

“THEY SAID HER HEART WAS IN DISTRESS”:

The Electronic Fetal Monitor and the Experience of Birth in the U.S.A., 1960s to the Present

Jacqueline H. Wolf

After Joseph DeLee’s call in 1920 for obstetricians to perform routine medical interventions during birth, obstetricians in the United States began to adopt a series of standards, hoping to create the ideal conditions for “normal” labours. This predisposed obstetricians to embrace the electronic fetal monitor in 1969, years before researchers tested the machine for efficacy. Several well-publicised tragedies relating to births—including the thalidomide crisis in 1962—similarly predisposed the American public to accept the fetal monitor quickly. Continually monitoring the fetal heart rate during labour seemed a surefire safeguard for fetal wellbeing compared to intermittent use of the less flashy fetal stethoscope. Obstetricians envisioned only benefits from continual monitoring, including a reduction in stillbirths and in the incidence of cerebral palsy. Using the history of the electronic fetal monitor in the United States as a case study, this article explores the negative consequences for physicians and mothers of setting rigid standards for “normal” birth.

In 1976, a first-time mother undergoing spontaneous labour checked into a large urban hospital in the United States. She was experiencing regular, light contractions and thought to herself, “Oh, this is going to be easy.” Her pregnancy was full-term, she carried one fetus, and the fetus was positioned head-first. She had followed physicians’ advice religiously during pregnancy—she never missed a prenatal exam, she attended childbirth education classes, she ate well, she exercised regularly, and now she felt healthy and strong and ready to labour. In other words, her pregnancy was prototypically low-risk.

Shortly after she settled into her hospital bed, a physician ruptured her amniotic sac so he could place an electronic fetal monitor electrode internally, through her cervix, to track the fetal heart rate (FHR). “I went,” the mother said years later, “from feeling nothing to being totally in excruciating pain.” A team of doctors and nurses soon told her that the situation was dire. “They said either that I would die, or my baby would die, or both of us would die if I didn’t have a cesarean. They said her heart was in distress.”

The first-time mom tried to stay calm, “but I think I just felt disoriented to what was going on and I was feeling stress with the fetal monitor and the conversations.” Doctors performed emergency cesarean surgery. “That’s something I guess I’ll never forget,” she said, “...that the baby would die, or I could die, or both of us...What they were saying, it just didn’t seem right.” The emergency cesarean seemed even less right to her when she described the birth 28 years later. “Since then, of course, I’ve read these books that said that half of [physicians]... don’t know how to read” the monitors.¹

Within a decade, the mother’s experience would prove to be typical of an electronically monitored birth. Since the advent of electronic fetal monitoring (EFM) in the United States in the late 1960s, false positive rates for fetal distress have been high, causing the cesarean section rate to rise dramatically. Looking back on a forty-year career, one obstetrician summed up the sweeping effect of EFM on childbirth in the United States: “It just changed the face of how we run labour and delivery units and how we practice obstetrics.”² The physician’s observation was not an overstatement. Electronic fetal monitors tethered women to hospital beds throughout labour. Monitors changed the way supervising physicians trained obstetric residents. The device dictated how obstetricians would spend their time when attending births and where in the hospital they would spend it. Fetal monitor strips, presumably solid evidence of the course of a labor, put American obstetricians at risk for malpractice suits and increasingly expensive malpractice premiums. Electronic monitoring normalized the cesarean section. It shifted the focus of obstetric care from primarily labouring women to primarily fetuses and created the perception that even women undergoing “low-risk” pregnancies carry fetuses that are at perpetual risk for death or disability during the birth process. In short, the fetal monitor changed birth to the detriment of all parties.

The purpose of the electronic fetal monitor is deceptively simple. Invented by Yale University obstetrician Edward Hon, the monitor records the fetal heart rate (FHR) throughout labour. Monitors even today measure the FHR either directly and internally—through an electrode attached to the fetal scalp after breaking the amniotic sac—or indirectly and externally—through an electrode placed on a mother’s abdomen. The FHR manifests visually in two ways: on the monitor’s screen, and as a permanent record of the entire labour on a long strip of paper. To laypeople, the FHR appears to be an endless squiggly line with marked peaks and valleys. Obstetricians study the pattern to assess how the fetal heart is responding to the stress of uterine contractions, making medical decisions based on their interpretation

1 Interview of mother by author, 18 July 2004, Chicago area, IL, transcribed from tape recording.

2 Interview of obstetrician by author, 4 October 2012, Chicago physician interview #6, transcribed from digital recording.

Figure 1. A woman in labor in the United States in the early 1970s, shortly after American hospitals began to adopt the electronic fetal monitor. The belt across her abdomen indicates she is externally attached to the monitor on her left. (Photo courtesy of Sam Sweezy © Sam Sweezy.)



of the monitor's visual output. Most notably, obstetricians might decide to perform emergency cesarean surgery after diagnosing the fetus as "distressed." Labouring women have come to think of the monitor as a guardian of fetal wellbeing, constantly sending messages to physicians about their fetus.³

Although Hon originally intended his invention be used only in high-risk pregnancies,⁴ obstetricians quickly adopted the monitor for all labours. This wholesale acceptance occurred before researchers published even one study to determine the efficacy of EFM; the first such study to do so did not appear until 1976. By then, half of all hospital births in the United States were electronically monitored.⁵ Perhaps more significantly for long-term acceptance of the device, when the first study appeared, 278 of the country's 279 hospitals with obstetric residency programmes already had adopted the monitor.⁶

The United States was not the only country to embrace EFM swiftly. In 1970 in the United Kingdom, only one of every 279 labouring women were electronically monitored. Seven years later, every teaching hospital in the United Kingdom deemed the electronic monitoring of labouring patients to be the standard of care.⁷ Today, the device is a ubiquitous presence at hospital births around the world. Learning

3 Placek et al., "Electronic Fetal Monitoring."

4 Hon, "Fetal Monitoring for the Practicing Physician."

5 "Labor-Saving Devices," *Newsweek*, 6 February 1976, 84.

6 Banta and Thacker, "Assessing the Costs and Benefits."

7 Kennedy, "Electronic fetal heart rate monitoring."

how to read a fetal monitor strip has become central to obstetricians' training, and faith in the monitor has become central to women's experience of childbirth.

This article examines why EFM quickly replaced the previous standard of care—intermittent use of the fetal stethoscope during labour—without proof that EFM was safe and effective. I argue that obstetricians and labouring women in the United States proved to be uniquely susceptible to adopting EFM hastily and unquestioningly due to several developments. First, the Friedman curve, a medical standard devised in the 1950s to illustrate the “normal” trajectory of first-time labour, had inadvertently broadened the pathologies associated with childbirth and obstetricians embraced EFM in order to avoid those newly recognized pathologies. A series of well-publicised, national and international pregnancy- and birth-related calamities predisposed the public to accept EFM as well, as a means of thwarting disasters that seemed to be commonplace.

Quickly following the initial acceptance of EFM in the early 1970s, there was a backlash to the legalization of abortion. The backlash was followed a decade later by widespread use of ultrasound equipment. Both anti-abortion sentiment and sonography moved the medical focus during pregnancy from the mother to the fetus, cementing the centrality of EFM to childbirth, which likewise focused on the fetus. Rather than improve neonatal outcomes, however, EFM simply created a medical culture tolerant of unnecessary medical interventions.⁸ Most notably, the device normalised cesarean surgery as an ostensible means of guaranteeing a good birth outcome and implied that undesired outcomes are always the result of a medical error. In the United States, this supposition sparked dramatic increases in the number of malpractice suits filed against obstetricians, the size of malpractice awards, and the cost of obstetricians' malpractice insurance. As a result, obstetricians became ever more dependent on the fetal monitor. To not use the monitor put them at even greater risk of a malpractice suit.

The adoption of the fetal monitor in the United States is especially interesting because introduction of the monitor, and its subsequent normalization, coincided with a robust birth reform movement. The writings of Grantly Dick-Read and Fernand Lamaze, two obstetricians who promised “painless childbirth” through education and preparation rather than drugs, inspired white, educated, middle-class women in the 1950s to seek a more humane way of giving birth. The nascent movement for birth reform persisted, eventually attracting national attention in the 1970s as one of many crusades inspired by second-wave feminism. The feminists active in the women's health reform movement called for fewer unnecessary medical interventions during birth—interventions that they charged were foisted on women by chauvinistic male obstetricians. Reformers envisioned birthing mothers in control

8 Interview of obstetrician by author, 28 June 2006, Chicago, IL, transcribed from tape recording.

of, and empowered by, the birth process. They wanted medical personnel to be there to assist labouring women only in the unlikely event of a complication. Ultimately, however, the requirements of EFM negated birth reformers' views. The blinking, beeping machine eclipsed reformers' vision and re-normalized medical interventions during birth.

"Standing Around"

Controversy in obstetrics did not begin with the electronic fetal monitor and birth reform; controversy was longstanding. In the late nineteenth century, obstetricians struggled to defend even the existence of their field. Skeptics wondered why an ordinary physiological activity needed a specially trained physician. U.S. medical schools adhered to that philosophy, offering no training in obstetrics to medical students, not even rudimentary explanations of the physiology of labour. The omission was so glaring that in 1910, when Abraham Flexner issued his influential study of the inadequacy of American medical education, he saved his harshest criticism for the absence of any training in obstetrics in American medical schools.⁹

The exclusion was shaped by the medical community's belief that physicians required neither expertise nor experience in the unlikely event they were summoned to a birth in an era when birth was the purview of midwives. Charles Ziegler, professor of obstetrics at the University of Pittsburgh, alluded to colleagues' ongoing derision of his field when he noted in 1922 that the word "obstetrics" derived from a Latin word meaning "'to stand before' or, as a sneering colleague once observed, 'to stand around.'"¹⁰

Pregnant women were similarly convinced that physicians were unnecessary at births. The first director of New York's Bureau of Child Hygiene noted that women were comfortable giving birth with midwives or, if none were available, with "the janitor's wife or the woman across the hall."¹¹ Pregnant women likely recognised that midwives, and even mothers with no midwifery training, had more experience with childbirth than physicians did. Accordingly, most women were unaware that the medical specialty of obstetrics even existed.

In this environment, obstetricians attempted to elevate the status of their specialty. Joseph DeLee, professor of obstetrics at Northwestern University and the University of Chicago, championed obstetrics on both the personal and professional levels. In a letter written in 1922 to a disgruntled new father who had complained about DeLee's bill, DeLee responded, "This is one of the fundamental reasons for

9 Flexner, *Medical Education*.

10 Ziegler, "How Can We Best Solve."

11 Leavitt, *Brought to Bed*, 110.

the high mortality in childbirth....[which] never will be better until the public is willing to properly remunerate the obstetrician for his arduous work and sacrifices.”¹² And in what has become his most famous missive to physicians, DeLee suggested in the 1920 inaugural issue of the *American Journal of Obstetrics and Gynecology* that medical treatment during childbirth be systematised. The routine medical interventions he recommended administering included scopolamine during first-stage labour to induce amnesia, ether during second-stage labour to decrease mothers’ consciousness, an episiotomy (a surgical cut to widen the vagina), forceps to deliver the newborn, and extraction of the placenta manually.¹³

The Tyranny of the Curve

His 1920 article in the first issue of what became the dominant obstetric journal in the United States is only one indication of DeLee’s influence on obstetric practice. His authority was so significant that he eventually earned the moniker, “father of modern obstetrics.”¹⁴ In keeping with his recommendation that a series of medical interventions become routine to alleviate what he described as the “pathogenic... disease producing” birth process,¹⁵ obstetricians began to exert DeLee’s recommended medical control, including using forceps prophylactically.¹⁶ Obstetricians’ embrace of this routine use of medical technology helped to persuade the public and broad medical community that obstetrics was a vital discipline.¹⁷ The view that birth leaned toward pathology likewise helped.

Reflecting the approach that began with DeLee, a subsequent generation of obstetricians developed numerical standards for identifying “normal” labour and attempting to rectify labour identified as “abnormal.” One of the adopted standards was the Friedman curve. Emanuel Friedman was an obstetric resident in the early 1950s who learned about labour, in part, by sitting at birthing women’s bedsides and observing them. This education method afforded Friedman the opportunity to develop the curve that he unveiled in the *American Journal of Obstetrics and Gynecology* in 1954. Friedman based the curve, representing the average length of each stage and substage of a first-time labour in the form of a sigmoid curve, on the data he collected from 100 labours.¹⁸

12 Letter, Ogden T. McClurg from Joseph B. DeLee, 8 August 1922, Dr. Joseph B. DeLee MD Papers, Box 10 Folder 1922 Correspondence, Northwestern Memorial Hospital Archives, Chicago IL.

13 DeLee, “The Prophylactic Forceps Operation.”

14 de Kruif, *The Fight for Life*.

15 DeLee, “The Prophylactic Forceps Operation.”

16 Leavitt, “Science’ Enters the Birthing Room.”

17 Wolf, J.H. “Mighty glad.”

Initially, Friedman did not characterise his curve as a rigid standard. To the contrary, he noted that his interest in timing each segment of first-time labours stemmed from his fascination with the “extreme variations” of human births.¹⁹ By the early 1960s, however, American obstetricians had begun to base medical decisions on the Friedman curve. Friedman, too, implied for the first time that his curve had diagnostic value, explaining that his ongoing accumulation of data demonstrated “the normal progress in labour.”²⁰ Use of the word “normal” to describe the utility of his curve served to redefine “abnormal” labour as any labour veering from the curve.

One obstetrician confirmed professional devotion to the curve when she recalled that the hospital she worked at during her residency in 1991 had a “very strict . . . rule. If someone fell off that labour curve and they had their two hours [after falling off the curve], we would say, ‘. . . we really ought to intervene!”²¹ Another obstetrician, who was a first-year resident in 1989, explained, “They actually had a transparency with the Friedman curve that they would put over the top of the patient’s labour chart. And if they were falling off the curve, you would start Pitocin [a synthetic form of the labor hormone oxytocin].”²² And if Pitocin failed to hasten labour enough to adhere to the curve, obstetricians performed a cesarean section.²³

Most consequentially for obstetric practice and women’s experience of childbirth, obstetricians used the Friedman curve to redefine labour dystocia. Historically, dystocia was a labour blocked so unambiguously and dangerously that a mother died if labour continued. Yet dystocia was so rare that obstetricians learned that even the birth of a “double monster,” the nineteenth- and early twentieth-century pejorative for conjoined twins, could be “readily accomplished” vaginally without intervention.²⁴ With the adoption of the Friedman curve, however, dystocia came to mean any labour not conforming to the temporal parameters of the curve and the diagnosis became commonplace. By the 1970s, Friedman himself had identified sixty-five “labor variants,” all falling under the new dystocia rubric. Among the “variants” were “arrested labour,” “desultory labour,” “dysfunctional inertia,”

18 Friedman, “Graphic Analysis of Labor,” Finding aid, Emanuel A. Friedman papers, 1953-1989, Accessed 20 December 2021, http://www.columbia.edu/cu/lweb/archival/collections/ldpd_5550283/.

19 Friedman, “Graphic Analysis of Labor.”

20 Friedman and Sachtleben, “Dysfunctional Labor.”

21 Interview of obstetrician by author, 1 October 2012, Chicago physician interview #2, transcribed from digital recording.

22 Interview of obstetrician by author, 24 August 2012, Ohio physician interview #1, transcribed from digital recording.

23 Interview of retired obstetrician by author, 5 October 2012, Chicago physician interview #7, transcribed from digital recording.

24 Williams, *Obstetrics*, 1917, 712–3, 723, 729–33; Williams, *Obstetrics*, 1924, 767.

“functional inertia,” “uterine asynchrony,” and “uterine exhaustion.” Also among the variants was the diagnosis that would eventually become the number one reason for performing a primary cesarean section: “failure to progress.”²⁵

In providing obstetricians with a growing number of pathologies to recognize and treat, the new dystocia primed them to view the electronic fetal monitor as an essential diagnostic tool. Before the monitor, physicians and nurses used a fetal stethoscope to check the FHR every 20 to 30 minutes during labour. “I would listen to the heart tones after contractions,” explained one obstetrician who began his medical training in 1947. “And I may have done one, two that I can remember, cesarean sections because the heart tones went bad while I was listening.”²⁶ As this physician implied, the fetal stethoscope indicated that fetal distress during labour was rare. The new definition of labour dystocia, however, seemed to indicate that labor pathologies were common, and thus the fetal stethoscope was dangerously inadequate. Perhaps a more consistently employed, less fallible instrument would identify fetal distress more often, more definitively, and to greater effect.²⁷

Hon first promoted his invention in an article in 1958, more than a decade before the monitor’s release, by disparaging the fetal stethoscope. Hon charged that the fetoscope was “relatively inaccurate” when compared to the monitor, a device that, he claimed, would identify fetal distress unflinchingly, thereby saving countless lives while also preventing needless interventions.²⁸ In subsequent articles, Hon explained precisely why the fetal stethoscope was inferior to his invention. The fetal heart rate is twice—or more—that of an adult. Manually counting the FHR while listening via fetoscope is therefore prone to error. Hon wrote, “When data is compromised, interpretation is difficult at best.” Although he also acknowledged that no “accurate index” of what constituted fetal distress existed, he nevertheless blamed stillbirths and some birth defects on fallible physicians using fetal stethoscopes, miscounting heartbeats, and mistakenly assuming fetal wellbeing.²⁹

Thus, when the electronic fetal monitor appeared in 1969, obstetricians were primed to view the monitor’s benefits as obvious, the disadvantages as nonexistent. Continual fetal monitoring could have only one consequence—a marked improvement in birth outcomes, including the elimination of cerebral palsy caused by fetal hypoxia during labour.³⁰ Proving the efficacy of EFM seemed to be an unnecessary, even irresponsible, waste of time.

25 Friedman, *Labor*, 4–5.

26 Interview of retired obstetrician by author, 19 July 2004, Chicago, IL, transcribed from tape recording.

27 Quilligan and Paul, “Fetal Monitoring.”

28 Hon, “The electronic evaluation.”

29 Hon, “The Diagnosis of Fetal Distress.”

30 J. E. Brody, “Updating a Standard: Electronic Fetal Monitoring,” *New York Times*, 7 July 2009.

The Effects of National and International Disasters Related to Childbirth

While the Friedman curve created the medical perception of new and burgeoning birth pathologies that were not particularly meaningful, and encouraged physicians' and hospitals' quick embrace of the fetal monitor, frightening news stories in the 1960s relating to pregnancy and childbirth assured that the public would accept EFM as readily as obstetricians had. In 1962, the public learned about the teratogenic effects of thalidomide on fetal development. Originally, physicians and scientists had believed that thalidomide was safe. Indeed, some European countries permitted the sedative to be sold over the counter. Sedative use in the 1950s and 1960s was especially common among pregnant women because pharmaceutical companies ran ads in obstetric journals peddling tranquilizers as an antidote for "anxiety of pregnancy" and obstetricians prescribed the medications freely.³¹ Only after clusters of phocomelia appeared among newborns—limbs so shortened that hands grew from shoulders and feet grew from hips—did the medical community associate thalidomide taken during the first trimester of pregnancy with a host of serious birth defects.³²

On the heels of the thalidomide crisis came the death in 1963 of Patrick Bouvier Kennedy, son of the 35th president of the United States. Born six weeks prematurely, Patrick Kennedy died when he was two days old. Following the infant's death, stories about the dangers of pregnancy and childbirth became prominent in the United States, especially in women's magazines.³³

Two years later, a rubella epidemic struck the United States. Physicians had known for more than two decades that when a mother contracted rubella during the first trimester of pregnancy, the virus put the developing fetus at risk for blindness, deafness, microcephaly, and other disabling conditions. One prominent weekly newsmagazine warned Americans, "Rubella virus is as deadly as thalidomide for the unborn."³⁴

The back-to-back calamities played out in the United States against the backdrop of a nationwide public health campaign to prevent birth defects that lasted for fifteen years, from 1959 through 1974. Public service announcements appeared regularly in newspapers and magazines, and on radio and television. Americans learned that most birth defects were preventable, if only pregnant women took

31 Metzel, "Mother's Little Helper."

32 "The Untold Story of the Thalidomide Babies." *Saturday Evening Post*, 1962, 19–27; J. Ridgeway, "More about Thalidomide," *New Republic*, 1966, 12–15; Brynner and Stephens, *Dark Remedy*.

33 W. M. Blair, "Kennedys Mourning Baby Son Funeral Today Will be Private," *New York Times*, 10 August 1963, 1, 44; L. Burd, "Requiem Mass Slated Today for Kennedy Boy," *Los Angeles Times*, 10 August 1963, 1, 7.

34 "Rubella Vaccines," *Time* 92, November 1968, 84.

“simple, common-sense precautions.”³⁵ In response to the public health messages, medical journals emphasised the “national commitment to reduce mental retardation.” Simultaneously, relevant journal editorial boards, one after another in turn, endorsed EFM.³⁶

Popular magazines exacerbated the fears that surrounded childbirth in the United States in the 1970s. An article in *Newsweek* magazine described labour as “the most perilous hours in an infant’s life” and warned the public that even during uncomplicated births, “thousands” of babies suffer from oxygen deprivation, resulting in brain damage. The medical community viewed brain damage as precisely the type of peril that EFM would prevent.³⁷ Describing EFM for the first time in 1969, *Life* magazine assured parents that the fetal monitor would save 20,000 babies annually from death or debility. Medical and lay articles depicted the now-discarded fetal stethoscope as rudimentary technology. EFM, on the other hand, was cutting-edge. As Hon explained: “We can talk to an astronaut who is hundreds of thousands of miles above the earth but without modern electronics, a doctor had little or no idea what was happening to the fetus just inches from his ear.”³⁸ The implication was that only old-fashioned physicians and irresponsible mothers would doubt the benefits of Hon’s machine. In this atmosphere, hospitals and obstetricians adopted the electronic fetal monitor and presented the machine to mothers as a lifesaving component of modern birth practices.

A “Stubbornly Persistent” Notion

Hon’s predictions for his machine were grandiose. He claimed that the monitor would eliminate stillbirth, perinatal death, and cerebral palsy, and that the machine was so accurate that obstetricians would never again perform an unnecessary emergency cesarean section.³⁹ Other doctors soon echoed Hon, noting that intermittent use of the fetal stethoscope allowed physicians to sample only “1-2% of information on fetal status.” In contrast, the fetal monitor unremittingly displayed, and recorded, the FHR during labour.⁴⁰ American physicians abandoned the fetal stethoscope. “Yeah,” an obstetrician who began her residency in 1991 observed, “nobody does that anymore. Zero. I have seen one in Africa.”⁴¹

35 Wolf, *Cesarean Section*, 114–9; Virginia Apgar, “They’re Solving the Mysteries of Birth Defects,” *Family Circle*, January 1964, 48–49, 88–90.

36 Quilligan and Paul, “Fetal Monitoring.”

37 “Monitoring Childbirth.”

38 “Watching’ the Unborn,” *Life*, 25 July 1969, 63–65.

39 Hon, “Fetal Monitoring for the Practicing Physician.”

40 Kelly and Kulkarni, “Experiences with Fetal Monitoring.”

41 Chicago physician interview #2.

Initially, Hon recommended that only high-risk women—those requiring “fetal intensive care”—needed EFM.⁴² By 1975, however, Hon, echoing the popular press in the 1960s, was describing labour as “a hazard for all fetuses.” As chemically induced labours increased in popularity, he specifically warned that labour induction placed even greater stress on the vulnerable fetus than spontaneous labor. In a typical medical cascade, Hon implied that his new technology was necessary to mitigate the hazards of another medical technology—labour induction.⁴³

Although Hon, medical journals, and the popular press initially portrayed EFM as unambiguously lifesaving, the medical community, after very quickly embracing the machine, soon discovered that in practice, given its false positive rate for fetal distress of 40 percent, the fetal monitor was considerably less reliable than advertised.⁴⁴ One study of 24,863 continually monitored labours could not find any dependable indicator for fetal distress, except under extreme circumstances, even as obstetricians’ maintained the “stubbornly persistent” notion that variations in the FHR were medically significant.⁴⁵ Despite the conviction that EFM was of unambiguous value, more than half a decade after the monitor’s release Hon and his cohorts still struggled to understand the correlation between the FHR and fetal wellbeing.⁴⁶

At obstetricians’ national professional meetings in the late 1970s, one obstetrician began to call for a change in terminology to avoid giving EFM such unwarranted influence over the medical conduct of labour. She urged using the phrase “non-reassuring fetal status” instead of “fetal distress” when interpreting the monitor’s readout. She explained, “fetal distress’ describes the fetus, ‘non-reassuring fetal status’...describes your interpretation of what’s going on....Because the vast majority of babies with so-called ‘fetal distress’ have perfectly normal [blood] gases and Apgars.”⁴⁷

As the suggestion for a change in vocabulary intimates, difficulties interpreting EFM strips were widespread. In 1977, editors of the inaugural issue of the *Journal of Perinatal and Neonatal Nursing* published some physicians’ negative descriptions of the fetal monitor. One described fetal monitors dismissively as “complicated machines with many tiny toggle switches.” Another described the problems inherent in attaching an electrode to the fetal head. The process required rupture of the amniotic sac, caused women discomfort, and “unfortunately, was also unfastened

42 Paul and Hon, “A Clinical Fetal Monitor”; Kelly and Kulkarni, “Experiences with Fetal Monitoring.”

43 Hon and Petrie, “Clinical Value.”

44 Lee and Baggish, “The Effect of Unselected Intrapartum Fetal Monitoring.”

45 Benson et al., “Fetal Heart Rate as a Predictor.”

46 Lowensohn et al., “Computer Assessed Fetal Heart Rate Patterns.”

47 Chicago physician interview #6.

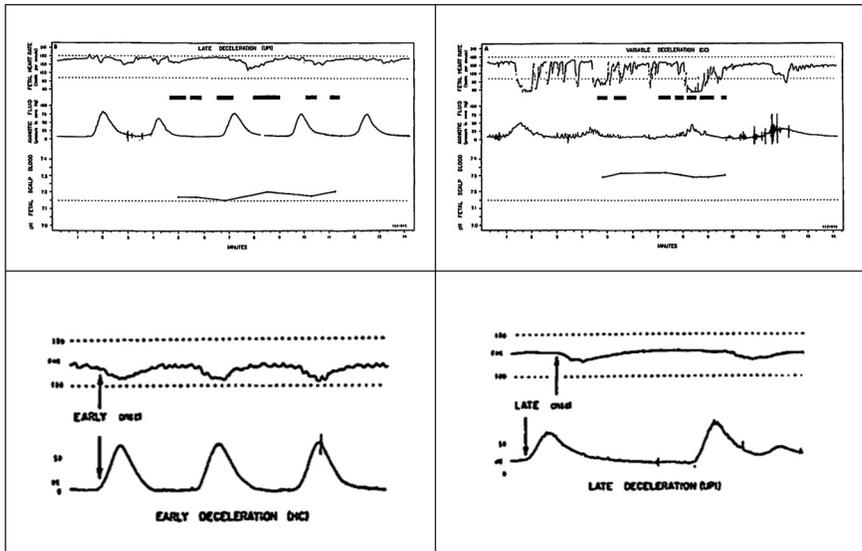


Figure 2. Electronic fetal monitor strips were hard to read. Edward Hon's earliest articles, containing complex explanations of how to interpret (and not interpret) electronic fetal monitor strips, unintentionally portended the difficulties physicians would have interpreting readings accurately. *Upper left*: According to Hon: "Clinically, this FHR deceleration pattern would be considered normal. However, this degree of late deceleration probably indicates low margin of fetal reserve." *Upper right*: Hon: "Clinically, this degree of FHR irregularity and slowing would be considered diagnostic of fetal distress. However, since it is thought to be largely reflex in origin, variable deceleration of this degree appears to be innocuous." *Lower left*: An FHR pattern associated with fetal head compression. *Lower right*: An FHR pattern depicting uteroplacental insufficiency. (Source: Hon and Quilligan, "Electronic Evaluation of Fetal Heart Rate," 150, 160, 161.)

quite easily and frequently," creating further discomfort as a nurse reattached the electrode, often multiple times.⁴⁸

There were other, even more serious, problems with using EFM. Hospitals were unable to find a reliable correlation between a diagnosis of fetal distress based on the monitor's paper trail and umbilical cord blood gases.⁴⁹ As one obstetrician charged, the monitor was "only 50 percent predictive, so you could have a bad tracing and still have great gases and a great baby, or you can have a mediocre tracing and have really bad gases." She characterized EFM as "the bane of obstetrics."⁵⁰ Obstetricians at one Chicago hospital assumed that improper training caused the

48 Afriat, "Historical perspective."

49 Kubli et al., "Observations on heart rate and pH."

50 Interview of obstetrician by author, 3 October 2012, Chicago physician interview #4, transcribed from digital recording.

incongruity so they ordered obstetric residents to measure umbilical cord blood gases after every birth. Then, supervising physicians asked residents to compare their interpretation of monitor strips with the blood gases. If an unnecessary cesarean had been performed, supervisors would chastise residents: “You didn’t take in the whole picture. You did an emergency cesarean and the pH of the baby was perfectly normal! . . . So the next time you see that [fetal monitor] pattern—think!”⁵¹

Some hospitals employed another tactic. Years before the invention of fax machines, they used telecopiers and phone lines to send monitor strips to EFM experts at distant sites for confirmation of a diagnosis.⁵² Yet this, too, often proved fruitless. Even the top-level EFM experts could agree on the meaning of a particular FHR pattern only sixty-eight percent of the time.⁵³ In 2012, one obstetrician who had seen myriad failed attempts over forty years to make the device more reliable, acknowledged the problem was likely unsolvable: “It’s like standing in front of a piece of modern art. Everyone interprets it differently.”⁵⁴ Another frustrated doctor dubbed the fetal monitor, the “feeble monitor.”⁵⁵

Detractors remained in the minority, however. Most obstetricians continued to view EFM as a means of eliminating stillbirth, cerebral palsy, and perinatal mortality. They cited the steady decrease in perinatal deaths during the 1970s as validation of their belief. Critics of EFM however, had a different explanation. Between 1965 and 1975, as infant mortality dropped from 24.7 to 16.1 deaths per 1,000 live births in the United States, innovations in obstetrics and pediatrics in addition to EFM appeared. These included the subspecialties of neonatology and maternal-fetal medicine, neonatal intensive care units, perinatal centers, improved prenatal nutrition, more effective contraceptives to prevent unwanted pregnancies, ultrasound devices, a lower birth rate, and the liberalization of abortion laws.⁵⁶ Yet most obstetricians failed to connect the myriad innovations with improved neonatal outcomes. Instead, they linked the lowered infant death rate solely to the growing use of EFM, likely because the machine dominated their daily experience. One critic characterised colleagues’ unshakeable faith in EFM as “a special type of tyranny. . . . You think it works, so you don’t look for what will.”⁵⁷

51 Chicago physician interview #6.

52 Boehm and Goss, “The Xerox 400 Telecopier.”

53 Cohen et al., “Electronic Fetal Monitoring.”

54 Chicago physician interview #6.

55 Cole, “Can Natural Childbirth Survive.”

56 Steinfels, “New Childbirth Technology”; Kelly and Kulkarni, “Experiences with Fetal Monitoring”; Hall and Alexander, “Fetal monitoring”; Haverkamp et al., “Evaluation of continuous fetal heart rate monitoring.”

57 Chicago physician interview #6.

First Randomised Controlled Trials of the Monitor

Faith in the reliability of EFM, and the unshakeable belief that labour is a threat to the fetus, contributed to the monitor's quick adoption before conducting any systematic tests of its effectiveness. Today, the gold standard for testing a medical technology for safety and efficacy is the randomised controlled trial (RCT). Before releasing a new technology, researchers must conduct at least one, and often several, RCTs in which they randomly assign some research subjects to receive treatment with the new technology, and an equal number to receive either the old treatment or a placebo. In the case of EFM, researchers eventually conducted an RCT in 1976, seven years after American hospitals adopted the technology. The trial assigned a cohort of labouring women to be electronically monitored, and an equal number to have the heart sounds of their fetuses listened to periodically via fetal stethoscope. The researchers then compared four outcomes—Apgar scores, cord blood gases, neonatal morbidity, and neonatal death. The outcomes were the same in both groups although the researchers could not help but notice a difference they had not been looking for: a significantly higher cesarean section rate in the electronically monitored group.⁵⁸ Yet by the time the study appeared, its findings were largely ignored because the fetal monitor had already supplanted the fetoscope as the standard of care in U.S. hospitals.⁵⁹

Although the finding that EFM did not improve outcomes was a surprise to many obstetricians, the effect of EFM on the cesarean section rate surprised no one. Between 1965 and 1987, the cesarean section rate in the U.S. rose 455 percent, from 4.5 to 25 percent of births and most obstetricians connected the rise, at least in part, to the monitor. One obstetrician noted that before his hospital employed the fetal monitor, the cesarean rate at his institution had been 6.6 percent. Ten years later, in the early 1980s, despite retaining largely the same cohort of obstetricians, the rate had increased to 24.5 percent.⁶⁰ Physicians pointed to EFM-induced anxiety as the cause. “You see the abnormalities and you jump at it,” noted one. EFM “made me more nervous, made me crazy with the patients,” admitted another. Still another obstetrician observed that the fetal monitor “made you realise that there were these wide variations that you did not expect to see, these decreases in heart rate that you don’t pick up with a stethoscope....As we started seeing these dips and things all over...it helped increase the section rate a lot.”⁶¹ The U.S. Department of Health, Education,

58 Haverkamp et al., “Evaluation of continuous fetal heart rate monitoring.”

59 “Labor-Saving Devices”; Banta and Thacker, “Assessing the Costs and Benefits.”

60 Hall and Alexander, “Fetal monitoring.”

61 Interview of retired obstetrician by author, 19 July 2004, Chicago, IL, transcribed from tape and digital recordings; Interview of retired obstetrician by author, 29 June 2006, Glenview, IL, transcribed from tape and digital recordings; Interview of obstetrician by author, 5 October 2012, Chicago physician interview #8, transcribed from tape and digital recordings.

and Welfare, in 1979, and the National Institutes of Health, in 1981, commissioned studies so they could better understand the sudden spike in cesarean sections.⁶²

Of the eight randomised controlled trials designed to assess the value of EFM, none demonstrated any difference in outcomes after comparing continual electronic monitoring of labour with the intermittent auscultation of labouring women via fetal stethoscope, only an increase in cesarean surgeries in the continually monitored group.⁶³ Although the American College of Obstetricians and Gynecologists (ACOG), the primary professional organisation of obstetricians in the U.S., has never definitively advised against EFM, ACOG has never disputed the conclusions of RCTs of the device either. To the contrary, ACOG warned in a *Committee Statement* in 1979 that the use of EFM in a low-risk pregnancy demonstrates no benefit over the fetal stethoscope and the organisation suggested that physicians return to intermittent use of the fetal stethoscope in low-risk labours.⁶⁴ Several years later, the organisation explained in another *Committee Statement* that EFM “is highly sensitive but has low specificity.” In other words, EFM reliably indicates when a fetus is tolerating labour well (exhibiting high sensitivity) but is unreliable when indicating that a fetus is compromised (demonstrating low specificity).⁶⁵ As one seasoned obstetrician explained, “The vast majority of babies really are fine. The positive predictive value of an abnormal [fetal heart] tracing is very poor in a low-risk population. That concept is not one that doctors are familiar with, because they are not epidemiology-trained.”⁶⁶

In another bulletin released in 2010, and reaffirmed in 2015, ACOG reiterated

62 Marieskind, *An Evaluation of Cesarean Section*; “NIH Consensus Development Task Force Statement.”

63 Placek and Taffel, “One-sixth of 1980 U.S. births”; Haverkamp et al., “A controlled trial”; Haverkamp and Orleans, “An Assessment of Electronic Fetal Monitoring”; MacDonald et al., “The Dublin randomized controlled trial”; Thacker, “The efficacy of intrapartum electronic fetal monitoring”; Leveno et al., “A Prospective Comparison”; Costaine and Saade, “The First Cesarean”; Gabert and Stenchever, “Electronic fetal monitoring as a routine practice”; Check, “Electronic fetal monitoring”; Kelso et al., “An assessment”; Prentice and Lind, “Fetal Heart Rate Monitoring.” Although one of the eight studies found that neonatal seizures were twice as likely to occur in the fetal stethoscope group, the significance of the finding became unclear in a follow-up study one year later. Of the babies who survived neonatal seizures, both groups had an identical number of abnormal infants (Placek and Taffel, “One-sixth of 1980 U.S. births”; Haverkamp and Orleans, “An Assessment of Electronic Fetal Monitoring”; MacDonald et al., “The Dublin randomized controlled trial”; Thacker, “The efficacy of intrapartum electronic fetal monitoring”; Leveno et al., “A Prospective Comparison”).

64 American College of Obstetricians and Gynecologists, *Current Role*.

65 American College of Obstetricians and Gynecologists, *State-of-the-Art*.

66 Interview of obstetrician by author, 26 June 2006, Chicago, IL, transcribed from tape recording.

that the predictive value of an abnormal FHR tracing was poor and that the best time to effect a delivery after a physician observes such a tracing has never been established, even after more than 40 years of trying.⁶⁷ The obstetrician who chaired the committee that wrote the 2010 guidelines observed at the time, “Honestly, the technology rolled out before we knew if it worked or not. Continuous monitoring became a standard obstetrical procedure before studies could show if the benefits outweighed the risks, and without clear-cut guidelines on how doctors should interpret findings.”⁶⁸

The hasty adoption of EFM, and other medical technologies that similarly bypassed rigorous testing, proved to be so problematic that a host of governmental and institutional safeguards were instituted in the United States to assure adequate testing of all future medical technologies before their release for sale.⁶⁹ For EFM, however, government regulations came too late. The machine remains a stalwart presence on U.S. hospital maternity floors and use of the machine has expanded globally.⁷⁰

EFM Feeds the American Way of For-Profit Health Care and Defensive Medicine

Despite evidence to the contrary, most obstetricians continued to believe that electronic fetal monitoring lowered neonatal morbidity and mortality “inescapably” and appreciably.⁷¹ Proponents of EFM characterised the increase in cesareans, not as a disadvantage of EFM, but as evidence of doctors’ monitor-enhanced “improved clinical judgment.”⁷² Yet not only did EFM increase the likelihood that women would undergo unnecessary major abdominal surgery, EFM was also proving to be detrimental to obstetricians’ professional well-being.

Malpractice suits against obstetricians in the United States burgeoned beginning in the early 1980s, encouraged by the seemingly incontrovertible evidence of wrong-doing provided by EFM.⁷³ As one obstetrician observed, a lawyer could now point to a squiggle on an electronic fetal monitor strip and tell a jury “that’s

67 American College of Obstetricians and Gynecologists, “Management of Intrapartum Fetal Heart Rate Tracings.”

68 Brody, “Updating a Standard.”

69 Banta and Thacker, “Policies toward Medical Technology.”

70 Thacker and Stroup, “Revising the Use of the Electronic Fetal Monitor.”

71 Kelly and Kulkarni, “Experiences with Fetal Monitoring.”

72 Gabert and Stenchever, “Electronic Fetal Monitoring as a Routine Practice”; Koh et al., “Experience With Fetal Monitoring.”

73 Lent, “The Medical and Legal Risks.”

where the baby was damaged.' How do you disprove that?'⁷⁴ A medical malpractice defense attorney has described EFM as a "no-win situation" for obstetricians. "Without EFM you're automatically liable for a bad result. With it, you provide instant replay for juries and evidence of a missed opportunity to save a damaged child."⁷⁵

John Edwards, who eventually became a U.S. senator from North Carolina and a vice-presidential candidate, was originally a trial lawyer, amassing a \$38 million fortune in the 1980s via his pioneering use of fetal monitor strips as evidence against obstetricians. Most of the suits that Edwards filed against physicians were on behalf of children born with cerebral palsy; he would argue that a delay in performing a timely cesarean section had caused his client's neurological damage. The *Boston Globe* described Edwards's courtroom tactics as "beyond a recitation of his case to a heart-wrenching plea to jurors to listen to the unspoken voices of injured children." According to the *Globe*, Edwards would stand before a jury and pretend to be a fetus in the womb begging to be let out before it was too late. If only the obstetrician had noticed the fetal monitor's message, Edwards would tell jurors, the child sitting before them would not have been damaged.⁷⁶ Other lawyers soon mimicked Edwards's tactic. Damage awards against obstetricians became so high that hospitals would not offer a staff position to any doctor who carried less than one million dollars of malpractice coverage.⁷⁷

The cost of obstetricians' malpractice premiums soared. A retired obstetrician recalled that in the early 1950s, "Everybody I knew had \$10,000 of malpractice insurance. I knew essentially nobody that was sued, except who really deserved it." Another retired obstetrician remembered the exact cost of his first annual malpractice premium—\$37. By the time he retired more than 40 years later, he was paying \$160,000 a year for malpractice insurance.⁷⁸

The lawsuits on behalf of children with cerebral palsy, however, wrongly assumed that damage occurred during delivery, even as evidence mounted that cerebral palsy arises almost exclusively during fetal development. Since the advent of EFM more than 50 years ago, and the increase in cesarean surgeries that accompanied EFM, the incidence of cerebral palsy, at one in 500 births, has

74 Chicago physician interview #6.

75 Sartwelle, "Electronic Fetal Monitoring."

76 W. Davis, "Edwards's Career Tied to Jury Award Debate," *Boston Globe*, 15 September 2003; C. Hurt, "Edwards' Malpractice Suits Leave Bitter Taste," *Washington Post*, 25 June 2007.

77 Beller, "A Guest Editorial"; Banta, "Medical Liability Crisis."

78 Interview of retired obstetrician by author, 19 July 2004, Chicago, IL, transcribed from tape and digital recordings; Interview of retired obstetrician by author, 1 October 2012, Avon, IN, transcribed from tape and digital recordings.

remained unchanged, supporting the claim that medical errors at birth rarely, if ever, cause cerebral palsy.⁷⁹ As one obstetrician noted, “Most fetal death and damage is unpreventable, in that it is related to events or factors before delivery, over which physicians have no control. . . No amount of expertise, skill, or excellence of care can compensate for or undo preexisting damage.”⁸⁰

The paradox created by EFM should have been obvious to obstetricians and to ACOG. The “evidence” supplied by the electronic fetal monitor sparked more lawsuits, and more lucrative lawsuits, against obstetricians than ever before. Yet the malpractice crisis in obstetrics created by the lawsuits prevented obstetricians from abandoning the unreliable device that had created the crisis. Because EFM was the standard of care, the prudent obstetrician had little choice but to make EFM a centerpiece of births.⁸¹

Ultimately, EFM encouraged obstetricians to practice “defensive medicine”—invasive, often unnecessary treatments to avoid lawsuits. Most notably, they increasingly performed emergency cesarean sections at the slightest indication. As one typical physician instructed the residents he supervised: even if a baby is “less than perfect,” if a Caesarean had been done, you’re ‘covered.’⁸² A medical malpractice defense attorney has condemned this mindset, arguing that continued use of the ineffective fetal monitor “not only substantially altered medical practice but medical ethics as well.” Physicians responded to the rising number of lawsuits, he observed, not by rejecting the fetal monitor, but by abandoning “the venerable ‘first do no harm’ principle, replacing it with the expedient, self-serving ethics of ‘do whatever is necessary to keep trial lawyers at bay,’”⁸³ meaning more cesarean surgeries for more patients.

Yet the flood of malpractice suits also fed the persistent notion that EFM was beneficial. Obstetricians could not admit that a medical technology they had spent so much time learning how to use was not worthwhile. One obstetrician explained, “In medicine there’s always what they call evidence-based practice and I think there’s also practice-based evidence.”⁸⁴ And as early as the mid-1970s, experience with fetal monitoring became a significant portion of obstetricians’ practice-based evidence. In other words, the use of EFM indicated its worth and therefore the practice continued. The obstetric community came to believe that their patients’ well-being—

79 Frigoletto and Nadel, “Electronic Fetal Heart Rate Monitoring”; Haverkamp and Orleans, “An Assessment”; Sartwelle and Johnston, “Cerebral Palsy Litigation.”

80 Friedman, “The Obstetrician’s Dilemma.”

81 Banta and Thacker, “Policies toward Medical Technology.”

82 Gilfix, “Electronic Fetal Monitoring.”

83 Sartwelle and Johnston, “Cerebral Palsy Litigation.”

84 Chicago physician interview #4.

and their own professional reputation—depended on use of the fetal monitor.

The economic peculiarities of the U.S. healthcare system likewise contributed to physicians' and hospital's dependence on the monitor. The fee-for-service system in the United States pays physicians and hospitals for every patient visit and for each service performed during visits. In the event of surgery, for example, the anesthetist and surgeon send separate bills to the patient or the patient's insurer, and the hospital similarly sends itemised bills for use of the surgical suite, anesthesia, intravenous fluids, hospital room, and each dose of every medication. An unnecessary cesarean surgery with no complications would therefore be remunerated at twice the rate of a vaginal birth. Critics of the fee-for-service billing method point out that the scheme rewards physicians and medical institutions for the quantity, rather than the quality, of provided medical care.⁸⁵

Fee-for-service billing is especially relevant to the persistent employment of the electronic fetal monitor. Childbirth is the most common reason for hospitalisation in the United States, thus maternity care is essential to hospitals' financial well-being.⁸⁶ And in a country where hospitals and physicians bill patients for every component of care separately, EFM has become a lucrative mainstay of hospitals' income.⁸⁷ The first 60 to 100 labouring women using a machine pay its purchase cost. Subsequently, each use of the machine (billed to insurers or directly to the patients lacking insurance) can be used to subsidise hospitals' overhead, including nurses, research, maintenance workers, and building repair.⁸⁸

Indeed, profit has been a consistent reason to defend the monitor. "It is easier to buy 10 machines than pay 10 nurses," explained one obstetrician. Hospital administrators became so dependent on EFM profits that they poured money into the reconfiguration of maternity floors to accommodate central monitoring stations, allowing one resident to watch multiple monitors simultaneously.⁸⁹ An obstetrician who was a resident during the monitor's early days lamented, "Institutions invested so much...that no matter what randomised trial came out showing the lack of benefit—and virtually all of them did—...it was so engrained that we couldn't get

85 A. A. Lockner, and C. A. Walcker, "The Healthcare Industry's Shift from Fee-for-Service to Value-Based Reimbursement," *Bureau of National Affairs*, 26 September 2018.

86 Callaghan et al., "Severe Maternal Morbidity"; Erikson, J. "New Focus on Women in Hospitals Here," *Arizona Daily Star*, 3 January 2006.

87 Gilfix, "Electronic Fetal Monitoring"; Banta and Thacker, "Policies toward Medical Technology."

88 Gilfix, "Electronic Fetal Monitoring."

89 Interview of retired obstetrician, 5 October 2012, Chicago, IL, transcribed from digital recording. Other studies likewise note the lower cost of EFM compared to human monitoring of the FHR: Gabert and Stenchever, "The Results of a Five-Year Study."

rid of it.”⁹⁰ Hospitals’ and physicians’ incomes were non-medical reasons to retain a medical technology.

EFM and Mothers’ Experience of Birth

The electronic fetal monitor changed not only obstetricians’ perception of birth but the experience of birth for their patients. A 1969 *Life* magazine article describing the benefits of EFM showcased a photograph of the machine in a hospital delivery room with a physician bending at the waist, peering at the monitor screen. In the photo’s background is another physician standing next to a woman lying in bed. The second doctor’s eyes are affixed, however, not on the labouring woman who he is ostensibly caring for, but on his colleague across the room staring at the monitor. The message is clear. Whatever information the monitor conveys is more valuable to physicians than anything a labouring woman might communicate.⁹¹

The image reflected the shift in medical focus during pregnancy from the pregnant woman to the developing fetus. Both the legalization of abortion in 1973



Figure 3. In 1969, *Life* magazine, a popular publication attracting 8.5 million subscribing households and many more newsstand purchasers, introduced the electronic fetal monitor to the American public, characterising the device as life-saving. This photo, on the first page of the article, illustrates how the monitor became central to childbirth immediately. Even the physician in the background, who ostensibly is attending to the needs of a laboring woman, has his eyes affixed on his colleague across the room, whose eyes are affixed to the all-important monitor. (Source: “‘Watching’ the Unborn Inside the Womb,” *Life*, 25 July 1969.)

90 Chicago physician interview #6.

91 “‘Watching’ the Unborn.”

and, a decade later, the introduction in the United States of ultrasound devices, helped shift the medical gaze. Beginning in the early 1970s, conservative politicians began to exploit emotional “social issues”—foremost the legalization of abortion—to attract the votes of one-issue “values voters.” The political slogan “pro-life,” describing anyone opposed to legal abortion and implying that life begins at conception, characterized the fetus as the primary medical concern during a pregnancy.⁹² On the heels of the ongoing abortion controversy was the establishment of ultrasound equipment as central to prenatal care in United States, almost a decade after establishment of the device in the British hospital system. Unveiling the previously invisible fetus further altered medical and public perceptions of pregnancy.⁹³ Parents now carried ultrasound images in their wallets and placed them on refrigerator doors alongside family photos.

The 1969 *Life* magazine article, celebrating the benefits of EFM for the fetus, described the technology as “painless and simple.” The ensuing explanation of how a doctor attaches a woman to a monitor, however, sounded neither painless nor simple. First, the doctor inserts a tube into the cervix. “Then with forceps he passes a silver electrode through the tube, clipping it to the baby’s scalp, or to a convenient limb if necessary.” Then the doctor inserts a catheter in the uterus, pushing the catheter past the baby’s head. The article continued, “This measures the mother’s labour contractions, and for the first time gives doctors precise information about their onset, strength and rate.”⁹⁴

Paradoxically, the introduction of the fetal monitor, and the series of invasive steps necessitated by its placement and use, coincided with women rebelling against harsh, unbending obstetric procedures and calling for *fewer* invasive treatments during birth. Women’s appeals for more humane treatment as they laboured began in the early 1950s, inspired by the writings of Grantly Dick-Read and Fernand Lamaze, whose books argued imperiously that women’s fear of, and lack of preparation for, birth caused labour pain.⁹⁵ Dick-Read’s and Lamaze’s philosophies were persuasive because heavily drugged hospital births were common just before and after the Second World War—one obstetrician in the late 1930s observed that women were so routinely narcotised throughout labour that the practice of obstetrics had become primarily “treatment of drug confusion.”⁹⁶

Mothers complained of feeling alone and powerless as they laboured. They accused doctors and nurses of treating them “cruelly.” The *Ladies’ Home Journal*

92 Eyal Press, *Absolute Convictions*, 68–72.

93 Nicolson and Fleming, *Imaging and Imagining the Fetus*, 30–35.

94 “Watching’ the Unborn.”

95 Dick-Read, *Childbirth without Fear*; Karmel, *Thank You*.

96 Montgomery, “Obstetric Amnesia, Analgesia, and Anesthesia.”

published a pair of damning exposés about hospital birth in 1958. “They give you drugs, whether you want them or not,” complained one mother. “I was helpless and at their mercy,” said another. A woman whose husband was a veterinarian remarked that animals were treated more humanely than human mothers when they gave birth.⁹⁷ By the early 1970s, just as EFM made its appearance, the backlash against routine, invasive obstetric care in the United States reached its influential peak. Second-wave feminists organized birth reform organizations to denounce the practices of paternalistic male obstetricians. The movement enjoyed widespread attention.⁹⁸

Women called for eliminating the routine administration of sedatives and anesthetics during labour. They wanted to stroll hospital corridors at will to ease discomfort during labour, rather than lie, drugged, in bed. They wanted to choose among midwife-attended, family-physician-attended, or obstetrician-attended births. They wanted to choose among birth locales—hospital, birth center, or home. Yet even as women called for less medicalised births with more options for care and during which their voices were heard, women were being tethered to the fetal monitors that were now a ubiquitous presence on hospital maternity floors.⁹⁹

Reformers did have some successes. In the wake of their demands, mothers no longer laboured in hospitals alone. For the first time, partners, other family members, and friends were allowed at labouring mothers’ bedsides. Homey “birthing rooms,” rather than stark “delivery rooms,” became a selling point for hospitals. Other calls for reform were ignored, however. The requirements of EFM ultimately trumped the vision of birth reformers.

The experience of one first-time mother illustrates how the demands of the fetal monitor thwarted the reforms that she and others had envisioned. During her pregnancy, she never had feared an unmedicated birth. Rather, she feared the opposite—“intervention by hospital personnel.” Shortly after going into spontaneous labor and checking into the hospital, she left her assigned room with her husband to amble through corridors. Soon, though, a doctor corralled her and told her she must stay in bed, hooked to the fetal monitor. Although the monitor indicated that the FHR was normal, doctors and nurses ignored the mother’s persistent pleas to be allowed to wander the hospital corridors again. The obstetrician explained that *continual* monitoring was vital.

The first-time mom described the forced confinement in bed as “unnecessary torture.” She remembered, “I was attached to modern technology by an IV with a contraction-inducing drug and a glucose bag; by a 3-inch belt fastened hard around

97 G. D. Shultz, “Journal Mothers Report on Cruelty in Maternity Wards,” *Ladies’ Home Journal*, May 1958, 44–45, 142–155.

98 Wolf, *Deliver Me from Pain*, 136–67.

99 Wolf, *Deliver Me from Pain*, 136–67.

my belly measuring mountains of contractions, and I had a wire coming out of my crotch measuring my baby's heartbeat." Immobility increased her discomfort and slowed her contractions, "an opposite response to what the doctors wished to achieve." Ultimately, after a diagnosis of "failure to progress," the birth ended in cesarean surgery.¹⁰⁰

Although birth reformers had envisioned settings in which attentive and flexible medical personnel listened to and comforted labouring women, EFM discouraged contact between labouring women and obstetric residents. Residents began to devote their time almost exclusively to observing centralized monitors far away from labouring patients. One midwife based at a rural hospital complained, "They [obstetric residents] sit outside at the desk and watch the monitors. How do they ever learn about normal labour? . . . That's why I hate those monitors at the desk. I just hate them."¹⁰¹ A physician agreed with the midwife's sentiment. "The suggestion that fetal monitors may be placed on a central console in the nursing station can only lead to patients feeling more isolated and alone during this critical period."¹⁰² Another obstetrician wrote, "...EM [electronic monitoring] has dehumanized obstetrics. We cannot divert our eyes or ears from EM's alluring LED's, beeps, and stylus-chattering graphs. We no longer listen to, talk with, gaze upon, or touch our patient."¹⁰³

The reaction of a new generation of mothers to the demands of the monitor, and to cesarean births, was more welcoming than the reaction of the first generation of women exposed to monitor use. After an obstetrician ruptured one mother's amniotic sac in 1984, the electronic fetal monitor indicated the FHR was fluctuating between 60 and 140 beats per minute. The obstetrician told the first-time mother urgently, "We've got to get this baby out of here." She responded unhesitatingly. "Just do what you need to do." The doctor prepared her for an emergency cesarean. Afterward, the new mother harbored no doubt that the surgery had been necessary and beneficial. "We got him out. We got him healthy. We didn't lose me. We didn't lose him. Everything was fine."¹⁰⁴ Another woman, who gave birth in 1996, reacted

100 The story of this birth came from two sources: a letter written by the mother to her newborn son on August 6, 1990, and completed on September 10, 1990, and a letter written by the same mother to a friend nine weeks after her son's birth. The mother gave a copy of each letter to the author. Although this birth occurred in 1990, the mother was approaching 40; she had come of age during the heyday of "natural" childbirth.

101 Interview of midwife by author, 28 August 2012, southern Ohio, transcribed from digital recording.

102 Youngs and Starkman, "Psychological and Physiological Aspects."

103 Haverkamp et al., "A controlled trial."

104 Interview of mother by author, 17 June 2013, Athens, OH mother interview #3, transcribed from digital recording.

similarly to her doctor's urging to have a cesarean. "I was like 'FINE, go for it!'" Later she characterised the surgery as "saving me and my baby."¹⁰⁵

The attitude of American women toward birth in general, and cesarean surgery specifically, changed with the acceptance of the fetal monitor. The first generation of women to experience the monitor often interpreted the device—and any surgery it indicated was necessary—as needless medical treatment; a subsequent generation interpreted the monitor and any ensuing surgery as a technology that often prompted a life-saving medical procedure.¹⁰⁶ Like their obstetricians, labouring women had come to believe in the value of EFM.

The Consequence of Establishing "Default Invasiveness"

Helen Marieskind, author of the 1979 study for the U.S. Department of Health, Education, and Welfare investigating the causes of the increase in cesarean surgeries, did not blame the electronic fetal monitor per se for the increase in cesareans. Rather, she concluded that "the use of technology seems in and of itself conducive to using more technology and increased cesarean sections are a logical outcome of this perspective." In support of her view, she cited data from hospitals in the 1970s that had not yet adopted the electronic fetal monitor but nonetheless had seen a similar spike in cesarean surgeries.¹⁰⁷ EFM had created an obstetric culture characterized by a "default invasiveness."¹⁰⁸

Defaulting to invasiveness negated the voices of women who called for freedom of movement, patient autonomy, and patient choice during pregnancy and birth. Adherence to the required protocols of the electronic fetal monitor, and the perception of labour that it provoked among obstetricians, pregnant women, and the general public, served as a countervailing force to the birth reform movement. The blinking, beeping machine that captured the attention of obstetric residents, obstetricians, and nurses foiled reformers' visions. EFM convinced obstetricians that continual monitoring was vital to avoid trouble; the stalwart machine might signal the need for medical intervention at any moment. This view further contributed to the malpractice climate that plagued obstetricians and drove up medical costs for patients. Yet despite the machine's negative effect on women's experience of birth, its negative impact on obstetricians' livelihood, its direct and indirect costs to the healthcare system, and its high false positive rate for fetal hypoxia, the electronic

105 Interview of mother by author, 13 March 2012, Chicago mother interview #2, transcribed from digital recording.

106 Wolf, *Cesarean Section*, 183–208.

107 Placek et al., "Electronic Fetal Monitoring."

108 Interview of obstetrician by author, 28 June 2006, Chicago, IL, transcribed from tape recording.

fetal monitor remains central to hospital births. One EFM critic explained the persistent acceptance of the monitor, despite the evidence of its many flaws: “the extremely high rate of false positive diagnoses of fetal distress is explained away; a high cesarean section rate seems a small price to pay to save large numbers of children from brain damage.”¹⁰⁹ In the case of the electronic fetal monitor, medical and public perception of the dangers of birth and the utility of EFM, rather than reality, has thus far prevailed.

Biography

Jacqueline H. Wolf (wolfjr@ohio.edu) is a professor in the Department of Social Medicine at Ohio University, Athens, Ohio, USA. Her research focuses on the history of birth and breastfeeding practices in the United States. Her most recent book is *Cesarean Section: An American History of Risk, Technology, and Consequence* (Johns Hopkins University Press, 2018).

Bibliography

Afriat, C.I. “Historical perspective on electronic fetal heart monitoring: A decade of growth, a decade of conflict.” *Journal of Perinatal and Neonatal Nursing* 1 (1977): 1–4.

American College of Obstetricians and Gynecologists. “Management of Intrapartum Fetal Heart Rate Tracings.” *ACOG Practice Bulletin* 116, no. 5 (2010): 1232–40.

American College of Obstetricians and Gynecologists. *The Current Role of Continuous Electronic Fetal Heart Rate Monitoring in Labor*. ACOG Committee Statement: State-of-the-Art Opinion in Obstetrics and Gynecology. Washington, DC: American College of Obstetricians and Gynecologists, 1979.

American College of Obstetricians and Gynecologists. *State-of-the-Art: Electronic Fetal Monitoring*. ACOG Committee Statement: State-of-the-Art Opinion in Obstetrics and Gynecology. Washington, DC: American College of Obstetricians and Gynecologists, 1984.

Banta, H.D. and Thacker, S.B. “Assessing the Costs and Benefits of Electronic Fetal Monitoring.” *Obstetrical and Gynecological Survey* 34 (1979): 627–42.

Banta, H.D. and Thacker, S.B. “Policies toward Medical Technology: The Case of Electronic Fetal Monitoring.” *American Journal of Public Health* 69 (1979): 931–5.

Banta, J.V. “Medical Liability Crisis: An International Problem.” *Developmental Medicine and Child Neurology* 45 (2003): 363.

Beller, F.K. “A Guest Editorial: The Cerebral Palsy Story: A Catastrophic Misunderstanding in Obstetrics.” *Obstetrics & Gynecology Survey* 50 (1995): 83.

Benson, R.C., Shubeck, F., Deutschberger, J., Weiss, W., and Berendes, H. “Fetal Heart Rate as a Predictor of Fetal Distress: A Report from the Collaborative Project.” *Obstetrics and Gynecology* 32 (1968): 259–66.

¹⁰⁹ Simkin, “Is Anyone Listening?”

- Boehm F.H. and Goss, D.A. "The Xerox 400 Telecopier and the Fetal Monitor." *Obstetrics and Gynecology* 42 (1973): 475-8.
- Brynnner, R. and Stephens, T. *Dark Remedy: The Impact of Thalidomide and Its Revival as a Vital Medicine*. Cambridge, MA: Perseus, 2001.
- Callaghan, W.M., Creanga, A.A., and Kuklina, E.V. "Severe Maternal Morbidity Among Delivery and Postpartum Hospitalizations in the United States." *Obstetrics & Gynecology* 120 (November 2012): 1029-36.
- Check, W. A. "Electronic fetal monitoring: how necessary?" *Journal of the American Medical Association* 241 (1979): 1772-4.
- Cohen, A.B., Klapholz, H. and Thompson, M.S., "Electronic Fetal Monitoring and Clinical Practice: A Survey of Obstetric Opinion." *Medical Decision Making* 2 (1982): 79-95.
- Cole, K.C. "Can Natural Childbirth Survive Technology?" *Maternal Health and Childbirth Resource Guide* 4 (1980): 18-19.
- Costaine, M.M. and Saade, G.R. "The First Cesarean: Role of 'Fetal Distress' Diagnosis." *Seminars in Perinatology* 36 (2012): 379-83.
- de Kruif, P. *The Fight for Life*. New York: Harcourt, Grace, 1938.
- DeLee, J.B. "The Prophylactic Forceps Operation." *American Journal of Obstetrics and Gynecology* 1 (1920): 34-44.
- Dick-Read, G. *Childbirth without Fear: The Principles and Practice of Natural Childbirth*. Harper, 1953.
- Flexner, A. *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching*. Stanford: Carnegie Foundation of the Advancement of Teaching, 1910.
- Friedman, E.A. *Labor: Clinical Evaluation and Management*. New York: Appleton-Century-Crofts, 1978.
- Friedman, E.A. "The Graphic Analysis of Labor." *American Journal of Obstetrics and Gynecology* 68 (1954): 1568-75.
- Friedman, E.A. "The Obstetrician's Dilemma: How Much Fetal Monitoring and Cesarean Section Is Enough?" *New England Journal of Medicine* 315 (1986): 641-3.
- Friedman, E.A. and Sachtleben, M.R. "Dysfunctional Labor: II. Protracted Active-Phase Dilatation in the Nullipara." *Obstetrics and Gynecology* 17 (1961): 566-78.
- Frigoletto, F.D. and Nadel, A.S. "Electronic Fetal Heart Rate Monitoring: Why the Dilemma?" *Clinical Obstetrics and Gynecology* 31 (1988): 179-83.
- Gabert, H.A. and Stenchever, M.A. "Electronic fetal monitoring as a routine practice in an obstetric service: A progress report." *American Journal of Obstetrics and Gynecology* 118 (1974): 534-7.
- Gabert, H.A. and Stenchever, M.A. "The Results of a Five-Year Study of Continuous Fetal Monitoring on an Obstetric Service." *Obstetrics and Gynecology* 50 (1977): 275-9.
- Gilfix, M.G. "Electronic Fetal Monitoring: Physician Liability and Informed Consent." *American Journal of Law and Medicine* 10 (1984): 31-90.

Hall, M.L. and Alexander, C.H. "Fetal monitoring in a community hospital: Analysis of health maintenance organization, fee-for-service, and clinic populations." *American Journal of Obstetrics and Gynecology* 143 (1982): 277-85.

Haverkamp, A.D. and Orleans, M. "An Assessment of Electronic Fetal Monitoring." *Women and Health* 7 (1982): 115-34.

Haverkamp, A.D., Orleans, M., Langendoerfer, S., McFee, J., Murphy, J., Thompson, H.E. "A controlled trial of the differential effects of intrapartum fetal monitoring," *American Journal of Obstetrics and Gynecology* 134 (1979): 399-412.

Haverkamp, A.D., Thompson, H.E., McFee, J.G., and Cetrulo, C. "The evaluation of continuous fetal heart rate monitoring in high-risk pregnancy." *American Journal of Obstetrics and Gynecology* 125 (1976): 310-20.

Hon, E.H. "Fetal Monitoring for the Practicing Physician." *California Medicine* 113 (1970): 46-47.

Hon, E.H. "The Diagnosis of Fetal Distress." *Clinical Obstetrics and Gynecology* 3 (1960): 860-73.

Hon, E.H. "The electronic evaluation of the fetal heart rate: Preliminary Report." *American Journal of Obstetrics and Gynecology* 75 (1958): 1215-30.

Hon, E.H. and Petrie, R.H. "Clinical Value of Fetal Heart Monitoring." *Clinical Obstetrics and Gynecology* 18 (1975): 1-23.

Karmel, M. *Thank You, Dr. Lamaze: A Mother's Experience in Painless Childbirth*. J. B. Lippincott, 1959.

Kelly, V.C. and Kulkarni, D. "Experiences with Fetal Monitoring in a Community Hospital." *Obstetrics and Gynecology* 41 (1973): 818-24.

Kelso, I.M., Parsons, R.J., Lawrence, G.F., Arora, S.S., Edmonds, D.K., and Cooke, I.D. "An assessment of continuous fetal heart rate monitoring in labor." *American Journal of Obstetrics and Gynecology* 131 (1978): 526-32.

Kennedy, R.G. "Electronic fetal heart rate monitoring: retrospective reflections on a twentieth-century technology." *Journal of the Royal Society of Medicine* 91 (1998): 244-50.

Koh, K.S., Greves, D., Yung, S., and Peddle, L.J. "Experience with fetal monitoring in a university teaching hospital." *Canadian Medical Journal* 112 (1975): 455-60.

Kubli, F.W., Hon, E.H., Khaxin, A.F., and Takemura, H. "Observations on heart rate and pH in the human fetus during labor." *American Journal of Obstetrics and Gynecology* 104 (1969): 1190-1206.

Leavitt, J.W. *Brought to Bed: Childbearing in America 1750-1950*. Oxford University Press, 1986.

Leavitt, J.W. "'Science' Enters the Birthing Room: Obstetrics in America since the Eighteenth Century." *The Journal of American History* 70 (1983): 281-304.

Lee, W.K. and Baggish, M.S. "The Effect of Unselected Intrapartum Fetal Monitoring." *Obstetrics and Gynecology* 47 (1976): 516-20.

Lent, M. "The Medical and Legal Risks of the Electronic Fetal Monitor." *Stanford Law Review* 51 (1999): 807-37.

Leveno, K.J., Cunningham, F.G., Nelson, S., Roark, M., Williams, M.L., Guzik, D., Dowling, S., Rosenfeld, C.R., and Buckley, A. "A Prospective Comparison of Selective and Universal Electronic Fetal Monitoring in 34,995 Pregnancies." *New England Journal of Medicine* 315 (1986): 615–8.

Lowensohn, R. I., Yeh, S. Y., Forsythe, A., and Hon, E. H. "Computer Assessed Fetal Heart Rate Patterns and Fetal Scalp pH." *Obstetrics and Gynecology* 46 (1975): 190–3.

Marieskind, Helen I. *An Evaluation of Caesarean Section in the United States: Executive Summary*. Department of Health, Education, and Welfare Office of the Assistant Secretary for Planning and Evaluation/Health, 1979.

MacDonald, D., Grant, A., Sheridan-Pereira, M., Boyland, P., and Chalmers, I. "The Dublin randomized controlled trial of intrapartum fetal heart rate monitoring." *American Journal of Obstetrics and Gynecology* 152 (1985): 524–39.

Metzel, J.M. "Mother's Little Helper': The Crisis of Psychoanalysis and the Miltown Resolution." *Gender and History* 15 (2003): 228–55.

Montgomery, T.L. "Obstetric Amnesia, Analgesia, and Anesthesia: Their Relationship to Sudden Death in Labor." *Journal of the American Medical Association* 108 (1937): 1679–83.

Nicolson, M. and Fleming, J.E.E. *Imaging and Imagining the Fetus*. Baltimore: Johns Hopkins University Press, 2013.

"NIH Consensus Development Task Force Statement on Cesarean Childbirth." *American Journal of Obstetrics and Gynecology* 139 (1981): 902–09.

Paul, R.H. and Hon, E.H. "A Clinical Fetal Monitor." *Obstetrics and Gynecology* 35 (1970): 161–9.

Placek, P.J., Keppel, K.G., Taffel, S.M. and Liss, T.L. "Electronic Fetal Monitoring in Relation to Cesarean Section Delivery, for Live Births and Stillbirths in the U.S., 1980." *Public Health Reports* 99 (1984): 173–83.

Placek, P.J. and Taffel, S.M. "One-sixth of 1980 U.S. births are by cesarean." *Public Health Reports* 97 (1982): 183.

Prentice, A. and Lind, T. "Fetal Heart Rate Monitoring During Labour—Too Frequent Intervention, Too Little Benefit?" *The Lancet* 2 (1987): 1375–7.

Press, Eyal. *Absolute Convictions: My Father, a City, and the Conflict That Divided America*. New York: Henry Holt, 2006.

Quilligan, E.J. and Paul, R.H. "Fetal Monitoring: Is It Worth It?" *Obstetrics and Gynecology* 45 (1975): 96–100.

Sartwelle, T.P. "Electronic Fetal Monitoring: A Bridge Too Far." *Journal of Legal Medicine* 33 (2012): 313–79.

Sartwelle, T.P. and Johnston, J.C. "Cerebral Palsy Litigation: Change Course or Abandon Ship." *Journal of Child Neurology* (2014): 1–14.

Simkin, P. "Is Anyone Listening? The Lack of Clinical Impact of Randomized Controlled Trials of Electronic Fetal Monitoring." *Birth* 13 (1986): 219–20.

Steinfelds, M.O. "New Childbirth Technology: A Clash of Values." *Hastings Center Report* 8 (1978): 9–12.

Thacker, S.B. "The efficacy of intrapartum electronic fetal monitoring." *American Journal of Obstetrics and Gynecology* 156 (1987): 24–30.

Thacker, S.B. and Stroup, D.F. "Revising the use of the electronic fetal monitor." *The Lancet* 361 (2003): 445–6.

Williams, J.W. *Obstetrics: A Text-Book for the Use of Students and Practitioners*. New York: D. Appleton, 1917.

Williams, J.W. *Obstetrics: A Text-Book for the Use of Students and Practitioners*. New York: D. Appleton, 1924.

Wolf, J.H. *Cesarean Section: An American History of Risk, Technology, and Consequence*. Baltimore: Johns Hopkins University Press, 2018.

Wolf, J.H. *Deliver Me from Pain: Anesthesia and Birth in America*. Baltimore: Johns Hopkins University Press, 2009.

Wolf, J.H. "Mighty glad to gasp in the gas': perceptions of pain and the traditional timing of obstetric anesthesia." *Health: An Interdisciplinary Journal for the Social Study of Health, Illness and Medicine* 6 (2002): 365–87.

Youngs, D.D. and Starkman, M.N. "Psychological and Physiological Aspects of Electronic Fetal Monitoring." *Primary Care* 3 (1976): 691–700.

Ziegler, C.E. "How Can We Best Solve the Midwifery Problem." *American Journal of Public Health* 12 (1922): 409.