

Fetal Monitors

Guide to Selection

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FETAL MONITORS

Fetal monitoring is an important diagnostic tool to monitor fetal health. Improving intrapartum monitoring is a key to reducing intrapartum stillbirths.ⁱ Fetal monitoring can occur in a variety of ways, but the cost of most devices is still prohibitively expensive for low-resource settings.

There are several methods of monitoring. These include:

- **Intermittent auscultation**, which is a method of sampling and counting the fetal heart rate at specified intervals with the human ear.ⁱⁱ This is a method of monitoring the fetal heart rate periodically through either a fetoscope or a Doppler transducer.
 - A fetoscope, such as a Pinard Horn, is the lowest cost technology available for fetal heart rate monitoring and is the only method that does not require consumables or spare parts. In general, it is possible to detect a fetal heart rate using a fetoscope beginning around 18 to 20 weeks of pregnancy, but it can be difficult to pinpoint the fetal heart rate using a fetoscope if the mother has an anterior placenta. Fetoscopes require the user to be very well trained and requires great skill to become proficient in interpreting the results. However, Wall and colleagues state that, historically, much of the reduction in fetal deaths has occurred through intermittent auscultation using fetoscopes. In low-resource settings, a well-trained nurse using a fetoscope may be an effective and affordable option for identifying obstetric complications, but should be confirmed by further research.ⁱⁱⁱ
 - The Doppler transducer, which uses ultrasound, can detect the fetal heart rate around 10 to 12 weeks of pregnancy and is the most common method of intermittent auscultation in high-resource settings.ⁱⁱ However, all fetal Doppler transducers require the purchase of accessories, such as transducer gel or batteries, which can increase the cost.

- **Cardiotocography (CTG)**, also known as Electronic Fetal Monitoring (EFM), which can monitor both the fetal heart rate and uterine contractions. This method provides a paper recording of the fetal heart rate and the uterine contractions, but prevents the mother from leaving the hospital bed and restricts general movement. This method of fetal monitoring is the most expensive and such machines typically cost around US\$7,000 for a base model. Electronic fetal monitoring can be done externally through the use of an ultrasound transducer belt placed around the mother's abdomen and, when closer surveillance is needed, internal monitoring can be conducted through the use of a wire electrode passed through the cervical opening and connected to the fetal scalp. A review of electronic fetal monitoring studies conducted in developed countries found no benefit to electronic fetal monitoring for low-risk women upon admission to the hospital in labor and that admission CTG increases the caesarean section rate by approximately 20%.^{iv}
- **Umbilical artery monitoring**, which uses Doppler ultrasound to measure the blood flow through the umbilical cord. This method measures placental insufficiency, which is associated with intra-uterine growth restriction, placental abruption, pre-eclampsia, pre-term labor and delivery, and stillbirth. Little info exists about the umbilical artery Doppler use in low- and middle-income countries.

As with all diagnostic tools, appropriate interventions must be available to treat the identified conditions in order for such tools to be effective.

This guide contains a sample of fetal monitoring options that are on the market today.

ⁱ Bhutta ZA, Darmstadt GL, Haws RA, Yakoob MY, Lawn JE. Delivering interventions to reduce the global burden of stillbirths: improving service supply and community demand. *BMC Pregnancy Childbirth*. 2009;9(Suppl 1):S7.

ⁱⁱ Martis R, Emilia O, Nurdianti DS. Intermittent auscultation (IA) of fetal heart rate in labour for fetal well-being. *Cochrane Database of Systematic Reviews* 2010, Issue 9.

ⁱⁱⁱ Wall SN, Lee ACC, Waldemar C, Goldenberg R, Niermeyer S, Darmstadt GL, Keenan W, Bhutta ZA, Perlman J, Lawn JE. Reducing Intrapartum-Related Neonatal Deaths in Low- and Middle-Income Countries—What Works? *Semin Perinatol*. 2010, 34:395-407.

^{iv} Devane D, Lalor JG, Daly S, McGuire W, Smith V. Cardiotocography versus intermittent auscultation of fetal heart on admission to labour ward for assessment of fetal wellbeing. *Cochrane Database of Systematic Reviews* 2012, Issue 2.

SECTION I:

FETOSCOPE AND DOPPLER TRANSDUCER

PINARD STETHESCOPE (FETOSCOPE)



Basic information	Manufacturer	Various
	Link	Not available
	Manufacturer description	Not available
	Characteristics applicable to low-resource settings	Widely available, multiple manufacturers, inexpensive, portable, made of wood, aluminum, or plastic.
	Features	Training required, especially in interpretation of results, follow-up, and management of detected complications.
	Pre-/post-sales support	No
	Approximate price	US\$1 (plastic) - \$20 (wooden)
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	NO

WINSENGA



(FINAL DEVELOPMENT AND TESTING)

Basic information

Manufacturer	Cipher 256 Co. Ltd.
Link	http://cipher256.com/
Manufacturer description	WinSenga is a collage of mother-child care apps/solutions, among them a fetal heart rate monitor on mobile phone. We use mobile technology to improve the quality of antenatal care delivered in the poorest and remotest parts of Sub-Saharan Africa, increase the number of mothers in this region that receive antenatal care by making this care more accessible and improve monitoring of the fetal distress during labor.
Characteristics applicable to low-resource settings	Developed in Uganda. Modified pinnard/fetoscope which connects to a Windows mobile phone. Does not require in-depth training. More affordable than ultrasound or fetal Doppler.
Features	Device can alert the healthcare provider to situations that require referral. Results can be sent from the phone to the mother or other healthcare provider.
Pre-/post-sales support	Yes
Approximate price	US\$100 - \$500 (estimated pricing)

Purpose of device

Fetal heartbeat detection	✓
Monitor strength/duration of uterine contractions	NO
Fetal movement detection	NO
Measure umbilical cord blood flow	NO

ANGEL SOUNDS

Basic information	Manufacturer	Jumper Medical Equipment Co., Ltd.
	Link	http://www.jumper-medical.com/
	Manufacturer description	The AngelSounds Fetal Doppler is the most popular Fetal Doppler device on the market today. Easy to use, the AngelSounds Fetal Doppler includes everything you need to begin listening to your baby's heartbeat right away, including headphones to ensure optimal audio quality. With AngelSounds, you'll even be able to record your baby's heartbeats as either an MP3 or WAV file - perfect for sending to others.
	Characteristics applicable to low-resource settings	Designed for home use in developed countries. Portable. Depending upon model, requires 9-volt or AAA batteries. Can be used with or without transducer gel. Sold in over 60 countries.
	Features	3MHz probe, LCD screen displays fetal heart rates, heartbeat can be heard through built-in speaker or headphones, can record and replay fetal heart sounds, can transmit fetal heart signal to a monitoring system in a hospital through a monitoring telephone.
	Pre-/post-sales support	No
Purpose of device	Approximate price	US\$30
	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	NO

HI BEBE

Basic information	Manufacturer	Hi Bebe Fetal Doppler Systems
	Link	http://www.hibebe.org/index.html
	Manufacturer description	The Hi Bebe baby Doppler is a medical grade fetal Doppler used by doctors, midwives and pregnant women who want to monitor their baby's heartbeat and/or movements in the comfort of their own home
	Characteristics applicable to low-resource settings	Currently sold only in Canada and the United States. Designed for home use in developed countries. Portable. Durable. Requires AA batteries and transducer gel.
	Features	200S model has a 2MHz probe and provides sound only. 200T model has a 3MHz probe and provides both sound and an LCD display.
	Pre-/post-sales support	No
	Approximate price	US\$75 (200S model) US\$120 (200T model)
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	NO

WIND-UP FETAL DOPPLER



(PROTOTYPE IN TESTING)

Basic information	Manufacturer	Powerfree Education Technology (PET) in collaboration with Philips Healthcare (Philips Africa Innovation Hub)
	Link	www.pet.org.za and www.philips.com
	Manufacturer description	The Wind-up Fetal Doppler is a device to easily and accurately count the fetal heart rate while the mother is in labor...Current methods to measure the fetal heart rate are either too expensive, too inaccurate or rely on replaceable batteries or electricity to run; the Wind-up Fetal Doppler is especially designed to empower midwives and delivering nurses to give better care.
	Characteristics applicable to low-resource settings	Hand-crank charging. Designed to be used with ultrasound gel or water. Portable. Durable.
	Features	2MHz probe, display screen shows the fetal heart rate, heart icon flashes with each heartbeat, and loudspeaker.
	Pre-/post-sales support	Yes
	Approximate price	Unknown
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	NO

SECTION II:

CARDIOTOGRAPHY

SONICAID ONE RATE DISPLAY DOPPLER

Basic information	Manufacturer	ArjoHuntleigh
	Link	http://www.huntleigh-diagnostics.com/diagnostics/
	Manufacturer description	This compact Fetal Doppler has been designed to easily fit into the clinicians pocket. Its high sensitivity and wide beam coverage enable quick location of the fetal heart from early gestation to full term.
	Characteristics applicable to low-resource settings	Portable. Durable. Waterproof probe. Requires AA batteries. Long battery life (approx. 1000 one minute exams). Rechargeable battery option.
	Features	2MHz probe, battery operated, loud speaker, and LCD display.
	Pre-/post-sales support	Yes
	Approximate price	US\$650
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	NO

AVALON FM20 FETAL MONITOR

Basic information

Manufacturer	Phillips Healthcare
Link	http://www.healthcare.philips.com
Manufacturer description	The Avalon FM series fetal and maternal monitors are the first and only to offer automated coincidence detection (cross-channel verification) using Smart Pulse. This innovative feature allows automated maternal pulse detection via the Toco MP transducer without the need to monitor maternal SpO ₂ or ECG separately.
Characteristics applicable to low-resource settings	Requires electricity. Requires many accessories and consumables. Phillips is a market leader in fetal monitoring for developing countries.
Features	Separate maternal pulse measurement; continuous monitoring during transport in healthcare facilities; optional integrated monitoring of maternal pulse rate and blood pressure; external fetal heart rate monitoring, uterine activity and fetal movement; an extensive set of internal fetal parameters (ex: direct fetal heart rate and uterine pressure); and optional maternal SpO ₂ monitoring.
Pre-/post-sales support	Yes
Approximate price	US\$5,600

Purpose of device

Fetal heartbeat detection	✓
Monitor strength/duration of uterine contractions	✓
Fetal movement detection	✓
Measure umbilical cord blood flow	NO

COROMETRICS 170

SERIES FETAL

MONITOR

Basic information	Manufacturer	GE
	Link	http://www3.gehealthcare.in/en/
	Manufacturer description	Delivering cost-effective, reliable, and accurate fetal monitoring with mother's comfort in mind
	Characteristics applicable to low-resource settings	Requires electricity. Requires many accessories and consumables. GE is a market leader in fetal monitoring in developing countries.
	Features	Fetal heart rate alarm with visual and audible alerts, option to monitor twins, compatible with a GE mini telemetry unit to monitor ambulatory patients within the clinic/hospital, optional fetal movement detection software.
	Pre-/post-sales support	Yes
	Approximate price	US\$6,400 - \$8,400
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	✓
	Fetal movement detection	✓
	Measure umbilical cord blood flow	NO

SONICAID BD4000XS (ENTRY LEVEL)

Basic information	Manufacturer	ArjoHuntleigh
	Link	www.huntleigh-diagnostics.com
	Manufacturer description	The BD4000xs series fetal monitors provide solutions for all areas of antenatal fetal monitoring. Using state of the art digital signal processing technology with enhanced FHR performance. This provides the most cost effective and flexible solution for all your fetal monitoring needs. Its compact size and styling belie its ruggedness and robust design, using the same materials, construction and design expertise as our world-renowned handheld Dopplers.
	Characteristics applicable to low-resource settings	Requires electricity. Requires many accessories and consumables.
	Features	Twins capability is standard, automatic fetal movement detection and maternally sensed fetal movement marker, hospital information system and vital signs monitor interface, alerts for multiple event types.
	Pre-/post-sales support	Yes
	Approximate price	US\$8,400
Purpose of device	Fetal heartbeat detection	✓
	Monitor strength/duration of uterine contractions	✓
	Fetal movement detection	✓
	Measure umbilical cord blood flow	NO

SECTION III:

UMBILICAL ARTERY DOPPLER

Please note:

Evaluation of placental function is generally performed by assessing the blood flow through the umbilical arteries using a pulsed-wave Doppler ultrasound machine. Such machines have a variety of medical uses, but are not within the scope of this guide. The umbilical artery Doppler included in this guide (the Umbiflow) was designed specifically for the purpose of assessing placental function in low-resource settings and is not indicated for other medical purposes.

UMBIFLOW

Basic information	Manufacturer	CSIR Material Science and Manufacturing
	Link	http://innovation.mrc.ac.za
	Manufacturer description	A sophisticated portable continuous wave Doppler with bi-directional indication of blood flow velocity in the umbilical cord. This type of ultrasound Doppler technology allows health care practitioners to assess placental function...The Doppler measurement is used to recommend specialist intervention should the fetus be at risk.
	Characteristics applicable to low-resource settings	Portable. Developed in South Africa for use by nursing staff and midwives in primary care settings in remote and low-resource areas. Doppler probe connects to a standard PC or laptop. Clinical assessment technology provides guidance to operator.
	Features	Captured data is automatically compared to the onboard proprietary clinical database information and a clinical assessment is suggested to the clinician or midwife. Reduces referral to secondary level care by providing accurate assessment of fetal risk.
	Pre-/post-sales support	Yes
Purpose of device	Approximate price	Unknown
	Fetal heartbeat detection	NO
	Monitor strength/duration of uterine contractions	NO
	Fetal movement detection	NO
	Measure umbilical cord blood flow	✓

This guide to selection is part of a six-piece series of Survive and Thrive guides, including birthing and cesarean section simulators, continuous positive airway pressure (CPAP), fetal monitors, portable ultrasound, rechargeable lighting, and thermoregulation devices. You can search for any of these guides in the PATH Publications Catalogue at <http://www.path.org/publications/index.php>.

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