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Original Research

Timing and Outcomes of an Indication-Only Use of Intravenous Cannulation During Spontaneous Labor

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Introduction: In the United States, most women presenting in spontaneous labor undergo intravenous (IV) cannulation on admission to hospital labor and birth units. There is limited evidence for this routine practice in pregnant women at low risk for adverse outcomes during labor or birth.

Methods: A retrospective, exploratory, descriptive study of an indication-only practice of IV cannulation on admission for women presenting in spontaneous labor and cared for by a nurse-midwife service was performed. Descriptive data included the timing of IV cannula placement (admission, during labor or postpartum period, or not at all) and indications for placement. Maternal outcomes of interest were estimated blood loss, postpartum hemorrhage rates, and management; neonatal outcome was 5-minute Apgar scores.

Results: Records for 1069 women cared for by nurse-midwives who presented in spontaneous labor were reviewed. In this cohort, 445 (41.6%) had IV access established on admission, 325 (30.4%) had an IV cannula placed during labor or postpartum, and 299 (28%) never had IV access during their hospital stay. For the 325 women with IV cannulas placed after admission, 25 (7.7%) were placed urgently for excessive postpartum bleeding. Further analysis of the subset of women who had a postpartum hemorrhage after vaginal birth (defined as >500 mL estimated blood loss) indicated that urgent IV cannulation was not associated with a lower mean postpartum hemoglobin or hematocrit or an increase in blood transfusion rate when compared with women who had an IV cannula placed earlier in their labor course.

Discussion: Indication-only IV cannulation for women experiencing an uncomplicated labor and birth is a reasonable practice in settings where IV access can be established urgently if needed.
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Keywords: spontaneous labor, intravenous access, IV cannulation, saline-lock, indication-only, postpartum hemorrhage

INTRODUCTION

Although the actual number of women who have an intravenous (IV) cannula placed during labor is unknown, 62% of women in the Listening to Mothers III survey reported receiving IV fluids during labor.[1] For low-risk women admitted in spontaneous labor, routine hospital admission orders often include placement of an IV cannula, irrespective of a clear need for IV access. Women considered to be at low risk are those who have an uncomplicated pregnancy with a single fetus in vertex presentation at term and have no a priori risk factors for complications during labor or birth.[2] It is unclear that routine placement of an IV cannula in a low-risk woman is beneficial or reduces risk for the woman or fetus.

IV cannulation, often referred to as a *saline-lock* (flushed with 10 mL of normal saline to prevent occlusion),[3] establishes IV access via a capped catheter. Because IV access has already been established, subsequent need for fluids and medications can be addressed more quickly in cases of emergent surgery, fetal distress, or maternal hemodynamic instability. The objective of this retrospective, descriptive analysis is to explore outcomes in a nurse-midwifery practice where IV cannulation in low-risk women presenting in active labor is done based on indication rather than as a routine practice.

Establishing IV access became routine during the mid-20th century as part of managing labor and birth as a surgical procedure. This management also included sedation (twilight sleep), routine episiotomy, and forceps use.[4] Women were instructed not to eat or drink to prevent risk of aspiration, and consequently IV fluids were routinely administered.[5] Since that time, many of these interventions are no longer common practice, yet routine IV cannulation continues to be standard practice in many hospital-based labor and birth units. The administration of IV fluids and restriction of oral nutrition and/or fluids is also common practice.[6] Although current postpartum hemorrhage (PPH) prevention guidelines do not include routine placement of IV cannulas for access,[7–9] an additional rationale for routine IV cannulation is the ability to institute rapid fluid resuscitation during PPH as well as for ease of oxytocin and other medication administration if needed. Several studies have examined the effect of different rates and types of IV fluids on the duration of labor and rates of cesarean birth[10,11]; however, the benefit of these guidelines for emergency care during childbirth has not been studied.

Although establishing IV access may be viewed as a benign intervention, the procedure does induce a risk of infection, superficial phlebitis, or thrombus.[12] Even with anesthetic use, IV cannula placement is painful.[13] Cost associated

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Quick Points

- Although placement of an intravenous (IV) cannula for women in labor is a common practice, there are limited data to support this as routine practice.
- Indication-only IV cannulation for women in spontaneous labor resulted in 28% of patients never requiring IV access during their admission.
- IV access established during labor and birth prior to a diagnosis of postpartum hemorrhage or excessive bleeding is not associated with decreased blood loss or with higher postpartum hematocrit and hemoglobin levels when compared with IV cannula placement at the time of the postpartum hemorrhage.

with each IV cannulation is estimated to be between $69 and $237.[14] Whether an indication-based approach versus routinely establishing IV access during labor is associated with delay of treatment or an increase in the incidence of adverse effects is unknown. Therefore, the purpose of this study was to explore timing of IV cannula placement and if an indication-only guideline for IV cannulation is associated with increased maternal blood loss or lower newborn Apgar scores. A retrospective, descriptive analysis of women presenting in spontaneous labor to a university hospital and cared for by nurse-midwives was performed. The primary outcome was to describe the timing and indication for IV cannula placement when an indication-only approach is used. Secondary outcomes included estimated blood loss, postpartum hemoglobin and hematocrit, and 5-minute Apgar scores.

METHODS

This was a retrospective, descriptive analysis of maternity care outcomes from a large Midwestern university hospital. The nurse-midwifery service has been collecting data for quality improvement and to assess outcomes of care for the last 35 years. The nurse-midwifery service is a collaborative practice model with independent midwifery care during the antepartum, intrapartum, and postpartum periods unless health complications necessitate consulting physician involvement. This nurse-midwifery service cares for approximately 700 women giving birth each year, with an overall 22% labor induction rate and 17% cesarean rate.[15]

From January 1, 2015, to December 31, 2016, data were reviewed from women admitted in spontaneous labor and receiving care with the nurse-midwifery service. Women included in the study presented in spontaneous labor, were established nurse-midwifery service patients; did not have medication-requiring gestational diabetes or hypertension; were at more than 34 weeks' gestation with a singleton, vertex fetus; and had reassuring fetal status at time of admission. Women presenting for induction of labor and women who presented in labor but were not a candidate for vaginal birth at time of admission (because of, eg, breech presentation, placenta previa, category III fetal heart rate pattern, evidence of placental abruption) were excluded from this analysis.

The nurse-midwifery service recommends IV cannulation at time of admission in labor only if there is an indication: for example, history of PPH or prior cesarean birth. Commonly, during labor, birth, and postpartum, IV access is recommended for concerning changes in maternal and/or fetal status. Some women decline placement of an IV cannula despite this recommendation, for example, when a woman has a previous cesarean birth or has excessive postpartum bleeding. In these situations, ongoing discussion, shared decision making, and risk assessment continue while respecting individual autonomy and choice. Woman presenting for care in the hospital labor and birth unit have a complete blood count and blood type and antibody screen collected routinely on admission. A repeat complete blood count is collected only if indicated, such as after a PPH or cesarean birth.

During the period of data collection at this facility, postpartum blood loss was visually estimated rather than quantified. An estimated blood loss of greater than 500 mL was defined as a PPH for vaginal births. During antenatal care, active management of the third stage of labor (AMTSL), with 10 units of oxytocin given intramuscularly for all women immediately after vaginal birth, is discussed. If a woman declines AMTSL, this decision is documented in the record and in the quality improvement database.

For this study, institutional review board approval was obtained with a waiver of informed consent. Then, a review of the quality improvement database was completed to identify low-risk women admitted in spontaneous labor, with a singleton pregnancy and vertex fetus, and at more than 34 weeks' gestation. Next, a focused chart review in the electronic health record was completed to document the timing and indication of IV cannula placement. Descriptive data obtained included age, number of pregnancies, number of births, body mass index, gestational age at onset of labor, mode of birth, and 5-minute Apgar score. Complete blood counts both at admission and subsequently were collected for women who experienced PPH after vaginal birth. Estimated blood loss was recorded.

Timing of IV cannula placement was divided into 3 groups: 1) IV cannula placement at the time of admission, 2) IV cannula placement later in labor or postpartum, and 3) no IV cannula placement during the intrapartum and postpartum periods. For all IV cannula placements, the indication was documented. Indications for urgent IV cannula placement were concerning immediate maternal or fetal status changes, including category III fetal heart rate pattern, active maternal bleeding, severe hypertension, and signs or symptoms of hemodynamic instability, including acute changes in maternal pulse, blood pressure, oxygen saturation,

Table 1. Demographic, Antenatal, and Labor Characteristics of Women Admitted in Spontaneous Labor (N = 1069)

Characteristic	Total	IV Cannula Placed on Admission	IV Cannula Placed Later	No IV Cannula Placed
Total, n (%)		445 (41.6)	325 (30.4)	299 (28.0)
Age, mean (range), y	30.3 (15-47)	30.6 (15-47)	29.3 (16-42)	30.7 (17-43)
Insurance, n (%)				
Private	835 (78.1)	348 (78.2)	244 (75.1)	243 (81.3)
Medicaid	222 (20.8)	94 (21.1)	76 (23.4)	52 (17.4)
None	12 (1.1)	3 (0.7)	5 (1.5)	4 (1.3)
Race or ethnicity, n (%)				
White	873 (81.7)	356 (80.0)	264 (81.2)	253 (84.6)
Black	106 (9.9)	51 (11.5)	31 (9.5)	24 (8.0)
Other	90 (8.4)	38 (8.5)	30 (9.2)	22 (7.4)
Parity, n (%)				
Nulliparous	398 (37.2)	147 (33.1)	164 (50.4)	87 (29.1)
Multiparous	671 (62.8)	298 (66.9)	161 (49.6)	212 (70.9)
GBS positive, n (%)				
Yes	287 (26.8)	270 (60.7)	4 (1.2)	13 (4.3)
No	736 (68.8)	157 (35.3)	309 (95.1)	270 (90.3)
Unknown	46 (4.3)	18 (4.0)	12 (3.7)	16 (5.4)
BMI, n (%)				
$\leq$29.9 kg/m^2	908 (85.1)	372 (83.8)	270 (83.1)	266 (89.3)
$\geq$30.0 kg/m^2	159 (14.9)	72 (16.2)	55 (16.9)	32 (10.7)
History of prior cesarean birth, n (%)				
Yes	107 (10.0)	66 (15.3)	26 (8.0)	13 (4.3)
No	962 (90.0)	377 (84.7)	299 (92.0)	286 (95.7)
EGA, mean (range), wk	40 (34-43)	40 (35-43)	40 (35-43)	40 (36-42)
Neuraxial analgesia, n (%)				
Yes	448 (41.9)	200 (44.9)	248 (76.3)	0 (0.0)
No	621 (58.1)	245 (55.1)	77 (23.7)	299 (100.0)
Fetal monitoring, n (%)				
Only IA	297 (27.8)	85 (19.1)	51 (17.2)	161 (53.8)
cEFM	772 (72.2)	360 (80.9)	274 (84.3)	138 (46.1)
Cesarean birth, n (%)				
Yes	80 (7.5)	49 (15.0)	31 (7)	0 (0.0)
No	989 (92.5)	395 (85)	294 (93)	299 (100)
5-min Apgar score <7, n (%)				
Yes	5 (0.5)	3 (0.6)	2 (0.6)	0 (0.0)
No	1064 (99.5)	442 (99.4)	323 (99.4)	299 (100)
AMTSL, n (%)[a]				
Yes	675 (71.4)	304 (77.2)	211 (81.2)	160 (54.8)
No	271 (28.6)	90 (22.8)	49 (18.8)	132 (45.2)
PPH, n (%)[b]				
Yes	108 (11.3)	37 (9.0)	56 (21.2)	15 (5.0)
No	881 (88.7)	376 (91.0)	221 (78.8)	284 (95.0)

Abbreviations: AMTSL, active management of the third stage of labor; BMI, body mass index; cEFM, continuous electronic fetal monitoring; EGA, estimated gestational age; GBS, group B streptococcus; IA, intermittent auscultation; IV, intravenous; PPH, postpartum hemorrhage.
[a]Total n = 946; missing data for 43 women, as well as cesarean births, were excluded.
[b]Total n = 989; cesarean births are excluded.

and syncope. The electronic health record was reviewed by 2 of the 3 authors to confirm the information for all of these indications.

Additionally, for all patients with a documented immediate PPH of 500 mL or more after vaginal birth, data on admission and postpartum hemoglobin and hematocrit, use of uterotonics, blood transfusion, and management of the PPH were collected for review. Data were analyzed in IBM SPSS version 24 with frequencies, mean, chi-square, Student's *t* test, and analysis of variance.

RESULTS

During the period between January 2015 and December 2016, 1069 women presented in spontaneous labor at or after 34 weeks' gestation with a singleton, vertex fetus (Table 1). The women were predominately privately insured (78.1%), white (81.7%), multiparous (62.8%), and with a body mass index less than 30 kg/m^2 (85.1%). Mean age was 30.3 years, and mean gestational age at the onset of labor was 40 weeks. Fewer than half (41.9%) of the women received neuraxial analgesia. Fetal monitoring with exclusive intermittent auscultation was used for 297 (27.8%) of the women. The cesarean birth rate for this cohort of low-risk women was 7.5%. Five newborns were assigned an Apgar score of less than 7 at 5 minutes of life (0.5%).

Of the 1069 women included in this analysis, 445 (41.6%) had IV cannulation at admission, 325 (30.4%) had IV cannulation later (either during labor or postpartum), and 299 (28%) never had IV access established. There were anticipated differences in labor management practices associated with required IV cannula placement such as need for group B streptococcus (GBS) prophylaxis or placement of neuraxial analgesia. Notably, women monitored only with intermittent auscultation were much less likely to have an IV cannula placed (161 of 297 [54.2%]) compared with women with who had continuous electronic fetal monitoring during their labor (138 of 772 [17%]).

For postpartum maternal outcomes, analysis was conducted using the subset of women who had a vaginal birth (n = 989). AMTSL with 10 units of oxytocin administered intramuscularly immediately after the birth is recommended for all patients at this institution regardless of IV access. However, 28.6% of women in the overall sample declined AMTSL, and a significantly higher number of women who never had IV access declined AMTSL when compared with women who had an IV cannula placed on admission or an IV cannula placed in labor (45.2% vs 22.8% and 18.8%, respectively; $P < .001$). PPH with estimated blood loss greater than or equal to 500 mL occurred in 108 women (11.3%) overall.

The timing and indications for IV cannula placement are presented in Table 2. The most common indications for IV cannula placement on admission were GBS colonization requiring antibiotic prophylaxis, trial of labor after cesarean, and presence of risk factors for PPH (which were defined as history of PPH, blood clotting disorder, or parity >4). For women who received IV cannulation during the labor process, the most common reasons were maternal request for neuraxial analgesia or IV pain medication. There were no urgent IV cannula placements during labor.

Table 2. Timing and Indication for Placement of Intravenous Access (n = 770)

Indication	Total (n = 770) n (%)	IV Cannula Placed on Admission (n = 445) n (%)	IV Cannula Placed Later During Labor or Postpartum (n = 325) n (%)
Admission			
GBS positive	279 (36.2)	274 (61.6)	5 (1.5)
TOLAC	41 (5.3)	40 (9.0)	1 (0.3)
PPH risk	19 (2.4)	19 (4.3)	0
No rationale documented	8 (1.0)	8 (1.8)	0
Other indication[a]	6 (0.7)	6 (1.3)	0
Intrapartum			
Neuraxial analgesia	303 (39.3)	67 (15.0)	236 (72.6)
Opioid pain relief	47 (6.1)	16 (3.6)	31 (9.5)
Hydration	9 (1.0)	5 (1.1)	4 (1.2)
Category II FHR	7 (0.9)	5 (1.1)	2 (0.6)
Augmentation	6 (0.8)	1 (0.2)	5 (1.5)
Preeclampsia	5 (0.6)	3 (0.7)	2 (0.6)
Unstable fetal presentation	2 (0.2)	1 (0.2)	1 (0.3)
Cesarean birth[b]	1 (0.1)	0	1 (0.3)
Fever	1 (0.1)	0	1 (0.3)
Postpartum			
Excessive bleeding	25 (3.2)	NA	25 (7.7)[c]
Laceration repair requiring neuraxial analgesia	5 (0.6)	NA	5 (1.5)
Retained placenta removal	2 (0.2)	NA	2 (0.6)
Syncope	2 (0.2)	NA	2 (0.6)[c]
Dizziness	1 (0.1)	NA	1 (0.3)
Nonspecific chest pressure	1 (0.1)	NA	1 (0.3)

Abbreviations: FHR, fetal heart rate; GBS, group B streptococcus; IV, intravenous; PPH, postpartum hemorrhage; TOLAC, trial of labor after cesarean; NA, not applicable.
[a]Laboring woman's request (n = 1), nausea management (n = 1), IV steroid administration (n = 1), maternal tachycardia (n = 1), maternal bradycardia (n = 1), known fetal anomalies (n = 2).
[b]After experiencing an arrest of descent during labor, an IV cannula was placed at time of decision to proceed with cesarean birth.
[c]Urgent IV cannula placement.

Table 3. Women with Postpartum Hemorrhage After Vaginal Birth (n = 108)

Results and Interventions	Total (n = 108)	IV Cannula Already Placed (n = 70)	Urgent IV Cannula Placed (n = 23)	Declined Urgent IV Cannula (n = 15)	*P* Value
Estimated blood loss, n (%)					
500-999 mL	76 (70.4)	50 (71.4)	12 (52.2)	14 (93.3)	
≥1000 mL	32 (29.6)	20 (28.6)	11 (47.8)	1 (6.7)	
Admission Hct, mean (SD)[a]	35.7 (3.4)	35.7 (3.7)	35.7 (3.3)	35.9 (1.5)	.99
Admission Hgb, mean (SD)[a]	12.2 (1.4)	12.2 (1.5)	12.2 (1.3)	12.2 (0.9)	.99
Postpartum Hct, mean (SD)[b]	29.1 (4.4)	28.8 (4.2)	28.7 (5.0)	31.7 (2.2)	.16
Postpartum Hgb, mean (SD)[b]	9.9 (1.7)	9.8 (1.6)	9.7 (1.9)	10.8 (1.0)	.17
Intervention, n (%)					
AMTSL	78 (72.2)	57 (81.4)	12 (52.2)	9 (60)	.01
Misoprostol	72 (66.7)	43 (61.4)	21 (91.3)	8 (53.3)	.02
Methergine	24 (22.2)	15 (21.4)	9 (39.1)	0 (0.0)	.02
IV oxytocin	20 (18.5)	14 (20)	6 (26.1)	0 (0)	.11
IM oxytocin	18 (16.7)	8 (11.4)	6 (26.1)	4 (26.7)	.14
Transfer to operating room	13 (12)	10 (14.3)	3 (13)	0 (0.0)	.30
Transfusion	7 (6.5)	6 (8.6)	1 (4.3)	0 (0.0)	.42
Dilation and curettage	4 (3.7)	2 (2.9)	2 (8.7)	0 (0.0)	.31

Abbreviations: AMTSL, active management of the third stage labor; Hct, hematocrit; Hgb, hemoglobin; IM, intramuscular; IV, intravenous.
[a]n = 94 because of missing data.
[b]n = 78 because of missing data.

During the postpartum period, 36 women had IV cannulas placed, and of those, 27 women required urgent placement. The postpartum urgent placements accounted for 8.3% of all IV cannula placements. Indications for urgent placement were excessive postpartum bleeding (25 women) and syncope unrelated to PPH (2 women).

Of the 108 women with a PPH after vaginal birth, 70 women already had an IV cannula placed, and 38 women did not have an IV cannula at the time the PPH was identified. Most women with a PPH had an estimated blood loss of 500 mL or more but less than 1000 mL; however, 32 (29.6%) had an estimated blood loss greater than or equal to 1000 mL (Table 3). Of the 38 women who did not have an IV cannula, 15 declined placement of an IV cannula despite recommendation for placement secondary to excessive bleeding, although only one woman with an estimated blood loss of 1000 mL or greater declined IV cannula placement.

The outcomes of the subgroup of women experiencing PPH after vaginal birth were evaluated. For this cohort of women, the mean hemoglobin was 12.2 g/dL, and hematocrit was 35.7% on admission. After birth, the mean hemoglobin was 9.9 g/dL, and hematocrit was 29.1% for this cohort. There were no significant differences in the admission-to-postpartum change in hemoglobin and hematocrit values between women with an IV cannula placed earlier in the labor course, those with an IV cannula placed urgently, and women who declined IV cannula placement.

Misoprostol administered rectally was the most common uterotonic used to treat PPH (66.7%), followed by intramuscular methergine (22.2%). IV oxytocin was not used as a single agent to treat PPH; however, for some women it was used secondarily if the patient had IV oxytocin infusing during labor (18 of 108 women [18.5%]). Patients with urgent IV cannula placement were more likely to receive misoprostol when compared with those who had an IV cannula already in place (91.3% vs 61.4%, respectively; $P = .015$). Of the 108 women with PPH, 13 were transferred to an operating room, with 4 women ultimately receiving a dilation and curettage procedure to evacuate the uterus. Seven women required a transfusion with 2 units of blood (6.5% of all women with a PPH), 6 of whom had IV cannula placement on admission and one who had urgent IV cannula placement for PPH. There were not significant differences in the need for transfusion, transfer to the operating room, or need for dilation and curettage when women who already had an IV cannula placed were compared with women who had an urgent IV cannula placement. None of the 15 women who declined urgent IV cannula placement required blood transfusion, transfer to the operating room, or dilation and curettage.

Six women declined both AMTSL and IV cannulation at the time of PPH. In this cohort, one woman received no uterotonics, one was given misoprostol rectally only, 2 had intramuscular oxytocin only, and 2 had both misoprostol and intramuscular oxytocin. All 6 women had no further complications during their hospital stay.

DISCUSSION

In this retrospective, descriptive study, we explored the outcome of the policy to establish IV access based on specific indications for women who were at low risk for labor complications at the onset of labor and admitted in spontaneous labor at a gestational age of 34 weeks or greater. Fewer than half of the women (41.6%) had an IV cannula placed on

admission, and 28% never required IV access. However, for women who had a PPH, there was no difference in postpartum hemoglobin or hematocrit values regardless of whether IV access was ever placed. This would suggest that for women who are at low risk and presenting in spontaneous labor, IV access on admission may not be mandatory, particularly in high-resourced facilities.

To our knowledge, there are no published studies of the impact of routine IV cannulation compared with indication-only IV access for women who are at low risk and in spontaneous labor. A review of the literature regarding outcomes of establishing IV access in emergency departments indicates that many IV cannula insertions were never used, leading to preventable complications and financial burden from unnecessary IV cannulation.[16] The authors of the review concluded that there is a culture in emergency departments of misperceived risk and lack of confidence that results in routine IV cannula placements. The same may be applicable to the culture in maternity care units where healthy, laboring women have an IV cannula placed as a routine practice.

The majority of women in the United States give birth in a hospital,[17] and although no source could be found for actual numbers, establishing IV access is often part of the hospital admission process or guidelines. Results of this study indicate that a policy of establishing IV access when there is an indication instead of routinely for low-risk, spontaneously laboring woman may be a safe and reasonable practice. This practice would result in cost and time savings, decrease patient discomfort, and facilitate mobility during labor and birth. Potential risk of venous complications would be avoided.

This study, although it is the first to explore the outcomes of indication-only IV access in labor, is not without limitations. This was a retrospective, observational study using a data collection tool used for quality improvement purposes with targeted health record review. Data on the number of attempts at IV cannulation were missing for many of the 27 urgent placements, preventing analysis of whether or not waiting for IV access resulted in a more difficult placement in an urgent clinical situation. Although there was no significant difference in hematologic outcomes, need for blood transfusion, or operating room management between women who had an IV cannula placed on admission or during labor and those who had an IV cannula placed for PPH, a difference in clinical symptoms such as syncope is not known. Women included in the study were predominately white, privately insured, healthy, and at low risk for complications; thus the results may not apply to women from other demographic groups. Finally, the setting for this study was in a high-resourced, high-volume hospital; therefore, results may not be generalizable to lower-resourced or smaller settings.

CONCLUSION

Professional organizations have called for decreasing unnecessary intervention and respecting individuals' choices during childbirth.[18,19] Respectful maternity care includes honoring laboring women's choices for their birth, including avoiding interventions such as routine IV cannula placement. Although further study is needed, a policy of indication-only IV access during spontaneous labor is reasonable in a higher-resourced setting, is fiscally responsible, and supports physiologic birth, particularly for women who desire minimal intervention during birth.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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