

SPECIAL ARTICLE

A Behavioral Intervention to Improve Obstetrical Care

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ABSTRACT

BACKGROUND

Implementation of evidence-based obstetrical practices remains a significant challenge. Effective strategies to disseminate and implement such practices are needed.

METHODS

We randomly assigned 19 hospitals in Argentina and Uruguay to receive a multifaceted behavioral intervention (including selection of opinion leaders, interactive workshops, training of manual skills, one-on-one academic detailing visits with hospital birth attendants, reminders, and feedback) to develop and implement guidelines for the use of episiotomy and management of the third stage of labor or to receive no intervention. The primary outcomes were the rates of prophylactic use of oxytocin during the third stage of labor and of episiotomy. The main secondary outcomes were postpartum hemorrhage and birth attendants' readiness to change their behavior with regard to episiotomies and management of the third stage of labor. The outcomes were measured at baseline, at the end of the 18-month intervention, and 12 months after the end of the intervention.

RESULTS

The rate of use of prophylactic oxytocin increased from 2.1% at baseline to 83.6% after the end of the intervention at hospitals that received the intervention and from 2.6% to 12.3% at control hospitals ($P=0.01$ for the difference in changes). The rate of use of episiotomy decreased from 41.1% to 29.9% at hospitals receiving the intervention but remained stable at control hospitals, with preintervention and postintervention values of 43.5% and 44.5%, respectively ($P<0.001$ for the difference in changes). The intervention was also associated with reductions in the rate of postpartum hemorrhage of 500 ml or more (relative rate reduction, 45%; 95% confidence interval [CI], 9 to 71) and of 1000 ml or more (relative rate reduction, 70%; 95% CI, 16 to 78). Birth attendants' readiness to change also increased in the hospitals receiving the intervention. The effects on the use of episiotomy and prophylactic oxytocin were sustained 12 months after the end of the intervention.

CONCLUSIONS

A multifaceted behavioral intervention increased the prophylactic use of oxytocin during the third stage of labor and reduced the use of episiotomy. (ClinicalTrials.gov number, NCT00070720; Current Controlled Trials number, ISRCTN82417627.)

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EFFECTIVE IMPLEMENTATION OF EVIDENCE-based health care practices remains a significant challenge.¹ In maternity hospitals, evidence-based interventions often are underused, whereas ineffective or harmful practices continue to be used. For example, in the United States and Latin America, active management of the third stage of labor, consisting of the administration of a prophylactic uterotonic such as oxytocin, controlled traction of the umbilical cord, and uterine massage,² is used in less than 15% of deliveries.³⁻⁷ In contrast, rates of the use of episiotomy among primiparous women range from 40 to 92%.^{8,9} Active management of the third stage of labor prevents postpartum hemorrhage and is recommended as standard care.^{2,10} Routine use of episiotomy is harmful to women's health,^{11,12} and selective use is recommended as standard care.¹³

Use of evidence-based guidelines improves quality of care, the behavior of health care practitioners, and the health outcomes of patients.¹⁴⁻¹⁷ Effective dissemination and implementation strategies for these guidelines are needed. Passive approaches have limited effectiveness,¹⁴⁻¹⁷ whereas multifaceted, active strategies for obstetrical care have yet to be evaluated.^{1,15,18}

We report a multifaceted intervention to facilitate the adoption of evidence-based practices in Latin American maternity hospitals.¹⁹ Our cluster-randomized, controlled trial evaluated the behavior and attitudes of birth attendants with respect to two evidence-based recommendations for obstetrical practice: the selective use of episiotomy and active management of the third stage of labor.¹⁰⁻¹²

METHODS

STUDY DESIGN

The participating institutions and partners of the Global Network for Women's and Children's Health Research (listed in the Appendix) implemented the trial between September 2003 and December 2005. The trial was conducted in 19 public maternity hospitals in Argentina and Uruguay that had at least 1000 vaginal deliveries annually, no explicit policy for selective episiotomy or active management of the third stage of labor, and rates of episiotomy above 20% and rates of prophylactic use of oxytocin of 25% or less in women with single vaginal births.

The design was a cluster-randomized, controlled trial, with hospitals as the randomization unit.²⁰ One group of hospitals was assigned to receive a multifaceted behavioral intervention to develop and implement guidelines for the use of episiotomy and management of the third stage of labor. The control group of hospitals received no intervention. Data were collected during the following three intervals: a 3-month period before randomization (baseline), the last 3 months of the 18-month intervention (postintervention), and the 3 months beginning 1 year after the beginning of the postintervention interval (follow-up) (Fig. 1).

A balanced randomization procedure²¹ ensured that the intervention and control hospitals were balanced with respect to the rates of prophylactic use of oxytocin and episiotomy, the presence or absence of residency programs, the country and region where the hospital was located, and the annual number of births at the hospital. Of 184,756 possible ways of assigning hospitals to the intervention and control groups with acceptable balance, one sequence was randomly selected to determine the composition of the two groups.

To ensure that the personnel at all hospitals had similar knowledge at baseline, we conducted seminars before collecting baseline data to inform the providers about active management of the third stage of labor, the selective use of episiotomy, and use of the World Health Organization (WHO) Reproductive Health Library²² as a source of evidence-based interventions.

STUDY INTERVENTION

The intervention lasted for 18 months. Intervention strategies were chosen for their effectiveness in leading to a change in practice¹⁴ and were based on behavioral-change theories.²³⁻²⁵ Formative research with hospital administrators, birth attendants, and patients in nonparticipating regional hospitals similar to the study hospitals facilitated adaptation of the intervention to Latin American hospitals.²

Teams of three to six birth attendants (physicians, residents, or midwives) were identified as opinion leaders by their peers at each intervention hospital with the use of a previously validated sociometric questionnaire.²⁶ Each team was trained in a 5-day workshop to develop and disseminate evidence-based guidelines on management of the third stage of labor and the use of episiotomy.

The workshops focused on critical evaluation of the medical literature,²⁷ development of clinical-practice guidelines,²⁸ communication skills, and methods of conducting one-on-one academic detailing visits with hospital birth attendants to discuss their views regarding implementation of the intervention at the hospital.²⁹

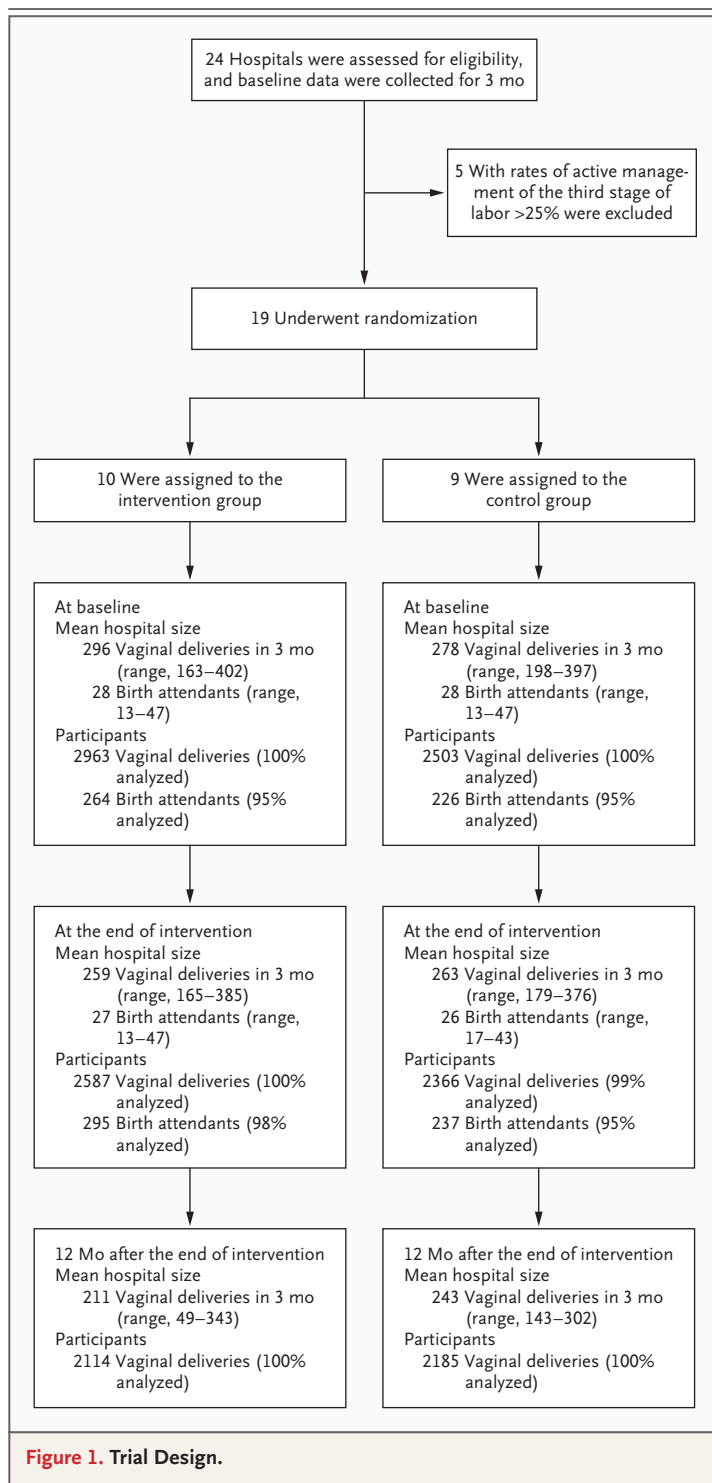
After returning to their respective hospitals, the teams participated in 1-day workshops to develop their training skills.³⁰ The teams then disseminated the guidelines, trained and visited birth attendants, and developed reminders to be placed in labor and delivery wards, inside surgical packages for birth attendants, and on clinical records. The teams also produced monthly reports on rates of use of episiotomy and prophylactic oxytocin based on hospital clinical data. Regional coordinators met monthly with each team to assess completion of the activities. Each intervention hospital received a computer with intervention materials installed on it, copies of the guidelines, the WHO Reproductive Health Library,²² and *BMJ Clinical Evidence*.³¹ Details of the intervention are described in Table 1 of the Supplementary Appendix, available with the full text of this article at www.nejm.org.

No intervention activities were conducted in the intervention hospitals during the follow-up period. After the end of the postintervention period, a closed, confidential, 2-hour meeting with selected representatives of the intervention and control hospitals was conducted to present the trial results.

During the intervention period, the control hospitals received no intervention other than standard in-service training. During the 1-year follow-up period, we offered the control hospitals all components of the intervention except the visits by the coordinators (see Table 1 of the Supplementary Appendix).

MEASUREMENT OF OUTCOMES

The primary outcomes were the rates of prophylactic use of oxytocin (a single 10-IU injection during the third stage of labor) and of episiotomy in singleton vaginal deliveries. The other components of active management of the third stage of labor (traction on the umbilical cord and uterine massage) were not part of the primary outcome because of the difficulty of objectively measuring and verifying the performance of maneuvers in all vaginal deliveries. The secondary outcomes were



the rate of use of perineal suturing, the rates of postpartum hemorrhage of 500 ml or more and 1000 ml or more, and the birth attendants' readiness to change their behavior regarding episio-

mies (i.e., to adopt prophylactic use of episiotomy) and active management of the third stage of labor. We also measured the prophylactic use of other uterotonic agents, such as ergonovine and prostaglandins.

Clinical outcomes were assessed during the baseline and postintervention periods; only primary outcomes were assessed during the 1-year follow-up period. Data were collected with the use of a standard perinatal clinical record form that had been modified to include all study clinical variables. The amount of blood lost during the third stage of labor was determined by collecting blood in a transparent plastic drape designed for the trial and then measuring the amount of blood in a calibrated pitcher. Trained in-hospital data collectors performed daily data entry, validation, and transmission; data quality was periodically checked against information abstracted from hospital records, including information on use of medication.

Birth attendants' readiness to change was measured at baseline and during the last month of the intervention period. The birth attendants completed anonymous, self-administered questionnaires to describe their readiness to adopt or maintain active management of the third stage of labor or to adopt the selective use of episiotomy.²³ The questionnaires were collected in opaque envelopes and placed in sealed containers at each hospital.

STATISTICAL ANALYSIS

The sample size was based on the hospital as the unit of analysis. On the assumption of a rate of episiotomy of 42% at baseline, with a standard deviation of 15%, we needed 18 hospitals (9 intervention and 9 control) to identify a decrease in the episiotomy rate from 40% to 20% (with a two-sided test at a 0.05 significance level and 80% power).¹⁹ That sample size would provide a power of more than 95% to identify an increase in the rate of oxytocin use from 10% to 50% and a power of more than 80% to identify a reduction in the rate of postpartum hemorrhage of at least 500 ml from 15% to 8%. To allow for hospitals to drop out or to be excluded before randomization, we collected baseline data from 24 hospitals (Fig. 1).

Analyses were performed according to the intention-to-treat principle, and no hospital was excluded from the analysis after it was assigned to the intervention or the control group. For vari-

ables measuring behavior (e.g., prophylactic use of oxytocin and episiotomy and the readiness to change behavior) and continuous variables (e.g., blood loss), the change in rate at outcome was calculated as the difference between the post-intervention and the baseline rates. First, the rate of the event at each hospital at baseline and post-intervention was calculated. Then the difference in the rates between the postintervention and the baseline periods was calculated for each hospital. The median of these differences for the intervention and control groups was determined as the median rate change. Finally, the difference between the median rate change for each treatment group was calculated as the intervention effect³² and tested with the use of an exact Wilcoxon rank test to determine the 95% confidence interval.³³ To assess the effect at follow-up, we used the same statistical approach but calculated the change in rate as the difference between the rates at follow-up and at baseline for each hospital.

A similar strategy was used for dichotomous clinical outcomes (e.g., postpartum hemorrhage), but the ratio of the postintervention and baseline rates (instead of the difference between them) was calculated for each hospital. An exact non-parametric confidence interval and a P value were calculated for the ratio of the median rate ratios in the control and the intervention groups.³²

Rate differences instead of rate ratios were selected for behavioral outcomes, because rate ratios were not good measures of effect size owing to the large variability at baseline; for example, an increase in the use of a practice from 1% to 50% would correspond to a rate ratio of 50, whereas an increase from 5% to 50% would correspond to a rate ratio of 10. However, we reported the intervention effects for clinical outcomes as ratios, because these outcomes do not usually present such variability.

Because a restricted randomization procedure was used, a restricted randomization test was performed.^{34,35} The results were compared with those obtained with the nonparametric strategy programmed in Python programming language and R statistical software.^{36,37}

Approval for the study was obtained from eight institutional review boards (listed in the Appendix). Because outcome data were routinely collected at hospitals and no personal identifiers were transmitted, all the institutional review boards waived the requirement for individual

consent.¹⁹ Responsible authorities from all the hospitals provided written consent,^{38,39} and birth attendants also provided written consent.

RESULTS

CHARACTERISTICS OF HOSPITALS, BIRTH ATTENDANTS, AND MOTHERS

Of the 20 Argentinean and 4 Uruguayan hospitals, 19 met the inclusion criteria (17 in Argentina and 2 in Uruguay) (Fig. 1). Ten hospitals were assigned to the intervention group and nine to the control group, and all completed the trial. The characteristics of the hospitals and delivery staff were similar in the two groups (Table 1). Most of the hospitals had physician residency programs and midwives.

Baseline data were collected for 2963 vaginal births in the intervention hospitals and 2503 in the control hospitals. The groups were similar with respect to maternal characteristics, rates of prophylactic use of oxytocin and episiotomy, and the prevalence of low-birth-weight infants (Table 1). Baseline data were missing for less than 0.5% of births, except for data on postpartum hemorrhage, which were missing for 1.3% of births in intervention hospitals and 1.7% of births in control hospitals.

The readiness-to-change survey was administered to 593 birth attendants (304 at intervention hospitals and 289 at control hospitals) at baseline. The mean response rate was 89.3% in intervention hospitals and 82.6% in control hospitals. Data were missing in 3.2% of the questionnaires from intervention hospitals and 7.1% of those from control hospitals.

The workshop guidelines recommended active management of the third stage of labor (prophylactic use of oxytocin, traction on the umbilical cord, and uterine massage) in all vaginal births and selective episiotomy in spontaneous, uncomplicated, term vaginal births. Results of post-training surveys showed that the opinion leaders were nearly unanimous in support of the recommendations. Compliance with the intervention was high (see Table 2 of the Supplementary Appendix).

The coordinators verified that intervention activities were not conducted at control hospitals during the intervention period. The control hospitals had no changes in policies regarding active management of the third stage of labor, prophyl-

actic use of oxytocin, or episiotomy, except for one hospital at which the authorities independently adopted a policy of active management of the third stage of labor during the trial. No intervention activities were conducted at the intervention hospitals during the 1-year follow-up period. At each of six control hospitals, one guidelines workshop was conducted for two or three birth attendants selected by the department head, but no other intervention activities were conducted at any control hospital during this period.

OUTCOME MEASURES

During the postintervention period, data were collected on 2587 vaginal births in the intervention hospitals and 2366 in the control hospitals. Clinical data were missing for less than 0.5% of

Table 1. Characteristics of Hospitals, Birth Attendants, and Mothers at Baseline.*

Characteristic	Intervention Hospitals (N=10)†	Control Hospitals (N=9)‡
Hospitals		
Country — no. (%)		
Argentina	9 (90)	8 (89)
Uruguay	1 (10)	1 (11)
Residency program — no. (%)	8 (80)	8 (89)
Midwives on staff — no. (%)	8 (80)	6 (67)
≥2000 births/yr — no. (%)	4 (40)	4 (44)
Birth attendants		
Age — yr	41.1±4.0	40.2±4.1
Female sex — %	70.7±15.6	67.6±13.2
Years since graduation — no.	16.3±4.2	15.8±3.9
Position — %		
Midwife	32.3±19.8	24.3±24.1
Head obstetrician–gynecologist	6.9±4.6	6.4±4.0
Staff obstetrician–gynecologist	35.8±13.3	33.6±9.8
Resident physician	26.5±25.4	37.7±22.1
Mothers		
Prophylactic oxytocin — %	4.4±6.4	4.3±5.5
Episiotomy — %	41.8±9.0	43.6±8.4
Primiparous — %	33.8±6.0	37.4±5.2
Age <20 yr — %	23.5±2.4	23.3±4.9
Infant's birth weight <2500 g — %	6.9±1.9	8.3±1.3

* Plus–minus values are means ±SD.

† There were 264 birth attendants and 2963 mothers in the intervention hospitals.

‡ There were 226 birth attendants and 2503 mothers in the control hospitals.

births, except for data on postpartum hemorrhage, which were missing for 3.7% of births in intervention hospitals and 1.0% of births in control hospitals.

The rate of prophylactic use of oxytocin increased from 2.1% to 83.6% in the intervention hospitals (median rate change, 77.2%) (Table 2) and from 2.6% to 12.3% in the control hospitals (median rate change, 9.8%). The size of the intervention effect, measured as the difference between the rate changes in the intervention and control groups, was 67.5% (95% confidence interval [CI], 38.9 to 87.1; $P=0.01$). Nine of the 10 intervention hospitals increased their rate of prophylactic use of oxytocin by more than 50% (Fig. 2). Only one of the nine control hospitals had a large change in the rate of prophylactic use of oxytocin; this hospital had independently adopted the use of prophylactic oxytocin. The rate of use of other uterotonic drugs was lower than 1% in the intervention and control groups in both data-collection periods.

The intervention was associated with a decrease in the median episiotomy rate in intervention hospitals from 41.1% at baseline to 29.9% at the end of the intervention; the rate was stable in control hospitals. The difference in rate change was -10.9% (95% CI, -16.1 to -5.8 ; $P<0.001$). The absolute changes in rates at each individual hospital are shown in Figure 2. The effect on episiotomy rates was slightly larger in primiparous women than in multiparous women (Table 2).

The intervention was associated with a statistically significant reduction in all postpartum hemorrhage indicators — the rate of postpartum hemorrhage of 500 ml or more, the rate of postpartum hemorrhage of 1000 ml or more, and the mean amount of postpartum blood loss (Table 3). There was no evidence of an effect on other secondary outcome measures, although the study was not powered to exclude potentially important but rare clinical effects (Table 3).

Readiness to change was measured after the end of the intervention in 617 birth attendants (324 in the intervention hospitals and 293 in the control hospitals); 90.5% of attendants in the intervention hospitals and 82.1% of attendants in the control hospitals responded to the questionnaire. Data were missing in 5.3% of the questionnaires from intervention hospitals and 2.1% of those from control hospitals. The intervention was associated with a statistically significant increase in the proportion of birth attendants in the “action” or “maintenance” stage for performing active management of the third stage of labor. In the intervention hospitals, the median rate of readiness to change increased from 14.4% to 55.9%, whereas the rates in the control hospitals remained stable. The absolute difference between the rate changes in the two groups was 38.4% (95% CI, 19.6 to 56.9; $P<0.001$). The increase in the stage of readiness to change was statistically significant for selective episiotomy: the median rates increased from 11.9% to 70.7% in the

Table 2. Effects of Behavioral Intervention on the Rates of Prophylactic Use of Oxytocin during the Third Stage of Labor and of Episiotomy.

Outcome	Intervention Hospitals (N=10)			Control Hospitals (N=9)			Intervention Effect	
	Median Baseline Rate (N=2963)	Median Post-intervention Rate (N=2587)	Median Rate Change*	Median Baseline Rate (N=2503)	Median Post-intervention Rate (N=2366)	Median Rate Change*	Absolute Difference in Median Rate Change (95% CI)†	P Value‡
	%			%				
Prophylactic oxytocin	2.1	83.6	77.2	2.6	12.3	9.8	67.5 (38.9 to 87.1)	0.01
Episiotomy	41.1	29.9	-12.7	43.5	44.5	-1.9	-10.9 (-16.1 to -5.8)	<0.001
Episiotomy in primiparous women	84.8	66.5	-21.2	84.1	84.6	-0.8	-20.4 (-28.9 to -3.3)	0.02
Episiotomy in multiparous women	18.4	12.4	-6.8	16.2	19.3	-1.2	-5.7 (-15.1 to -0.8)	0.01

* The median rate change is the median of the differences between the postintervention rate and the baseline rate for each hospital. (It is not the difference between the median postintervention and the median baseline rates.)

† The absolute difference in median rate change is the difference between the median rate change in the intervention hospitals and the median rate change in the control hospitals. Small discrepancies in the differences are due to rounding.

‡ P values were calculated with the use of the exact Wilcoxon rank-sum test.

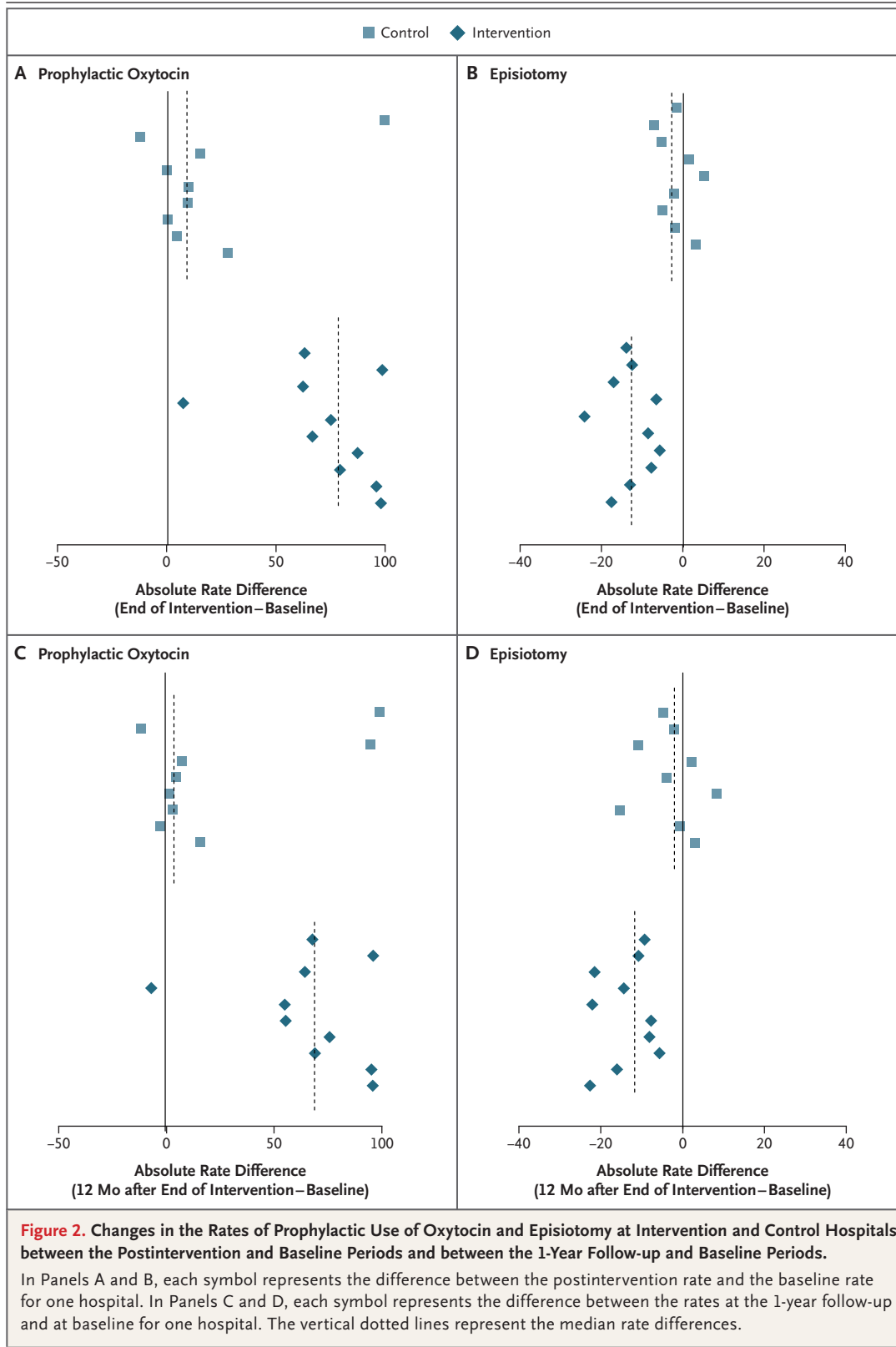


Table 3. Effect of Behavioral Intervention on Secondary Maternal and Perinatal Outcomes.

Outcome	Intervention Hospitals (N=10)			Control Hospitals (N=9)			Intervention Effect	
	Median Baseline Rate (N=2963)	Median Post-intervention Rate (N=2587)	Median Rate Ratio*	Median Baseline Rate (N=2503)	Median Post-intervention Rate (N=2366)	Median Rate Ratio*	Ratio of Median Rate Ratios (95% CI)†	P Value‡
Postpartum hemorrhage ≥500 ml (%)	18.6	6.9	0.31	9.8	8.1	0.55	0.55 (0.29 to 0.91)	0.03
Postpartum hemorrhage ≥1000 ml (%)	3.0	0.8	0.26	1.5	0.6	0.88	0.30 (0.22 to 0.84)	0.007
Postpartum blood loss (ml)	274.2	167.8	-121.5	211.9	215.3	0.4	-121.9 (-151.1 to -52.3)	<0.001
Manual extraction of placenta (%)	1.0	1.4	1.10	0.5	0.6	0.97	1.11 (0.47 to 5.98)	0.36
Perineal sutures (%)	54.6	48.6	0.88	55.2	55.9	0.97	0.91 (0.79 to 1.02)	0.08
Perineal tears (%)§								
2nd degree (tears and episiotomies)	44.2	33.3	0.77	45.3	46.4	0.97	0.80 (0.69 to 0.98)	0.03
3rd or 4th degree	0.5	0.5	1.14	0.4	0.5	1.11	1.04 (0.70 to 1.81)	0.60
Stillbirths (%)	0.8	0.7	1.04	0.7	0.6	0.88	1.19 (0.44 to 2.26)	0.78
5-min Apgar score <4 (%)	1.1	1.0	0.90	1.5	0.8	0.49	1.86 (0.53 to 2.54)	0.25
Neonatal death (%)	1.3	1.1	0.61	2.0	0.9	0.55	1.09 (0.55 to 2.55)	0.78
Maternal admission to the intensive care unit (no.)	3	3		1	3			
Maternal death (no.)	1	1		1	1			

* The median rate ratio is the median of the ratios of postintervention rate to baseline rate for each hospital. The values for postpartum blood loss are the differences between postintervention loss and baseline loss in milliliters.

† This value is the ratio of the median rate ratio in the intervention group to that in the control group. The value for postpartum blood loss is the difference between blood loss in the intervention group and in the control group in milliliters.

‡ P values were calculated with the use of the exact Wilcoxon rank-sum test.

§ Second-degree tears involve the perineal muscles; third-degree tears partially or completely disrupt the anal sphincter; and fourth-degree tears completely disrupt the external and internal anal sphincter and epithelium.

intervention hospitals and from 14.3% to 23.1% in the control hospitals, which represents an absolute difference of 34.5% between the rate changes (95% CI, 27.2 to 58.0; $P<0.001$).

During the 1-year follow-up period, data on the primary outcome were collected for 2114 vaginal births in the intervention hospitals and 2185 in the control hospitals. Data were missing for less than 0.2% of births. The median rate of prophylactic use of oxytocin remained high in the intervention hospitals and low in the control hospitals (73.3% and 7.1%, respectively) (Fig. 3). The absolute difference in rate change as compared with the baseline period was 63.9% (95% CI, -3.8 to 80.0; $P=0.08$). As in the postintervention period, 9 of the 10 intervention hospitals continued to use prophylactic oxytocin at a rate more than 50% higher than that at baseline. Only two control hospitals increased the rate of prophylactic

use of oxytocin over the rate at baseline (Fig. 2). A similar pattern was observed in the use of episiotomy: the median episiotomy rate at intervention hospitals remained low and the rate at control hospitals remained high (28.1% and 45.1%, respectively); the absolute difference in rate change was -8.7% (95% CI, -18.1 to -4.3; $P=0.004$) (Fig. 3). The absolute rate changes for hospitals are shown in Figure 2. The results of the restricted randomization test were equivalent to the results of the Wilcoxon rank test (data not shown) for all outcomes except for prophylactic oxytocin use at follow-up ($P=0.02$).

DISCUSSION

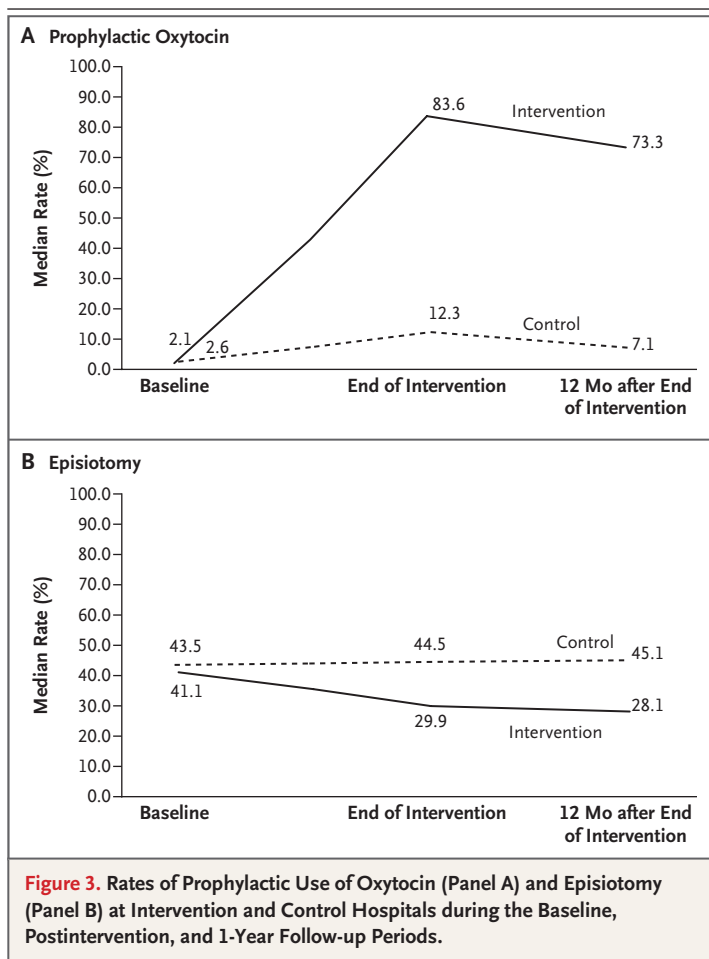
This randomized trial, conducted in Latin America, showed that a behavioral intervention can change health care practice. Our multifaceted in-

tervention increased the adoption of evidence-based clinical-management guidelines and changed birth attendants' attitudes regarding active management of the third stage of labor and the use of episiotomy. Not only did the intervention result in an absolute increase of 68% in the prophylactic use of oxytocin during the third stage of labor and an absolute reduction of 11% in the use of episiotomy, but also these practices remained stable at the 1-year follow-up. The intervention also was associated with 45% and 70% relative reductions in the rates of mild and severe postpartum hemorrhage, respectively. Our results suggest that for every 1000 vaginal deliveries in which the intervention was applied, prophylactic oxytocin would be used in 675 more deliveries than in similar hospitals without intervention activities, which would prevent 100 mild and 13 severe postpartum hemorrhages and avert 109 episiotomies, as compared with routine practice in similar hospitals.

The trial has several strengths. We used a rigorous experimental design and achieved similar groups by using balanced randomization. Careful monitoring of patient data resulted in minimal missing data. The statistical inferences are strong and were obtained with the use of statistical methods currently recommended for cluster-trial analysis.³⁵ The selected intervention strategies used the conceptual framework of diffusion theory,²³⁻²⁵ were documented as effective in changing behavior,¹⁴ and were tailored according to formative research.³ Finally, the significant effect on readiness to change suggests that the intervention changed providers' attitudes and intentions instead of simply exerting an effect by a hierarchical directive.

We did not assess the effects of controlled traction on the umbilical cord and uterine massage (the other components of active management of the third stage of labor) because we could not measure these procedures reliably; however, prophylactic use of oxytocin is the only component of active management of the third stage of labor that is evidence-based.⁴⁰ Recommendations for controlled cord traction and uterine massage are based on expert opinion.⁴¹

The intervention significantly increased the prophylactic use of oxytocin during the third stage of labor and moderately decreased the use of episiotomy, a common practice that is associated with substantial complications. This result



suggests that adoption of a new practice (the prophylactic use of oxytocin) may be easier than elimination of a common practice (episiotomy).

For both practices, the effect sizes at follow-up 1 year after the end of the intervention were similar to those observed at the end of the intervention, but the effect on prophylactic use of oxytocin did not reach statistical significance. The decrease in episiotomy use remained stable, a result suggesting that the observed moderate reduction may be sustainable over time.

The results also highlight the effectiveness of active versus passive dissemination of information in changing the behavior of birth attendants. A recent cluster-randomized trial in Mexico and Thailand¹⁸ found no change in the practices of birth attendants after they were given access to the WHO Reproductive Health Library. We agree with the conclusion expressed by the authors

and in the accompanying editorial that access to knowledge alone is not sufficient to change health providers' behavior.^{18,42}

During the follow-up period, control hospitals were offered the intervention (without coordinated support) at the discretion of the hospital authorities; however, most of the components were not implemented, and the rate of prophylactic use of oxytocin and the rate of episiotomy at control hospitals remained unchanged at follow-up. These observations suggest that implementation of a behavioral-change intervention is enhanced by active dissemination by means of a program that provides coordinated support to the hospitals.

Our findings are consistent with those of several other trials in developed and developing countries that have tested multifaceted interventions.^{14,15} In the trial by Leviton et al. aiming to increase the use of antenatal corticosteroids in preterm labor,⁴³ local opinion leaders, grand rounds, chart reminders, group discussions, audit, and feedback were effective in changing birth attendants' behavior. Our results and those of Leviton et al. suggest that an intense, multifaceted

program is necessary to achieve substantial change in obstetrical practices.

The trial results are likely to be readily transferable to public hospitals in Latin America and in the United States and other developed countries on the basis of their similarity to the results of Leviton et al.⁴³ Further research is needed to assess the intervention's cost-effectiveness and its generalizability to other geographic areas and cultures as well as to other types of clinical practice. In addition, further research could determine whether this intervention could be simplified without decreasing its effect.

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APPENDIX

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REFERENCES

- Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet* 2003;362:1225-30.
- International Confederation of Midwives, International Federation of Gynecologists and Obstetricians. Joint statement: management of the third stage of labour to prevent post-partum haemorrhage. *J Midwifery Womens Health* 2004; 49:76-7.
- Belizán M, Meier A, Althabe F, et al. Facilitators and barriers to adoption of evidence-based perinatal care in Latin American hospitals: a qualitative study. *Health Educ Res* 2007;22:839-53.
- Fenton JJ, Baumeister LM, Fogarty J. Active management of the third stage of labor among American Indian women. *Fam Med* 2005;37:410-4.
- Phillips CA, Kinch RA. Management of the third stage of labor: a survey of practice among Texas obstetricians. *Tex Med* 1994;90:44-7.
- Colomar M, Belizán M, Cafferata ML, et al. Practices of maternal and perinatal care performed in public hospitals of Uruguay. *Ginecol Obstet Mex* 2004;72:455-65. (In Spanish.)
- Festini MR, Lumbiganon P, Tolosa JE, et al. International survey on variations in practice of the management of the third stage of labour. *Bull World Health Organ* 2003;81:286-91.
- Kozak LJ, Owings MF, Hall MJ. National Hospital Discharge Survey: 2002 annual summary with detailed diagnosis and procedure data. Vital and health statistics. Series 13. No. 158. Hyattsville, MD: National Center for Health Statistics, March 2005. (DHHS publication no. (PHS) 2005-1729.)
- Althabe F, Belizán JM, Bergel E. Episiotomy rates in primiparous women in Latin-America: hospital based descriptive study. *BMJ* 2002;324:945-6.
- Prendiville WJ, Elbourne D, McDonald S. Active versus expectant management in the third stage of labour. *Cochrane Database Syst Rev* 2000;3:CD000007.
- Carrolli G, Belizan J. Episiotomy for vaginal birth. *Cochrane Database Syst Rev* 2000;2:CD000081.
- Hartmann K, Viswanathan M, Palmieri R, Gartlehner G, Thorp J Jr, Lohr KN. Outcomes of routine episiotomy: a systematic review. *JAMA* 2005;293:2141-8.
- American College of Obstetricians-Gynecologists. Episiotomy: clinical management guidelines for obstetrician-gynecologists. ACOG practice bulletin. Number 71, April 2006. *Obstet Gynecol* 2006;107: 957-62.
- Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technol Assess* 2004;8:1-72.
- Chaillet N, Dubé E, Dugas M, et al. Evidence-based strategies for implementing guidelines in obstetrics: a systematic review. *Obstet Gynecol* 2006;108:1234-45.
- Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MA. Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. *BMJ* 1998;317:465-8.
- Lomas J. Making clinical policy explicit: legislative policy making and lessons for developing practice guidelines. *Int J Technol Assess Health Care* 1993;9:11-25.
- Gülmezoglu AM, Langer A, Piaggio G, Lumbiganon P, Villar J, Grimshaw J. Cluster randomised trial of an active, multifaceted educational intervention based on the WHO Reproductive Health Library to improve obstetric practices. *BJOG* 2007; 114:16-23.
- Althabe F, Buekens P, Bergel E, et al. A cluster randomized controlled trial of a behavioral intervention to facilitate the development and implementation of clinical practice guidelines in Latin American maternity hospitals: the Guidelines Trial: study protocol (ISRCTN82417627). *BMC Womens Health* 2005;5:4.
- Grimshaw J, Campbell M, Eccles M, Steen N. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Fam Pract* 2000; 17:S11-S16.
- Raab G, Butcher I. Balance in cluster randomized trials. *Stat Med* 2001;20:351-65.
- Department of Reproductive Health and Research, UNDP/UNFPA/WHO/World Bank Special Programme of Research, Development and Research Training in Human Reproduction. The WHO Reproductive Health Library. No. 5. Geneva: World Health Organization, 2002.
- Prochaska JO, Velicer WF, Rossi JS, et al. Stages of change and decisional balance for 12 problem behaviors. *Health Psychol* 1994;13:39-46.
- Rogers EM. Diffusion of innovations. 3rd ed. New York: Free Press, 1983.
- Beyer JM, Trice HM. Implementing change: alcoholism policies in work organizations. New York: Free Press, 1978.
- Hiss RG, MacDonald R, Davis WK. Identification of physician educational influences in small community hospital. In: Proceedings of the 17th Annual Conference on Research in Medical Education. Washington, DC: Association of American Medical Colleges, 1978:283-8.
- Guyatt GH, Rennie D. Users' guides to the medical literature. *JAMA* 1993; 270:2096-7.
- Committee to Advise the Public Health Service on Clinical Practice Guidelines, Institute of Medicine. Clinical practice guidelines: directions for a new program. Washington, DC: National Academy Press, 1990:38.
- Miller WR, Rollnick S. Motivational interviewing: preparing people for change. New York: Guilford Press, 2002.
- Sullivan RL, Magarick R, Berghold G, Blouse A, McIntosh N. Clinical training skills for reproductive health professionals. 2nd ed. Baltimore: Jhpiego, 1998.
- BMJ Publishing Group. Evidencia clínica 3. Bogota, Colombia: Legis S.A., 2004 (computer disk).
- Campbell MJ, Gardner MJ. Medians and their differences. In: Altman DG, Machin D, Bryant TN, Gardner MJ, eds. Statistics with confidence. 2nd ed. London: BMJ Books, 2000:36-44.
- Hothorn T. On exact rank tests in R. *R News*. Vol. 1/1. January 2001:11-2. (Vienna: R Project for Statistical Computing.) (Accessed April 7, 2008, at http://cran.r-project.org/doc/Rnews/Rnews_2001-1.pdf.)
- Murray DM. The design and analysis

- of group randomized trials. Oxford, England: Oxford University Press, 1998.
35. Raab GM, Butcher I. Randomization inference for balanced cluster-randomized trials. *Clin Trials* 2005;2:130-40.
36. Oliphant TE. Guide to NumPy. ebook. Tregol Publishing, 2006. (Accessed April 7, 2008, at <http://www.tramy.us/>.)
37. R Development Core Team. R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing, 2005. (Accessed April 7, 2008, at <http://www.R-project.org/>)
38. Hutton JL. Are distinctive ethical principles required for cluster randomized controlled trials? *Stat Med* 2001;20:473-88.
39. Edwards SJ, Braunholtz DA, Lilford RJ, Stevens AJ. Ethical issues in the design and conduct of cluster randomised controlled trials. *BMJ* 1999;318:1407-9.
40. Elbourne DR, Prendiville WJ, Carroli G, Wood J, McDonald S. Prophylactic use of oxytocin in the third stage of labour. *Cochrane Database Syst Rev* 2001;4:CD001808.
41. Althabe F, Bergel E, Buekens P, Sosa C, Belizan JM. Controlled cord traction in the third stage of labor: systematic review. *Int J Gynaecol Obstet* 2006;94:Suppl 2:S126-S127.
42. Thorp J. O', evidence-based medicine — where is your effectiveness? *BJOG* 2007; 114:1-2.
43. Leviton LC, Goldenberg RL, Baker CS, et al. Methods to encourage the use of antenatal corticosteroid therapy for fetal maturation: a randomized controlled trial. *JAMA* 1999;281:46-52.

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