Active management of the third stage of labor consists of physical and pharmacologic maneuvers to facilitate placental delivery and minimize maternal blood loss. It typically includes early umbilical cord clamping and cutting, controlled cord traction, and administration of a prophylactic uterotonic agent (eg, oxytocin) following the delivery of the infant. Active management differs from expectant management, in which the provider employs a “hands-off” approach, and from common practice in the United States of administering the prophylactic oxytocin only after spontaneous placental delivery. Randomized clinical trials suggest that active management of the third stage of labor reduces maternal blood loss without increasing risk of retained placenta. Moreover, few studies have evaluated the effectiveness of active management in rural hospitals, where delivery is more likely to be performed by family physicians rather than obstetrical specialists. To our knowledge, no studies of active management have been performed among American Indian populations.

In 1999, at a rural hospital serving Southwestern American Indians, medical and nursing staffs approved an evidence-based practice protocol for active management of the third stage of labor. We sought to compare measures of maternal blood loss among American Indian women who did and did not receive active management. We hypothesized that active management would be associated with reduced maternal blood loss without increased risk of retained placenta.

From the Department of Family Medicine, University of Washington (Dr Fenton); Burien Medical Center, Group Health Cooperative, Seattle (Dr Baumeister); and Crownpoint Healthcare Facility, Crownpoint, NM (Dr Fogarty).
Methods
Design, Setting, and Subjects
The study had a retrospective cohort design, with women classified by receipt of active versus routine management of the third stage of labor. The primary outcomes were (1) 3 g/dl postpartum hemoglobin decline, selected because it is consistent with an American College of Obstetricians and Gynecologists’ definition of a postpartum hemorrhage as a decline in hematocrit of 10% or greater and (2) estimated blood loss of 500 ml or greater. Secondary outcomes were selected for comparison to outcomes in randomized trials and included postpartum hemoglobin decline, estimated blood loss, postpartum hemoglobin <9 g/dl, postpartum blood transfusion, and retained placenta requiring manual extraction.

Located on tribal land, the hospital serves approximately 25,000 American Indians living within a catchment area of 7,500 square miles. Permission for this study was granted by the Tribal Research Review Board and Human Subjects Committee.

Twelve board-certified family physicians attend about 100 low-risk deliveries at the hospital annually and provide prenatal services at a hospital-based clinic and two outlying rural health posts. The hospital does not provide labor augmentation with oxytocin or other services requiring specialty anesthesia services (ie, cesarean delivery or epidural anesthesia). Pregnant women judged to be at high risk for maternal or fetal complications were transferred prior to delivery whenever possible. We included in this evaluation all American Indian women having singleton vaginal births at the hospital in 2000–2001 during the 2-year period following approval of the aforementioned practice protocol in 1999 (n=175).

Management Protocols
During two staff meetings in 1999, one of the authors presented the results of clinical trials and a Cochrane Review supporting active management of the third stage. The specific methods of active management were presented in detail, including early cord clamping and cutting, early oxytocin administration, and controlled cord traction. Consistent with its bylaws, the staff formally approved active management as a practice option. The previous practice protocol, which specified routine prophylactic administration of oxytocin following placental delivery, was retained because staff members differed in their preferred management. Five of twelve staff members predominantly used active rather than routine management during the study period.

In active management, nurses gave 10 units of oxytocin as soon as possible after the delivery of the infant's anterior shoulder. For intravenous administration, nurses diluted the oxytocin in 100 ml of saline and administered the solution as rapidly as possible. When an intravenous catheter was unavailable, oxytocin was given intramuscularly.

Patients not receiving active management of the third stage received 20–40 units of oxytocin diluted in one liter of saline intravenously over 1–2 hours after placental delivery. All staff physicians routinely clamped and cut the umbilical cord following the infant delivery.

Data Sources and Collection
We retrospectively collected birth data for the 175 singleton live births that occurred in 2000–2001 from the labor and delivery birth log and patients’ hospital charts. We collected data on maternal age, gestational age, parity, length of labor, infant birth weight, preeclampsia, estimated blood loss, active management of the third stage, and complications of the third stage, including laceration repair, retained placenta, and blood transfusions. We also collected the hemoglobin values at the time of admission and on the morning following delivery. If a woman delivered in the early morning hours, we collected the postpartum hemoglobin from the morning of the following day (greater than 24 hours after the time of birth). For patients who had hemoglobin measured at the time of admission and postpartum, we calculated the decrease in hemoglobin associated with delivery. We classified patients as “actively managed” if they received oxytocin by any route prior to placental delivery.

Data Analyses
We used descriptive statistics to compare baseline characteristics of subjects by management of the third stage. We compared measures of blood loss and third-stage outcomes among women receiving active and routine management using t tests, chi-square tests, or Fisher’s Exact Test. We used logistic regression to estimate the odds of a 3 g/dl or greater postpartum hemoglobin decline among women who received active management compared to women who received routine management. We adjusted for potentially confounding factors by simultaneously including in the model variables for preeclampsia, laceration repair, manual placental extraction, and advanced maternal age (≥35 years). In separate models that included only variables for infant birthweight of ≥4,000 grams and receipt of active management, the odds ratio (OR) and confidence interval (CI) for active management were unaffected, so infant birthweight was not included in the final model. Because hemoglobin measurements were missing for 23 women who received routine management and four women who received active management, we used multiple imputation to correct ORs and CIs for possible bias related to missing hemoglobin measurements.

Hypothesis tests were two sided, with a level of significance of 0.05. Statistical analyses were performed with STATA® (College Station, Tex).
Results
There were 175 singleton vaginal deliveries in 2000–2001. The women had a mean age of approximately 25 years, most were multiparous, and they had a low prevalence of preeclampsia (Table 1). The providers actively managed the third stage in 62 women (35%). Women who received active and routine management were similar with regard to age, parity, gestational age, admission hemoglobin, and other baseline characteristics. Preeclampsia, laceration repairs, and fetal macrosomia were slightly more common in women who received routine management compared to women who received active management.

Women who received active management had less maternal blood loss across several measures (Table 2). Active management was associated with significantly lower incidence of 3 g/dl postpartum hemoglobin decline (P<.001) and postpartum hemoglobin of 9 g/dl (P=.05). Women who received active management had a significantly lower mean postpartum decline in hemoglobin compared to women who received routine management (P=.001). Smaller proportions of women receiving active management had estimated blood losses greater than 500 ml or 1,000 ml, though these comparisons did not reach statistical significance. The incidence of postpartum blood transfusion and retained placenta requiring manual removal were not significantly different among women who did and did not receive active management.

Compared to women who received routine management, the crude odds of a ≥3 g/dl postpartum hemoglobin decline among women receiving active management was 0.14 (95% CI: 0.03, 0.57). The OR was similar after adjustment for preeclampsia, laceration repair, manual placental extraction, and maternal age (adjusted OR: 0.13 [95% CI: 0.03, 0.60]).

Discussion
Among a rural American Indian population, women who received active management of the third stage had reduced maternal blood loss, compared with women who received more conservative management with prophylactic oxytocin following placental delivery. Reduced blood loss in the active management group was not explained by greater frequency of laceration repair, manual placental extraction, advanced maternal age, or preeclampsia in the routinely managed cohort. Active management was not associated with increased frequency of retained placenta, although our study had limited power to detect a difference in rates of retained placenta in the two groups. Our experience nevertheless suggests that active management in a rural US family practice can achieve outcomes similar to randomized clinical trials in larger maternity hospitals.2-6

It is difficult to compare our results to those of most clinical trials of active management of the third stage, because control subjects in most trials did not receive routine prophylactic oxytocin.2-5 The two management protocols used at our hospital, however, were similar to the interventions in the Abu Dhabi trial, in which active management was also associated with reduced maternal blood loss compared to a protocol of diluted oxytocin given after spontaneous placental delivery.6

Table 1
Baseline Characteristics of Subjects and Risk Factors for Maternal Hemorrhage by Third-stage Management (n=175)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Active Management (n=62)</th>
<th>Routine Management (n=113)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean years (SD)</td>
<td>25.6 (6.1)</td>
<td>25.1 (5.9)</td>
<td>.60</td>
</tr>
<tr>
<td>≥35 years, n (%)</td>
<td>5 (8.1)</td>
<td>11 (9.7)</td>
<td>.71</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>2.1 (1.6)</td>
<td>1.9 (1.8)</td>
<td>.38</td>
</tr>
<tr>
<td>≥1, n (%)</td>
<td>53 (85.5)</td>
<td>86 (76.1)</td>
<td>.14</td>
</tr>
<tr>
<td>≥4, n (%)</td>
<td>11 (17.7)</td>
<td>19 (16.8)</td>
<td>.88</td>
</tr>
<tr>
<td>Gestational age, weeks, mean (SD)*</td>
<td>39.2 (1.6)</td>
<td>39.3 (1.2)</td>
<td>.55</td>
</tr>
<tr>
<td>Preeclampsia, n (%)</td>
<td>1 (1.6)</td>
<td>4 (3.5)</td>
<td>.66</td>
</tr>
<tr>
<td>Admission hemoglobin, g/dl, mean (SD)#</td>
<td>12.0 (1.6)</td>
<td>12.2 (1.4)</td>
<td>.47</td>
</tr>
<tr>
<td>First-stage duration, hours, mean (SD)</td>
<td>6.7 (5.2)</td>
<td>6.8 (4.4)</td>
<td>.92</td>
</tr>
<tr>
<td>Second-stage duration, minutes, mean (SD)</td>
<td>24.9 (68.0)</td>
<td>20.3 (29.1)</td>
<td>.61</td>
</tr>
<tr>
<td>Infant birth weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean grams (SD)</td>
<td>3,260 (340)</td>
<td>3,280 (396)</td>
<td>.73</td>
</tr>
<tr>
<td>≥4 kg, n (%)</td>
<td>2 (3.2)</td>
<td>8 (7.1)</td>
<td>.50</td>
</tr>
<tr>
<td>Laceration repair, n (%)</td>
<td>25 (40)</td>
<td>54 (48)</td>
<td>.34</td>
</tr>
</tbody>
</table>

* Data missing for one woman receiving early oxytocin and seven women receiving routine management.
# Admission hemoglobin was missing for four women receiving early oxytocin and 20 women receiving routine management.

Data missing for two women receiving routine management.
Our study was not designed to determine which components of active management are responsible for its efficacy in reducing maternal blood loss. A recent randomized trial, however, suggests that the timing of oxytocin administration alone may not be critical so long as an adequate dose is given relatively soon after infant delivery.\textsuperscript{12} All women in the trial received controlled cord traction and an intravenous bolus of 20 units of oxytocin diluted in 500 ml of saline at either the beginning or end of the third stage, which had a mean duration of only 8 minutes. Measures of blood loss and rates of postpartum hemorrhage were similar in both trial arms. In our study, subjects who received oxytocin after placental delivery received a gradual infusion of a more-diluted solution after a longer mean third stage. Together, these data suggest that the precise timing of oxytocin administration may be unimportant so long as an adequate dose is delivered quickly within several minutes of infant delivery. Moreover, controlled cord traction may be essential to the efficacy of active management.

Our study suggests that a small, rural medical staff can successfully translate evidence into practice and improve targeted clinical outcomes. Following an evidence-based literature review, nearly half of staff members used active management preferentially over the following 2 years, and nursing staff rapidly grew accustomed to implementing active management. We presented preliminary results of this study to the medical and nursing staff in June 2002. Today, active management is performed on nearly all deliveries at the study hospital (Eric Unzicker, MD, written communication, October 22, 2004).

## Limitations

Our study has several limitations and should be interpreted cautiously. First, its nonrandomized design cannot exclude unmeasured confounding that could have biased our results in favor of active management. Comparison of subject characteristics, however, suggests that the two study groups were similar with regard to several risk factors for postpartum hemorrhage, including maternal age, parity, preeclampsia, anemia, birth weight, and first- and second-stage durations.\textsuperscript{13} In addition, a strong association remained between active management and reduced maternal blood loss after adjustment for potential confounding factors and multiple imputation of missing hemoglobin measurements. Although the treatment groups differed in the provider groups who managed the third stage, the physicians who did and did not adopt active management had similar professional credentials and obstetrical experience. We doubt that

### Table 2

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Active Management (n=62)</th>
<th>Routine Management (n=113)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third-stage duration, minutes</td>
<td>12.7 (12.5)</td>
<td>12.7 (17.5)</td>
<td>.99</td>
</tr>
<tr>
<td>Postpartum hemoglobin, g/dl\textsuperscript{1}</td>
<td>10.3 (1.4)</td>
<td>10.1 (1.7)</td>
<td>.30</td>
</tr>
<tr>
<td>Postpartum decrease in hemoglobin, g/dl\textsuperscript{2}</td>
<td>1.7 (0.9)</td>
<td>2.2 (1.1)</td>
<td>.001</td>
</tr>
<tr>
<td>Estimated blood loss, ml</td>
<td>355 (170)</td>
<td>430 (245)</td>
<td>.02</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Data missing for one woman receiving active management and three women receiving routine management.

\textsuperscript{2} Unable to calculate for four women receiving active management and 23 women receiving routine management because of missing prepartum or postpartum hemoglobin measurements.
the degree of bias introduced by the observational study design is sufficient to account for the entirety of the observed effect of active management on the odds of a 3 g/dl or greater postpartum hemoglobin decline.

Second, retrospective data collection may be prone to misclassification and precluded direct or standardized measures of maternal blood loss. Although hemoglobin measurements may imperfectly reflect the true volume of blood lost during delivery, we believe the postpartum hemoglobin decline was the most objective measure of postpartum blood loss available, particularly in light of the inaccuracy of physicians’ estimates of maternal blood loss.14,15 Although we could not reliably ascertain use of cord traction from chart abstraction, the treatment groups likely differed substantially in their exposure to controlled cord traction because medical staff had been informed that controlled cord traction is an integral element of active management, while many training programs and obstetrical textbooks discourage cord traction in the routine management of the third stage prior to spontaneous placental separation.16

A third limitation is that the individuals who abstracted data from the medical records each practiced active management and were not blinded to whether the patients received active or standard management. While the information obtained from the medical records was largely objective numerical data (eg, hemoglobin levels, birth weights, etc) or dichotomous outcomes (transfusion requirements, yes or no) that were not subject to interpretation, the possibility of unintentional bias in data abstraction cannot be excluded.

Conclusions

We believe this is the first report of the effectiveness of active management of the third stage of labor among American Indian women or in a rural hospital setting in the United States. Our results suggest that active management of the third stage of labor is as safe and effective among rural American Indian women as it has been among women in other clinical trials. Because severe postpartum hemorrhage may be associated with poorer outcomes in rural facilities that lack operative capabilities, clinicians serving rural American Indian populations should consider the use of active management of the third stage of labor as a means of preventing postpartum hemorrhage.

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Dr Fenton was a Robert Wood Johnson Clinical Scholar during the later phases of this project. The statements herein are those of the authors and not necessarily those of the Robert Wood Johnson Foundation.

The authors presented preliminary results of this study at the Annual Midwinter Conference for Indian Health Providers on Women’s and Children’s Healthcare, Telluride, Colo, February 1, 2004.

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