neonatal* [Standardization of basic clinical skills in maternal and neonatal health]” and a written hospital directive sent to all nurse-midwives in the hospital.

The training workshop took place from 8–10 June 2009 and was designed to train hospital personnel on delayed umbilical cord clamping. It was run by two trained health professionals (one nurse-midwife and one obstetrician) from the Ministry of Health (MINSA) in Lima, and the director of the Instituto de Investigación Nutricional (IIN), a private, nonprofit institution in Lima that carries out health and nutrition research and provides teaching, training, and other services. The MINSA professionals were charged with training the hospital staff in new Ministry of Health birthing practice guidelines that included delayed umbilical cord clamping. All nurse-midwives from the study hospital were invited to attend this official workshop. The first two days of the workshop consisted of in-class theoretical training on

the practical techniques of the new guidelines, with an emphasis on delayed cord clamping. The course topics included the following: 1) Peru's National Strategic Plan to Reduce Maternal and Perinatal Mortality 2009–2015; 2) "Labor and normal deliveries"; 3) "Managing the new WHO [World Health Organization] partograms"; 4) "Guide for attending newborns"; and 5) "Clamping the umbilical cord to prevent anemia." Specific to umbilical cord clamping, the theory behind delayed cord clamping and its effect on anemia and placental transfusion was introduced using a game involving word association, played in small groups, in which the participating nurse-midwives were asked to match the correct answers to questions about anemia and mother-to-infant iron transfer during pregnancy. Following this activity, a review of the epidemiological literature examining the timing of umbilical cord clamping was presented, in lecture format, along with the biological rationale for delayed cord clamping and a detailed account of PAHO's recently updated guidelines advocating the practice. To integrate delayed cord clamping into the other components of the third stage of labor, nurse-midwives were instructed to provide oxytocin at 1 minute following delivery and to clamp the umbilical cord 2 minutes following delivery. Immediately after the lecture, a discussion period was initiated by inviting the participating nurse-midwives to ask questions. All questions and queries were addressed by the director of the IIN. The third day of the workshop took place in the labor and delivery rooms of Hospital Iquitos, where the participating nurse-midwives were divided into small groups. Led by the MINSa nurse-midwife, each group practiced hands-on techniques introduced in the past two days of workshop training and participated in discussions.

The second component of the intervention—the hospital directive—was signed by the head of the Department of Obstetrics and Gynecology of Hospital Iquitos and was issued on 3 July 2009 to all nurse-midwives employed by the hospital. In this document, the department head declared that the new hospital policy with regard to the timing of umbilical cord clamping would be consistent with the revised PAHO guidelines: "A partir de la fecha se recomienda que el clampaje del cordón umbilical en el Recién Nacido

que no necesita atención inmediata en Neonatología sera, entre los 2 y 3 minutos de nacido (cuando el cordón deja de latir) de acuerdo a las recomendaciones de la OPS. [From this date forward, I recommend that the clamping of the umbilical cord for newborns not needing immediate neonatal attention will be between 2 to 3 minutes after birth (when the cord stops pulsating), according to PAHO recommendations.]"

Following the conclusion of the training and the dissemination of the hospital directive, the hospital's supervising nurse-midwife and head physician-obstetrician were available to answer questions from the nurse-midwives who participated in the workshop. Prior to the initiation of the study, these two individuals and other hospital staff met with the research team (the Peruvian and Canadian principal investigators and research coordinators and one Master's epidemiology student) to review all aspects of the upcoming intervention.

Pre- and post-intervention data collection was identical. The in-hospital research team (which consisted of three study nurse-midwives) recruited the study participants and collected the data in three 8-hour shifts (i.e., recruitment and data collection were ongoing 24 hours/day). Upon obtaining informed consent, a study nurse-midwife administered a short questionnaire to each participant in the labor room to obtain demographic and antenatal information. Maternal hemoglobin levels were then obtained from finger-prick blood using a HemoCue[®] machine (HemoCue Inc., Cypress, California, USA). Additional medical information was abstracted from the woman's personal health record. Select information was subsequently verified from hospital registries and medical charts. When the woman entered the delivery room, the study nurse-midwife observed the delivery and, using a digital stopwatch, recorded the time between the delivery of the first shoulder and the clamping of the umbilical cord. Observations of the delivery were also noted. Infant characteristics at birth were obtained from hospital registries.

Statistical analyses

The sample size was calculated to measure the effect of the change in practice on infant anemia at 4 months of age. It was based on an inference for proportions,

comparing two independent groups (i.e., pre- and post-intervention) using a two-sided chi-square test with a level of significance of 0.05, 80% power, and an expected meaningful clinical difference of 20% in infant anemia (based on local expert opinion) following change in practice. Taking an estimated 20% attrition rate into account, the total sample size was calculated to be 112 in each group, for a total of 224 mother–infant pairs.

Student's *t*-tests and chi-square tests were used to compare baseline characteristics between the pre- and post-intervention groups. Univariate and multivariate linear regression analyses were used to assess the effect of the intervention on the change in the timing of cord clamping. The final multivariate linear regression model adjusted for variables found to be different between the groups as well as variables of interest previously identified from the published literature. All statistical analyses were done in R software, version 2.6.1 (The R Project for Statistical Computing, <http://www.r-project.org/>).

RESULTS

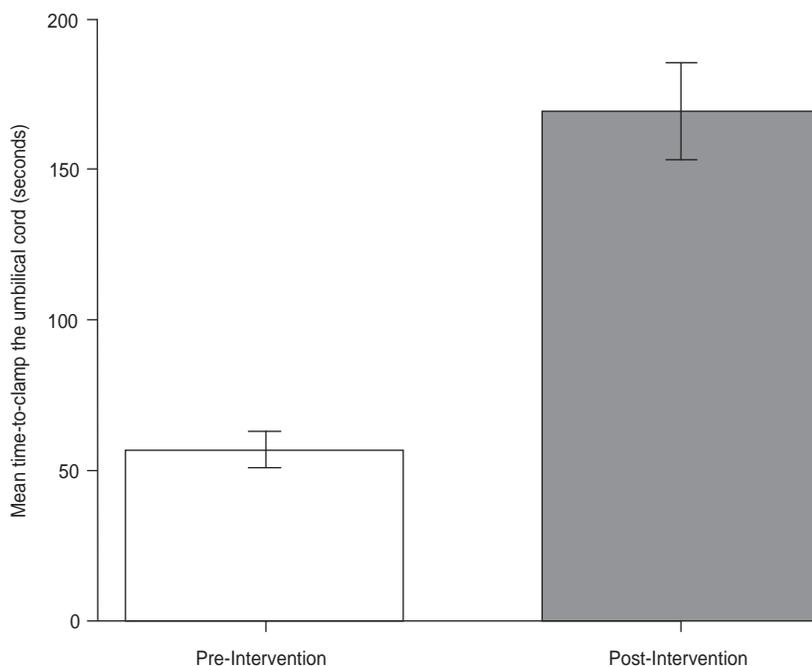
During the study period, a total of 270 women were approached for inclusion in the study. Of these, 6 refused to participate, 3 did not meet the inclusion criteria, and 37 were omitted by exclusion criteria. Complete hospital data were obtained for a total of 224 mother–infant pairs (83% of those approached).

During the entire study period, 13.4% of deliveries were attended by 11 nurse-midwives and 86.2% by 27 nurse-midwife interns (who attended deliveries under the supervision of a nurse-midwife). Nurse-midwives attended the training workshop and then subsequently trained the nurse-midwife interns. One birth was attended by a medical doctor. During the pre-intervention time period, 8.9% of births were attended by nurse-midwives and 91.1% of births were attended by interns. During the post-intervention time period, 17.9% of births were attended by nurse-midwives and 81.3% by interns.

Pre- and post-intervention groups were comparable on all demographic maternal and infant characteristics with the exception of gestational age and presence of a nuchal cord at birth, which differed significantly between the two groups (Table 1). For the entire study population, 8.1% of deliveries were pre-term (gestational age

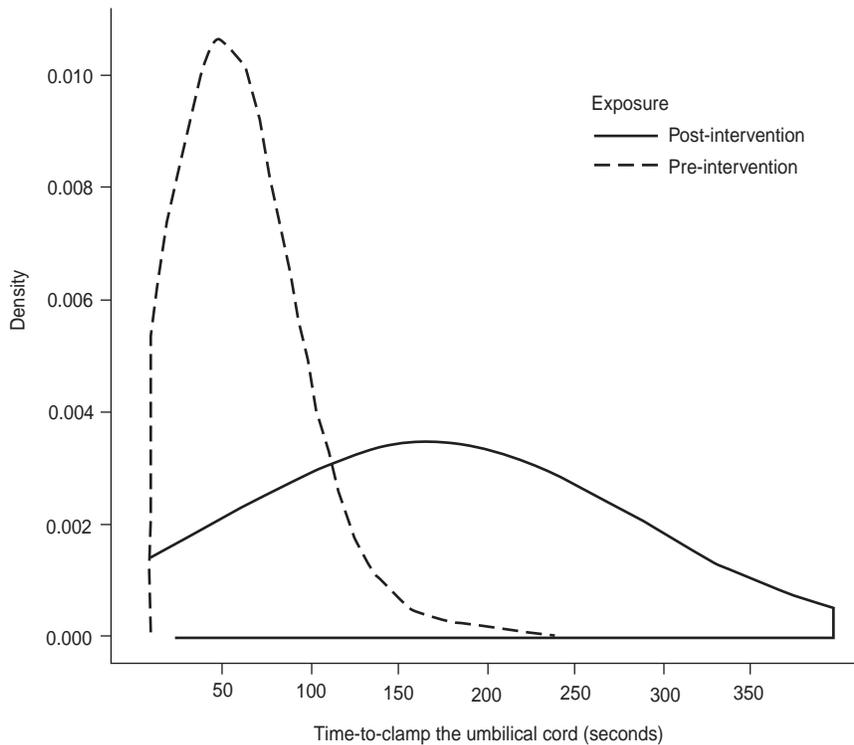
TABLE 1. Characteristics of pre- versus post-intervention groups comprising 224 mother–infant pairs in a study on changing hospital practice from early to delayed umbilical cord clamping, Iquitos, Peru, May–July 2009

Characteristic	Pre-intervention group (n = 112)	Post-intervention group (n = 112)	P
Mother's age (years) (mean [SD ^a])	23.5 (6.5)	23.8 (5.5)	0.723
Marital status (% married/common law)	90.2	86.6	0.532
Residence			0.725
Urban (%)	54.5	49.1	
Peri-urban (%)	37.5	42.0	
Rural (%)	8.0	8.9	
No. years of education (mean [SD])	8.9 (2.8)	9.4 (2.5)	0.165
Mother employed (%)	23.2	12.5	0.055
No. antenatal care visits (mean [SD])	6.8 (2.4)	6.7 (2.6)	0.641
Iron supplements (% mothers who took supplements during pregnancy)	94.6	93.8	1.000
Maternal Hb ^b (g/dL) (mean [SD])	12.02 (1.34)	11.77 (1.22)	0.158
Mother anemic (% with Hb < 11.0 g/dL)	18.8	23.2	0.512
Gestational age (weeks) (mean [SD])	38.8 (1.6)	38.2 (2.2)	0.021 ^c
No. of previous pregnancies (mean [SD])	1.3 (1.5)	1.5 (1.4)	0.577
No. of previous miscarriages (mean [SD])	0.2 (0.5)	0.3 (0.5)	0.156
Personnel attending delivery (% nurse-midwife interns)	91.1	81.3	0.053
Personnel clamping cord (% nurse-midwife interns)	94.6	89.3	0.219
Sex of health personnel clamping cord (% males)	11.6	8.0	0.500
Infant complications at birth ^d (%)	7.1	8.0	1.00
Presence of meconial amniotic fluid at birth (%)	11.6	17.9	0.258
Presence of nuchal cord at birth ^e (%)	26.8	11.6	0.007 ^c
Birth weight (g) (mean [SD])	3 152 (424.9)	3 182 (389.5)	0.582
Birth length (cm) (mean [SD])	50.05 (2.2)	50.2 (2.0)	0.521
Infant sex (% male)	54.5	50.0	0.593

^a SD: standard deviation.^b Hemoglobin.^c $P < 0.05$.^d Neonatal depression (including not crying at birth) and/or fractured collarbone.^e Nuchal cord present but able to be unwrapped easily during delivery.**FIGURE 2. Bar plots showing mean time between delivery of infant's first shoulder and clamping of the umbilical cord (with 95% confidence intervals) before and after an intervention to change hospital practice from early to delayed clamping, Iquitos, Peru, May–July 2009**

< 37 weeks). The percentage of pre-term deliveries did not differ significantly between the two groups (pre-intervention: 5.4%; post-intervention: 10.8%; $P = 0.22$). Pre-intervention, the mean time between delivery and cord clamping was 56.8 seconds (95% confidence interval [CI]: 51.0, 62.7). This ranged from a minimum value of 8.9 seconds to a maximum value of 191.7 seconds. Following the intervention, the mean clamping time increased to 169.8 seconds (95% CI: 153.8, 185.8), with a range of 13.4 seconds to 397.3 seconds (Figure 2). Before the intervention took place, the distribution of the time-to-clip variable was tightly centered around the mean (Figure 3). This distribution shifted toward delayed cord clamping following the intervention, with greater spread around the higher mean. The proportion of cord clamping times greater than or equal to 1 minute increased from 39.3% pre-intervention to 85.7% post-intervention. In addition, in the post-intervention group, only 27.7% of cord clamping times occurred at less than 2 minutes, whereas in the pre-intervention

FIGURE 3. Density plots demonstrating distribution of the timing of umbilical cord clamping (in seconds) before and after an intervention to change hospital practice from early to delayed cord clamping, Iquitos, Peru, May–July 2009



group 95.5% of cord clamping times occurred at less than 2 minutes.

Univariate linear regression showed that the mean cord-clamping time increased by 113.0 seconds following the intervention ($\beta = 113.0$ seconds; 95% CI: 95.2, 129.9). The magnitude of this effect remained unchanged in the multivariate analysis after adjusting for gestational age, type of health personnel clamping the cord, sex of health personnel clamping the cord, presence of infant medical complication at birth, presence of meconial amniotic fluid at delivery, presence of a nuchal cord, infant sex, and maternal age ($\beta_{\text{adjusted}} = 113.2$ seconds; 95% CI: 96.6, 129.9).

DISCUSSION

Although the benefits of delayed over early umbilical cord clamping have been thoroughly studied under experimental conditions, no study had previously investigated specific operational interventions to implement this policy.

Of the limited research done regarding implementation of delayed umbilical cord clamping, it has been shown that the evidence to date is not being appro-

priately disseminated to policy makers and is not reaching obstetricians and midwives working in hospital settings. A recent study that aimed to investigate whether obstetricians around the world were willing to adopt recommendations on delayed cord clamping showed that they were reluctant to do so and that this was mainly due to being unaware of the scientific evidence (22). Another study in which U.S. nurse-midwives were asked to report their current practices regarding the timing of umbilical cord clamping found an almost equal distribution in practice between early, intermediate, and late cord clamping and concluded that this was a result of confusion and an inadequate scientific knowledge base (23). These studies highlight the need for communication between researchers, policy makers, and hospital staff. In order to successfully change practice toward delayed umbilical cord clamping, health workers need to be made aware of the evidence.

Although the issue of changing hospital policy from early to delayed umbilical cord clamping has not previously been investigated, other hospital-based policy changes have undergone serious

investigation. One historical example is the success of changing hospital breastfeeding policy with the “Ten Steps to Successful Breastfeeding” program, which was developed to increase the duration of breastfeeding. The United Nations Children’s Fund (UNICEF) and WHO developed a list of 10 practices to guide change in hospital policy with regard to breastfeeding. The first two steps are: 1) have a written breastfeeding policy that is routinely communicated to all health care staff, and 2) train all health care staff in skills necessary to implement this policy. Implementation of these steps has been shown to successfully change hospital policy and practice with regard to breastfeeding practices (24). These techniques can be used to guide other attempts at hospital-based policy change.

This study has shown that it is feasible to change hospital practice from early to delayed umbilical cord clamping based on evidence that, following a training period and an official change in hospital policy, hospital nurse-midwives in the Peruvian Amazon were willing and able to change their practice toward later cord clamping. The mean and tight distribution of the time-to-clip variable pre-intervention represents adherence to the previous hospital policy that instructed cord clamping to take place at approximately 1 minute. Following the intervention, there was a shift toward delayed cord clamping. As to be expected in any policy change setting, the distribution of clamping time following the intervention showed large spread. There are many possible reasons for the 27.7% of cord clamping times demonstrating suboptimal practice (less than 2 minutes) post-intervention, including: 1) not having attended the workshop, 2) not having read the hospital directive, 3) not knowing how much time had elapsed, and 4) perceived need for immediate neonatal attention. It can be expected that, as in other policy-to-practice changes, the proportion of suboptimal practice will diminish with time and practice, and that the distribution of cord clamping times will exhibit a higher peak at the recommended time as this becomes routine in the delivery room.

This study had various limitations. First, the presence of the research team in the delivery room could have affected the hospital nurse-midwives’ practice.

Although the hospital workers were not aware of the research objectives, due to the nature of the project, it was impossible to observe the deliveries without the hospital workers being aware of the presence of the research team. It is possible that the presence of the research team in the hospital caused the nurse-midwives to act differently than they otherwise would have had no research team been present. Second, conducting the post-intervention data collection at a later date, not immediately following the intervention, may have been more informative regarding long-term change in practice and sustainability of the new policy. Nonetheless, this study demonstrates the feasibility of introducing the intervention into other aspects of delivery, and the ease of uptake by nurse-midwives of a new hospital policy on delayed cord clamping.

One challenge that arose during delivery was that it was unreasonable to expect nurse-midwives to accurately measure the time between delivery and cord clamping. Waiting for the umbilical cord pulsations to cease may be an acceptable alternative; however, in many cases, judging exactly when the cord has stopped pulsating can also be difficult. Accurately judging when 3 minutes has passed is a technique that requires practice by the nurse-midwives.

The observed success in implementing the new policy on delayed cord clamping in Hospital Iquitos is believed to be a result of three contributing factors: 1) the incorporation of delayed cord clamping into official Ministry of Health policy, 2) the use of training on the scientific reasoning behind delayed cord clamping to motivate hospital staff, and 3) collaboration at the hospital level.

Changing hospital policy was possible because delayed cord clamping had recently been incorporated into official Peruvian Ministry of Health (MINSA) policy. As a result, this study was supported by health care officials from the Department of Specialized Health Services at MINSA. In 2008, MINSA had begun drafting updated guidelines entitled "Atencion Integral de Salud Materna y Perinatal [Integrated Health for Maternal and Perinatal Attention]." These drafted guidelines included an update on the recommendation with regard to the timing of umbilical cord clamping; specifically, to extend it to allow for complete placental transfusion, usually between 2–3 minutes following delivery. As MINSA was eager to receive local epidemiological evidence on this topic, it was readily arranged that one of the first training workshops on the new guidelines could be undertaken in Iquitos by two obstetric professionals with experience in MINSA training workshops, and that the director of the IIN could be involved to provide information on the scientific background regarding delayed cord clamping. The workshop clearly demonstrated how delayed cord clamping was an essential component in the management of the third stage of labor. The incorporation of delayed umbilical cord clamping into this MINSA-led training workshop provided the assurance that this was official policy. This was essential in terms of gaining support from the hospital director and, ultimately, for ensuring hospital uptake of the new policy.

Training the hospital staff in an engaging manner with the three-day workshop was a crucial step. Most nurse-midwives were not aware of the scientific evidence favoring delayed cord clamping. Having

the epidemiological evidence and reasoning behind delayed cord clamping explained in a focused manner throughout a training workshop provided motivation that helped ensure that what might have been just another change in standard routine guidelines resulted in a change in practice.

Finally, hospital officials also collaborated in this study and were key in terms of planning the data collection, organizing the training workshop, and issuing the hospital directive. Although all nurse-midwives of the hospital were invited to attend the workshop, not all were able to attend. In order for the message regarding the new policy to reach all appropriate staff, the head of the Department of Obstetrics and Gynecology of Hospital Iquitos issued a hospital directive to every nurse-midwife in the hospital. This personnel directive explained the new policy and referred to the PAHO recommendations for further information.

In conclusion, to combat infant anemia, especially in low-resource settings, the most effective strategy is to scale up interventions that are known to be effective. Delayed umbilical cord clamping has not only been repeatedly shown to effectively reduce infant anemia, it is also cost-free and therefore an appropriate and sustainable intervention. Despite the body of scientific evidence supporting delayed umbilical cord clamping, a gap exists between research and practice. One method to bridge this gap is collaboration among researchers, government officials, and hospital staff members. Using a comprehensive capacity-building approach, hospital policy and practice can successfully be changed from early umbilical cord clamping to delayed umbilical cord clamping.

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RESUMEN

Efecto de una intervención de dos componentes para modificar la práctica hospitalaria de pinzamiento del cordón umbilical de precoz a tardío en la Amazonia peruana

Objetivo. Investigar el efecto de una intervención de dos componentes para modificar la práctica hospitalaria respecto del momento en que se practica el pinzamiento del cordón umbilical.

Métodos. Se empleó un estudio con diseño antes-después para medir el efecto de una intervención de dos componentes sobre el tiempo medio de pinzamiento del cordón umbilical. El estudio se llevó a cabo en el Hospital Iquitos “César Garayar García” en Iquitos (Perú). Se incluyeron en total 224 mujeres atendidas en la sala de trabajo de parto del hospital: 112 antes de la intervención, entre el 18 de mayo y el 3 de junio del 2009, y 112 después de la intervención, entre el 6 y el 20 de julio del 2009. La intervención consistió en: 1) un taller de capacitación sobre las “mejores prácticas” en la atención del parto, de 3 días de duración y 2) una directiva del hospital. Se observaron todos los partos y se midió el tiempo entre la salida del hombro anterior y el pinzamiento del cordón umbilical con un cronómetro digital.

Resultados. El tiempo medio entre el parto y el pinzamiento del cordón antes de la intervención fue de 56,8 segundos (intervalo de confianza [IC] de 95%: 51,0–62,7), y aumentó a 169,8 segundos (IC 95%: 153,8–185,8) después de la intervención. La diferencia en el tiempo medio hasta el pinzamiento siguió siendo significativa en los análisis multivariados ($\beta_{\text{ajustado}} = 113,2$ segundos, IC 95%: 96,6–129,9).

Conclusiones. Es posible cambiar las normas y las prácticas hospitalarias de pinzamiento del cordón umbilical de precoz a tardío mediante una intervención sencilla de dos componentes.

Palabras clave

Cordón umbilical; trabajo de parto; política de salud; países en desarrollo; Perú.