THE TAKE CHARGE OF YOUR BIRTH SERIES

LABOR INDUCTION

WHY, WHEN, AND HOW?

GET THE DATA.
MAKE A PLAN.
TAKE CHARGE
OF YOUR BIRTH.

HENCI GOER

Chapter 1: The Run-up to Labor

Figure 1.1: The Cervix During Pregnancy

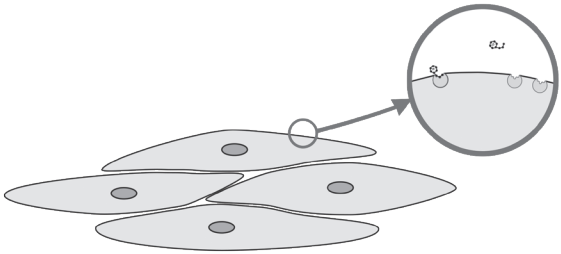


Figure 1.2: Uterine Muscle Cells During Pregnancy

Figure 1.3 a–c: Cervical Effacement

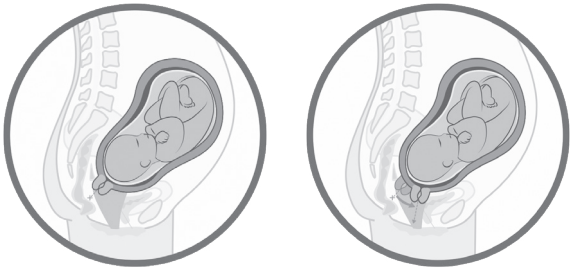


Figure 1.4 a–b: The Cervix Moves Anterior

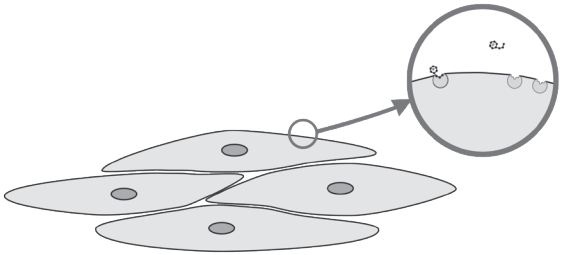


Figure 1.5: Uterine Muscle Cells During Pregnancy

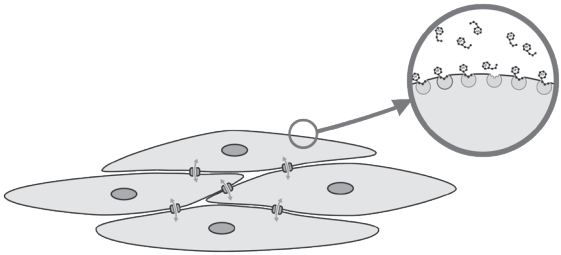


Figure 1.6: Uterine Muscle Cells Primed for Labor

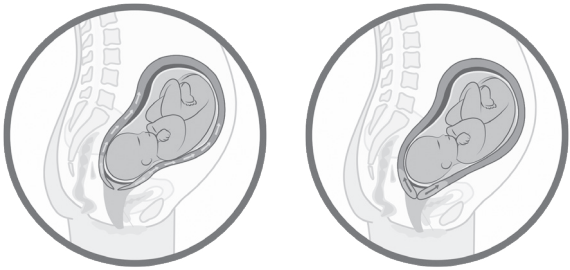


Figure 1.7 a–b: Prelabor Cervical Dilation

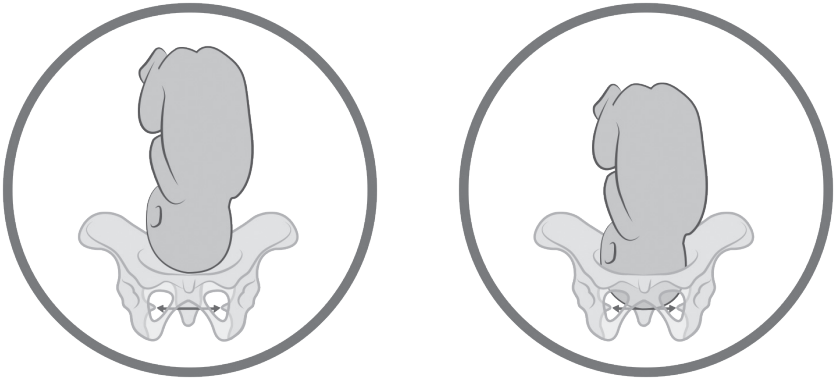


Figure 1.8 a–b: Engagement

Chapter 3: Suspected Big Baby

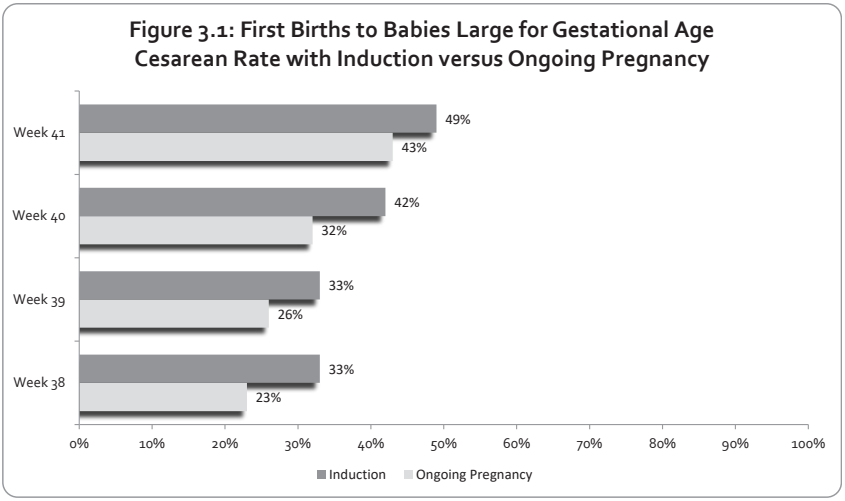
TAKING A DEEPER DIVE

As promised, this section covers a couple of issues that you may be interested in exploring more deeply but that aren't essential to your decision-making process.

Does Precautionary Induction for Suspected Big Baby Reduce Cesareans?

To recap, in the main section of this chapter, we looked at whether early term induction, i.e., at 37 or 38 weeks, reduced cesareans compared with labor starting on its own or induction at 39 weeks or later. As I wrote, most studies and reviews found that induction neither decreased nor increased cesareans. I pointed out that participants in those studies included both those having first births and those with prior vaginal births, and that including those with prior vaginal births could mask an effect on those having first births. In support of my theory, I cited a study of first births alone that found a marked increase in cesareans with induction and promised to give you the details here.[24]

The study I cited compared cesarean rates at first births in each week from week 38 through week 41 in pregnancies where babies weighed in the upper 10 percent for babies of that gestational age—a.k.a. *large for gestational age*—according to whether labor was induced in that week or pregnancy was extended beyond that week. As you can see in figure 3.1, while the cesarean rate in labors with bigger babies increased with advancing pregnancy, in every week, labor was more likely to end in cesarean with induction in that week than if pregnancy was allowed to continue, thereby giving an opportunity to start labor spontaneously. Keep in mind, too, that these were *actual* bigger babies, not just babies *predicted* to be bigger, many of whom would not have fulfilled that prediction.



Does Precautionary Induction for Suspected Big Baby Prevent Injury to Babies and Mothers?

The other issue I promised to discuss is the systematic review that, contrary to other studies, reported a decrease in the incidence of shoulder dystocia with early term precautionary induction for suspected macrosomia.[9] I said the review suffered from serious weaknesses. Let's see what they are.

To recap, the review pooled data from four *randomized controlled trials* (a study design in which participants are assigned by chance to one form of treatment or another) comparing induction at 37 to 38 weeks versus expectant management, meaning participants might go into labor on their own or might be induced later than 38 weeks. The reviewers concluded that early induction decreased incidence of shoulder dystocia (4 percent vs. 7 percent) and fractures (0.3 percent vs. 2 percent).

More than two-thirds of the 1,190 trial participants overall came from the same one of those four trials, which was helmed by the same investigator as the review.[8] This meant that when data from the trials were pooled, the results from that trial largely determined the results of the review. As that is the case, let's take a closer look at that trial.

In the trial, 822 participants believed to be carrying babies who were large for gestational age were assigned by chance to either induction between 37 and 39 weeks or to expectant management. Compared with allowing pregnancies to continue to at least 39 weeks, inducing labor at 37 or 38 weeks decreased the incidence of shoulder dystocia (4 percent vs. 8 percent), which in some cases could mean merely a delay of 60 seconds or more between the birth of the head and the body. Early term induction also decreased the occurrence of one or more outcomes in a composite list of adverse outcomes (2 percent vs. 6 percent) comprised of "significant shoulder dystocia," meaning obstetric manipulation to free the stuck shoulder was required; delay of 60 seconds or more between the birth of the head and the body; fracture; brachial plexus injury; bleeding within the brain; or death.

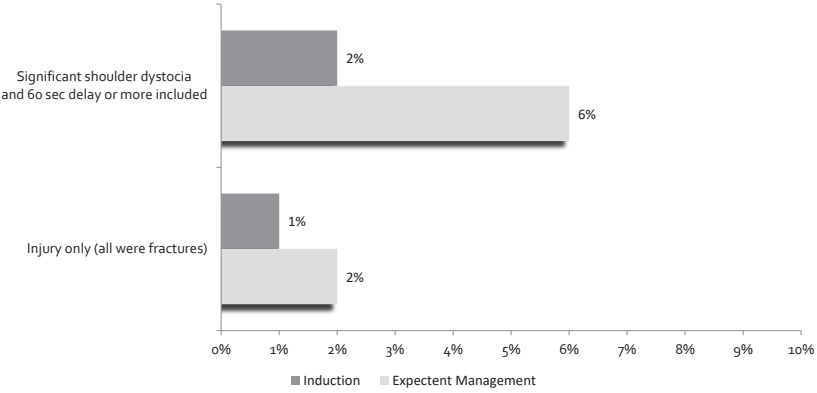
In this study, the devil is in the details.

For one thing, the investigators put their thumb on the scale by making a delay of 60 seconds or more between the birth of the head and the body an indication of "shoulder dystocia." A delay between the birth of the head and the body isn't itself a problem; it merely signals there might be a problem—or there might not. The investigators themselves acknowledge that some obstetricians pointed out that this delay may be no more than waiting for the next contraction to birth the baby. Including it, however, inflates the percentage of births identified as being problematic.

For another, "significant shoulder dystocia" and a delay between the birth of the head and the body were included in the investigators' composite list of adverse outcomes. These may be indicators of a difficult delivery, but they aren't actual harm to the baby, and harm to the baby is what counts. Figure 3.2 illustrates how including characteristics of a difficult delivery gives a misimpression of the true risk.

Furthermore, reporting adverse outcomes as a composite percentage also misleads as to the true risk. As we saw, the list in this case included fracture, brachial plexus injury, bleeding within the brain, and death; but, in fact, the only adverse event babies experienced was a broken bone, and as I said, while fractures are serious, they heal.

Figure 3.2: Composite Adverse Outcome Percentages Induction vs. Expectant Management



Finally, typical medical management may have contributed to adverse newborn outcomes. Did women deliver on their backs? It quintuples the likelihood of shoulder dystocia compared with side lying,[26] and delivering on all fours can both prevent and relieve shoulder dystocia.[10] Did they have epidurals? Epidurals increase the probability of instrumental vaginal delivery,[5, 16, 25, 35] which increases probability of shoulder dystocia.[12, 15, 41]

There's something else too. Whether induced or expectantly managed, the cesarean (28 percent vs. 32 percent) and instrumental vaginal delivery (13 percent vs. 17 percent) rates were appallingly high in both groups. Half the participants had already had prior vaginal births, which greatly decreases the likelihood of cesarean, and fewer than one-third of those expectantly managed had a baby weighing 4,000 grams or more. In other words, *the way doctors managed these labors overrides any relationships between induction and newborn outcomes and between induction and cesarean and instrumental deliveries*.

Chapter 4: Release of Membranes at Term

Figure 4.1: Newborn Infection Rates

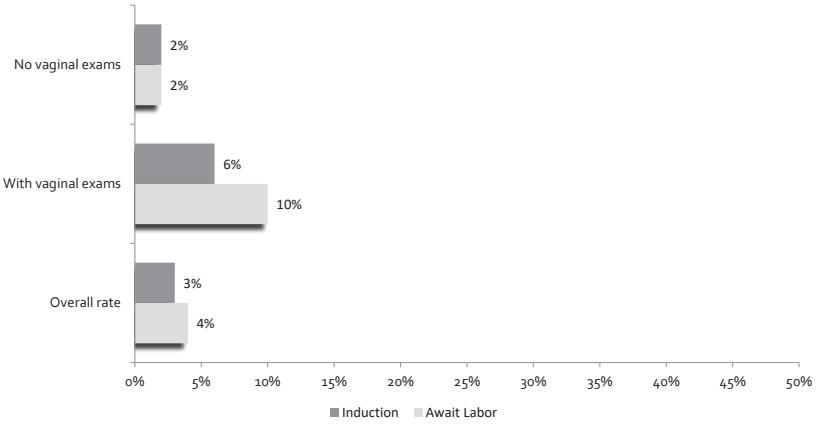
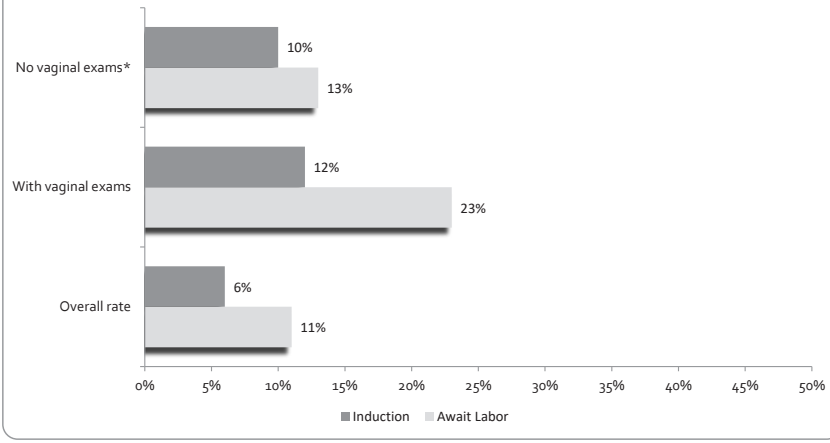


Figure 4.2: Maternal Infectious Morbidity Rates



Chapter 5: Impending Postterm

Figure 5.1: Cesarean Rates in the Induction Group Overall vs. According to Prior Births

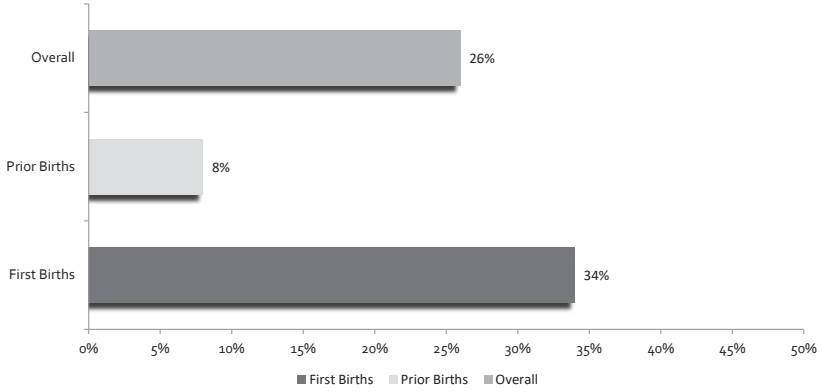


Figure 5.2: Cesarean Rates According to Assigned Group

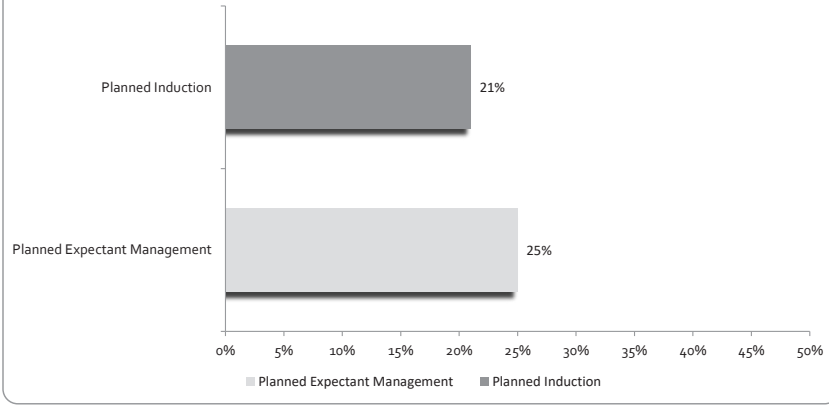
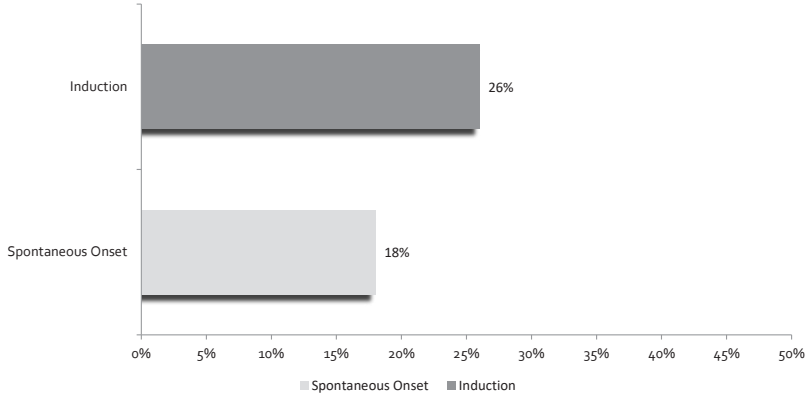


Figure 5.3: Cesarean Rates According to How Labor Started



TAKING A DEEPER DIVE

In the main body of the chapter, I promised more details on some topics for those who might be interested. If you're one of them, we've now arrived at the point where I'll make good on that promise. You'll find each topic listed under the chapter subheading where I first raised it.

Is Precautionary Induction Beneficial?

Here are the specifics of how the numbers change when you restrict the Cochrane review's results to those that answer the relevant research question, which is:

Does precautionary induction:

- in a contemporary medical system,
- in a high-resource country,
- in week 41,
- in uncomplicated pregnancies,
- reduce preventable perinatal deaths?

The starting point for perinatal mortality rates in the Cochrane review is:[9, 34]

- Expectant management: 25/9377 = 27 per 10,000
- Precautionary induction: 4/9418 = 4 per 10,000

If we exclude studies not conducted in high-resource countries (Thailand, India, Tunisia, Turkey) and studies that may not represent contemporary care (pre-1990), the rates become:

- Expectant management: 14/7776 = 18 per 10,000
- Precautionary induction: 3/7772 = 4 per 10,000

If we eliminate deaths occurring before 41 weeks and stillbirths where the timing of demise is unknown, that is, deaths that couldn't (or probably wouldn't) have been prevented by induction at 41 weeks, the numbers become:

- Expectant management: 9/7776 = 12 per 10,000
- Precautionary induction: 0/7772 = 0 per 10,000

If we eliminate deaths that weren't in low-risk infants (small for gestational age), the rate in expectantly managed pregnancies falls to:

- Expectant management: 7/7776 = 9 per 10,000
- Precautionary induction: 0/7772 = 0 per 10,000

Finally, if we eliminate deaths that were not preventable by induction (heart defect, true knot in the umbilical cord), the final numbers are:

- Expectant management: 5/7776 = 6 per 10,000
- Precautionary induction: 0/7772 = 0 per 10,000

To repeat what I said previously, 5 deaths with expectant management are a long way from 25, and a perinatal mortality rate of 6 per 10,000 is a number so small that the difference compared with precautionary 41-week induction may be due to chance.

If Precautionary Induction Is Beneficial, Do the Benefits Outweigh the Harms?

Studies looking at the effect of precautionary induction at 41 weeks on cesarean rate fall into two categories: studies that evaluated the effect of a change in induction policy on cesarean rate and studies looking at cesarean rates with precautionary induction in week 41 compared with labors beginning spontaneously.

Three studies evaluated the effect of a change in induction policy on cesarean rate:

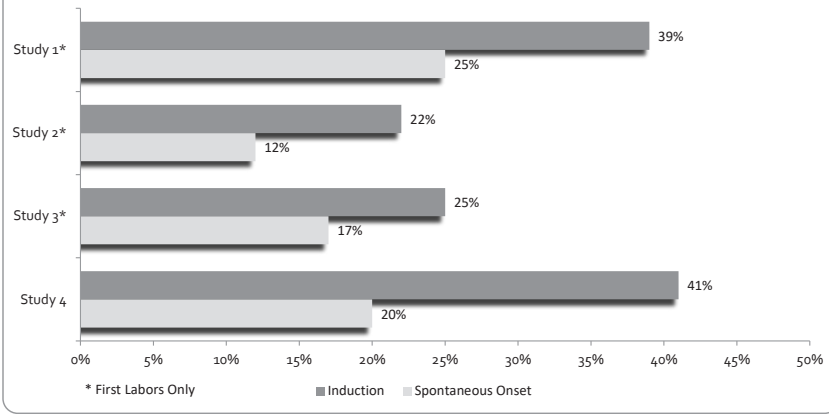
- A study in a mixed population of those having first babies and those with prior vaginal births looked at the effect of changing the timing of precautionary induction from 42 weeks to 41 weeks.[9] The cesarean rate increased from 11 percent to 14 percent.
- A study of first births looked at a change in the other direction: from precautionary induction at 41 weeks 3 days to induction at 42 weeks.[23] The shift to later induction dropped the cesarean rate from 33 percent to 24 percent.
- A study in a mixed population of those having first babies and those with prior births disagreed with the findings of the other two.[8] It evaluated a change in induction policy from precautionary induction upon reaching 42 weeks to induction upon reaching 41 weeks. The change decreased cesarean rates overall from 19 percent to 15 percent.

Six studies looked at the effect of precautionary induction in week 41. Figure 5.4 graphs data from four of them reporting on cesarean rates with induction compared with labor starting on its own:

- A study of first births at a US hospital looked at cesarean rates with induction versus spontaneous labor onset in each week from week 39 through week 41.[28] In week 41, the rates were 39 percent with induction versus 25 percent if labor started on its own.
- A study of first births found that the cesarean rate was 22 percent with induction versus 12 percent when labor started on its own.[30]
- Another study of first births compared rates between participants induced as planned during week 41 with those who began labor spontaneously during that week, either because they started labor before their induction date or induction wasn't planned until week 42.[41] The cesarean rate was 25 percent with induction versus 17 percent when labor started on its own.
- A French study combining first and subsequent births looked at cesarean rates with induction versus spontaneous labor onset in pregnancies that reached 41 weeks with a cervix unfavorable for labor.[33] French policy is to induce for medical indications or

maternal preference between 41 weeks 0 days and 41 weeks 4 days and to induce everyone who hasn't yet given birth at 41 weeks 5 days. Thirty-eight percent of the population started labor on their own between 41 weeks 0 days and 41 weeks 5 days. The cesarean rate was 41 percent with induction versus 20 percent when labor started on its own.

Figure 5.4: Cesarean Rates in Week 41
Induced Labor vs. Spontaneous Onset



An additional two studies also reported that inducing labor in week 41 increased cesareans markedly compared with spontaneous labor onset:

- A study found that even shifting the timing of planned induction from early to late in week 41 had a profound effect on both the percentage of labors that were induced (92 percent with induction planned between 41 weeks 0 days and 41 weeks 2 days versus 37 percent with planned induction between 41 weeks 5 days and 41 weeks 7 days) and the cesarean rate in induced labors (31 percent with induction early in week 41 versus 20 percent with induction late in week 41).[40] Twenty-two percent of the cesareans with planned induction early in the week were for failed induction versus 11 percent—half that many—with planned induction later in the week, which suggests that more of the population had

cervixes favorable for labor as the week progressed. In support of that explanation, a study of routine induction of first labors at 41 weeks in participants with an unfavorable cervix reported that half the labors (49 percent) ended in cesarean despite the use of cervical ripening techniques.[32]

- A study compared cesarean rates with labor induction at 41 weeks 0 days versus expectant management after that date.[44] Cesarean rates were 29 percent in the induction group versus 18 percent in the expectant management group. Most of the difference was in cesareans performed for fetal distress, suggesting that labor induction is more stressful for the baby. (See chapter 2 for more about the potential harms of induction.)

Conclusion: In contradiction to the findings of the Cochrane review, multiple studies report more cesareans with a policy of precautionary induction upon reaching, or early in, week 41 than with expectant management until week 42.

Chapter 6: Elective Induction at 39 Weeks

Figure 6.1: Cesarean Rates
39-Week Induction vs. Expectant Management

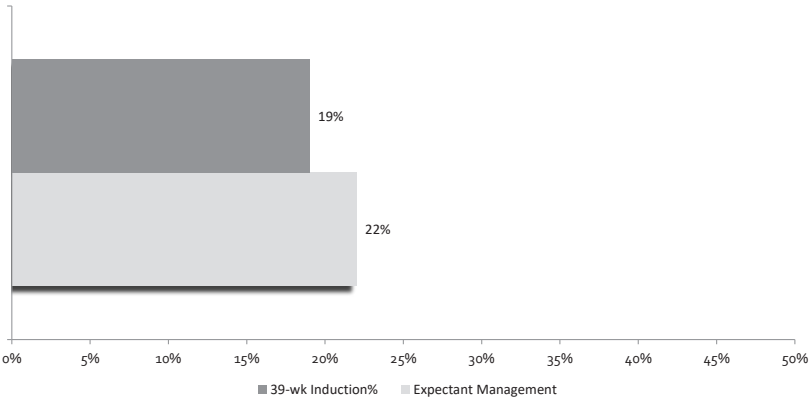


Figure 6.2: Expectant Management Cesarean Rates
Induction vs. Spontaneous Onset

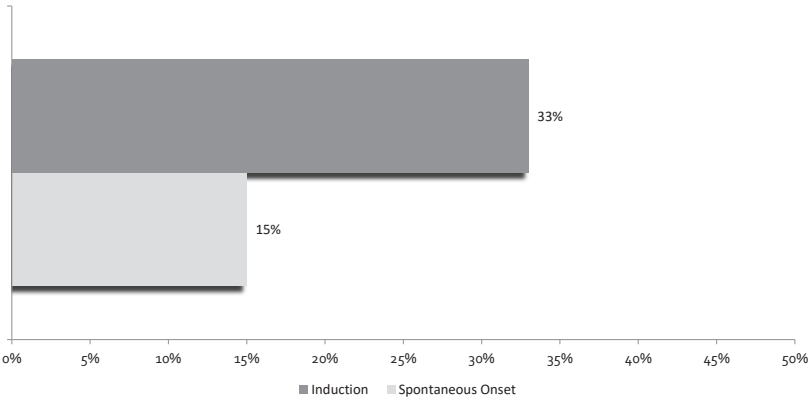


Figure 6.3: Cesarean Rates at First Births
ARRIVE Trial vs. Home and Freestanding Birth Center Births

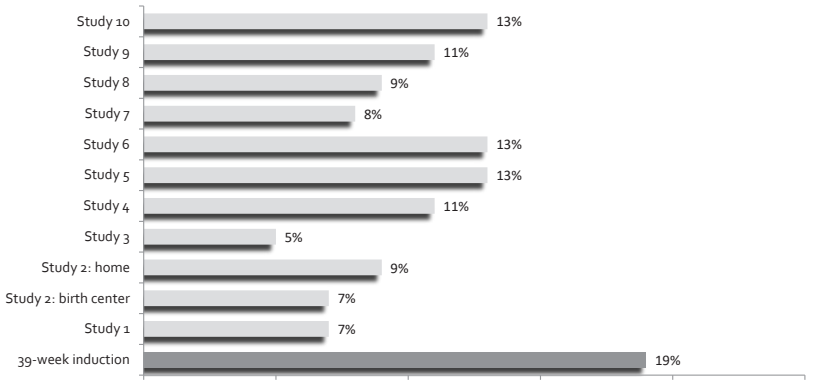
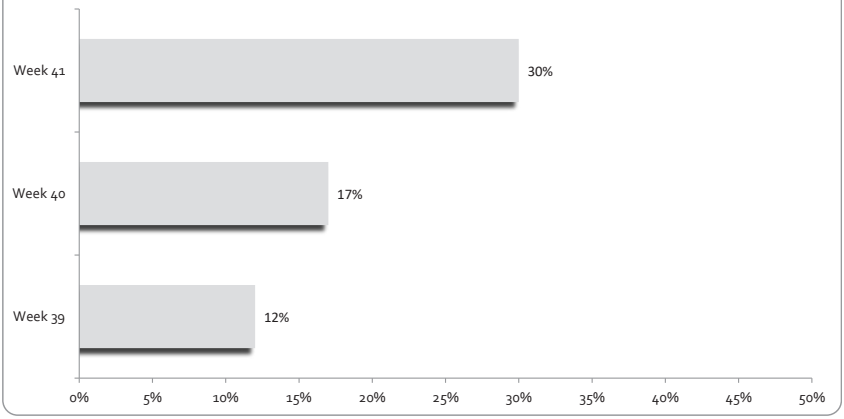


Figure 6.4: ARRIVE Trial Cesarean Rates
in Labors Beginning Spontaneously



TAKING A DEEPER DIVE

As promised above, here are more details on seven studies whose findings contradict those of the ARRIVE trial.

Does Implementing Routine 39-Week Induction Decrease Cesarean Rates?

To refresh your memory, in the ARRIVE trial, cesarean rates with routine 39-week induction were 19 percent, and rates with expectant management were 22 percent.

- A study of California hospitals reported that the *median* (half the hospitals had lower and half had higher) cesarean rate with induction of low-risk first labors was 32 percent. Nine of the 238 hospitals (4 percent) had rates more than 50 percent.[42] Yes, you read that right; more than half of low-risk induced first labors at those nine hospitals ended in cesarean.
- An Australian study of state data reported that the cesarean rate with elective induction in week 39 was 27 percent, and the cesarean rate in all low-risk first births in weeks 40 and week 41, which would be equivalent to the expectantly managed arm of the ARRIVE trial, was 18 percent.[18]
- An Australian study using data from a different state reported that the cesarean rate with induction of low-risk first births at 39 weeks was 30 percent versus 21 percent in pregnancies expectantly managed during and beyond that week.[30]
- A third Australian study using data from yet a different state reported that the cesarean rate with induction of first births for nonmedical reasons at 39 weeks was 31 percent versus 25 percent in pregnancies expectantly managed during and beyond 39 weeks.[13]
- A study at a single US hospital reported that the cesarean rate with induction in week 39 in low-risk first births was 34 percent.[40]

- To evaluate the effect of the ARRIVE trial (which was published in 2018), a US study looked at trends in induction and cesarean from 2016 to 2022 in ultra-low-risk first labors at three California hospitals.[22] Over the time period, induction rates increased from 15 percent to 23 percent, and cesarean rates with induction trended downward. Even so, the rate with induction in 2022 was 26 percent, and cesarean rates with induction were 30 percent or more in all but two of the seven years in the time span. As for cesarean rates in labors that weren't induced, these trended downward too, declining from 19 percent to 16 percent. Based on this data, the study's authors concluded that because it replaces non-induced labors with induced ones, a policy of electively inducing all first labors at 39 weeks would increase, not decrease, the cesarean rate in ultra-low-risk pregnancies.

- A study reported outcomes in low-risk first births in Michigan.[38] Similar to the studies above, expectant management resulted in lower cesarean rates than induction for non-medical reasons at week 39: 30 percent with elective induction at 39 weeks versus 24 percent with expectant management. The researchers then took their analysis one step further. They noted that participants who were electively induced at week 39 were more likely to have characteristics that could have increased their probability of cesarean—e.g., older age, higher BMI, more gestational diabetes, lower score measuring cervical readiness for labor—compared with those expectantly managed. This wouldn't have been a factor in the ARRIVE trial because assignment to treatment group by chance eliminates imbalances of this kind. Perhaps this explains why this study—and by extension, other data analysis studies—find a higher cesarean rate with 39-week induction while the ARRIVE trial found the reverse. To test this theory, the researchers used a technique that mimics assignment by chance. They created matched pairs with the same profile of characteristics in which one member of the pair was electively induced at 39 weeks and the other member was expectantly managed. Cesarean rates turned out to be virtually identical within the pairs (30 versus 31 percent), which means that an increase in characteristics that predispose both to induction

and cesarean in those induced at 39 weeks doesn't explain why data analysis studies have found higher cesarean rates with elective induction than with expectant management.

Chapter 7: Giving Mother Nature a Nudge

Increase Favorability for Labor?	
Sexual Intercourse	Not reported
Castor Oil	Not reported
Breast Stimulation	Yes
Acupuncture	Yes
Acupressure	Not reported
Membrane Sweeping	Not reported

Increase Onset of Labor?	
Sexual Intercourse	No, but factors might have affected this result, among them that many control-group participants also engaged in sexual intercourse.
Castor Oil	Yes (58 percent vs. 22 percent)
Breast Stimulation	Yes (94 percent vs. 63 percent)
Acupuncture	No
Acupressure	No
Membrane Sweeping	No

Reduce Cesareans?	
Sexual Intercourse	No
Castor Oil	No
Breast Stimulation	Possibly at first births (8 percent vs. 20 percent)
Acupuncture	Consistent finding of a small reduction, but finding may be due to chance
Acupressure	No
Membrane Sweeping	No

	Potential Harms?
Sexual Intercourse	Not in an uncomplicated pregnancy, but a potential of infection if the amniotic sac isn't intact
Castor Oil	Side effects: nausea, vomiting, and abdominal cramps
Breast Stimulation	Doesn't increase incidence of uterine hyperstimulation but strong contractions are a possible concern in pregnancies where the baby may be compromised
Acupuncture	None known
Acupressure	None known
Membrane Sweeping	May increase probability of prelabor release of membranes

Chapter 8: Inducing Labor

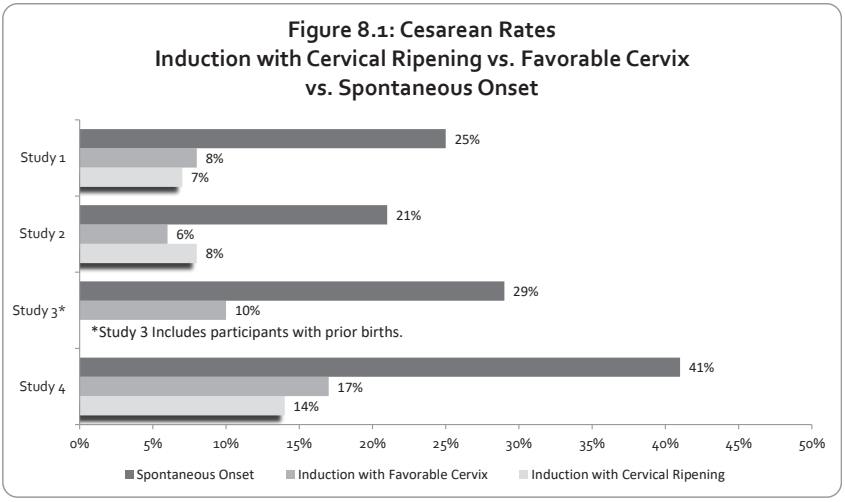


Figure 8.2: Balloon Catheter

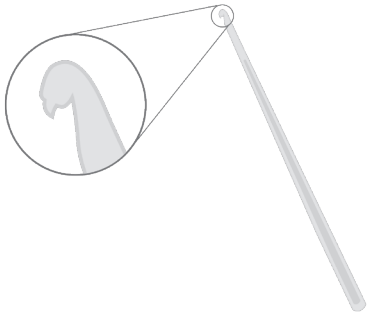


Figure 8.3: Amnihook

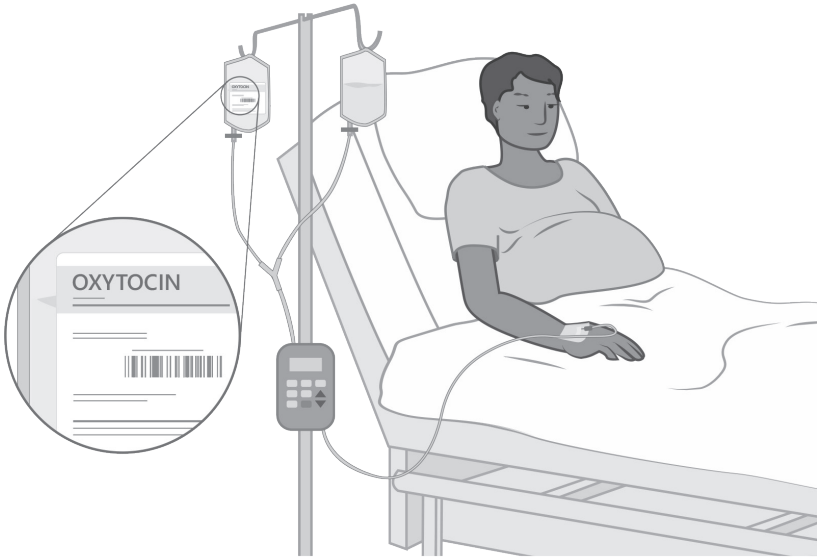


Figure 8.4: IV Oxytocin Setup

Figure 8.5: Methods of Administering Misoprostol

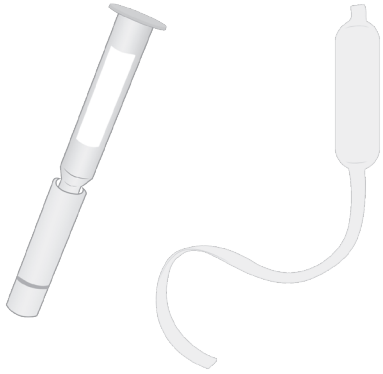


Figure 8.6: Methods of Administering Prostaglandin E2

	How Administered
Balloon Catheter (Foley catheter)	A narrow tube with a small inflatable balloon at the end of it is inserted into the cervix. The balloon is then filled with water to hold it in place.
Rupturing Membranes (amniotomy)	An instrument with a curved tip and a small tooth tucked under the curve is passed through the cervix to snag and tear open the amniotic sac.
Oxytocin	Oxytocin is administered via an IV using a pump that can be adjusted to control the dose.
Prostaglandin E1 (misoprostol, Cytotec)	A tablet is inserted vaginally or held in the mouth orally or dissolved in water and drunk.
Prostaglandin E2 (dinoprostone, Prepidil, Cervidil)	A gel preparation or an impregnated tampon is inserted vaginally.

	Effect
Balloon Catheter (Foley catheter)	Ripens the cervix
Rupturing Membranes (amniotomy)	Induces contractions
Oxytocin	Induces contractions
Prostaglandin E1 (misoprostol, Cytotec)	Ripens the cervix and induces contractions
Prostaglandin E2 (dinoprostone, Prepidil, Cervidil)	Ripens the cervix and induces contractions

	Advantages
Balloon Catheter (Foley catheter)	Improves cervical favorability Compared with vaginal prostaglandin or vaginal misoprostol, is less likely to provoke uterine hyperstimulation with abnormal fetal heart rate, which is an advantage when the baby may be compromised
Rupturing Membranes (amniotomy)	None when done to initiate labor or early in labor
Oxytocin	Effective at achieving vaginal birth with patience and a favorable cervix Effects dissipate rapidly, which means uterine hyperstimulation can be relieved within minutes of turning the infusion rate down or off
Prostaglandin E1 (misoprostol, Cytotec)	Low-dose oral liquid is the optimal means of administration: ▪ compared with vaginal misoprostol, results in reduced incidence of uterine hyperstimulation with abnormal fetal heart rate and identical cesarean rates ▪ compared with vaginal prostaglandin E2, reduces cesareans and incidence of uterine hyperstimulation with abnormal fetal heart rate ▪ compared with balloon catheter insertion, reduces cesareans and results in similar incidence rates of uterine hyperstimulation with abnormal fetal heart rate; however, this may have to do with care provider expectations of how fast labor should progress
Prostaglandin E2 (dinoprostone, Prepidil, Cervidil)	Compared with vaginal misoprostol, reduces incidence of uterine hyperstimulation with abnormal fetal heart rate

	Disadvantages
Balloon Catheter (Foley catheter)	Isn't an option if the cervix hasn't started to dilate Compared with vaginal misoprostol, may be more likely to end in cesarean, but this may have to do with care provider expectations of how fast labor should progress
Rupturing Membranes (amniotomy)	Can't pause or stop the induction and restart another day Increases the incidence of maternal infectious morbidity Releases the amniotic fluid, which cushions the baby from the contraction forces when membranes are intact Probably increases episodes of abnormal fetal heart rate Creates potential for the umbilical cord to slip down past the baby and be pinched between the baby's skull and the mother's pelvis, a complication requiring urgent cesarean delivery
Oxytocin	High-dose oxytocin protocols increase the probability of: ▪ excessive pain ▪ uterine hyperstimulation, which can increase the probability of fetal distress Administering high doses over an extended time period increases the probability of: ▪ postpartum hemorrhage
Prostaglandin E1 (misoprostol, Cytotec)	Contraindicated in VBAC labors because of increased risk of scar rupture
Prostaglandin E2 (dinoprostone, Prepidil, Cervidil)	Is associated with an increase in the scar giving way in induced VBAC labors Compared with low-dose oral misoprostol, increases cesareans and incidence of uterine hyperstimulation with abnormal fetal heart rate Compared with balloon catheter insertion, increases incidence of uterine hyperstimulation with abnormal fetal heart rate

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Chapter 2: Potential Harms of Induction

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