

BREATHING

Late preterm babies have a wide range of breathing abilities. Some babies can breathe maturely as soon as they are born, while others may need assistance with their breathing. Late preterm babies may have difficulty breathing properly because their lungs are not fully mature, extra fluid is in their lungs, or they have an infection. Some late preterm infants may also have pauses in their breathing because the breathing center in their brain is not yet mature.

Babies need to stay in the hospital until these signs of immature breathing resolve. Parents may be surprised, and possibly frightened, that a baby at this gestational age would have any of these breathing difficulties and require a longer time in the hospital. However, this is actually quite common and regardless of the extra support or time in the hospital that late preterm infants need, these respiratory issues are short-term. Most infants are ready to go home around their due date.

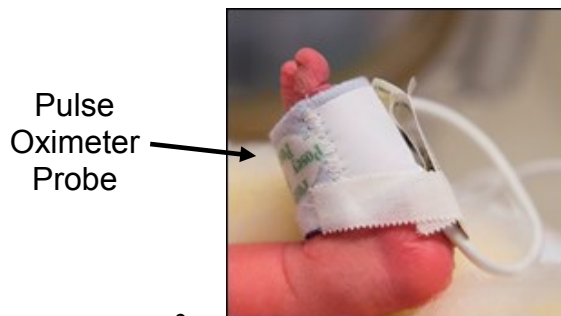
Signs of Breathing Difficulty

A baby who has difficulty breathing is described as having *respiratory distress*, which is an increased work of breathing. There are 5 ways that an infant can show this distress. Parents and family members might notice these signs, which are described as follows:

1. Breathing fast, also known as *tachypnea*, is the most common sign of breathing difficulty in the late preterm

baby. A normal breathing rate for an infant is 40 to 60 breaths per minute. A baby who has tachypnea consistently breathes at a rate of more than 60 breaths per minute, sometimes up to 120 breaths per minute.

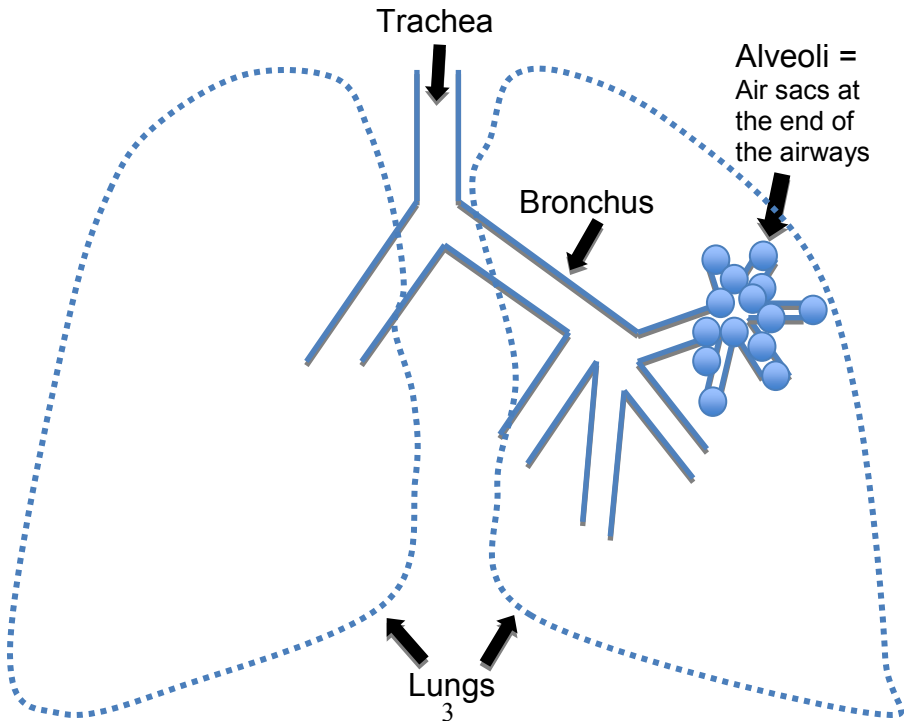
2. Grunting can be heard when a baby is exhaling. The sound is similar to groaning. This is a sign that the infant is trying to keep as much air in his/her lungs as possible.
3. Retractions can be seen on a baby's chest when the muscles between the ribs or under the diaphragm are pulling inward. This is a sign that the baby is using a lot of effort to breathe.
4. Nasal flaring occurs when a baby's nostrils expand for a few seconds with each breath. This happens because the baby is trying to make as much room as possible for air to pass through.
5. Cyanosis is a bluish color to a baby's lips, tongue or skin. Cyanosis is a sign that the baby needs more oxygen. A *pulse oximeter* is a monitor that helps to measure the baby's need for oxygen. This band-aid looking device most often is placed on the baby's toe, foot, palm, or wrist (see the picture below). It measures the oxygen saturation, which is the amount of oxygen carried by red blood cells in small blood vessels known as capillaries.



Babies may have any combination of these signs, which can be characterized as mild, moderate or severe respiratory distress. The more signs and the more severe those signs are, the more likely that a baby will need help to support his/her breathing. Families may feel anxious if their baby has respiratory distress. But, they should be reassured that this is a common finding in preterm infants that is treatable and will resolve in a short period of time.

Causes of Breathing Difficulty

Late preterm infants may have respiratory distress because their lungs are immature. This means that they are not producing enough of a protein called *surfactant*. Surfactant is produced by specialized cells in the lungs and coats the air sacs in the lungs, known as *alveoli*. A diagram of the lungs is shown below.



This is an excerpt from: Brodsky D, Quinn M. *A Parent's Guide to the Late Preterm Infant*. Lulu. 2014.

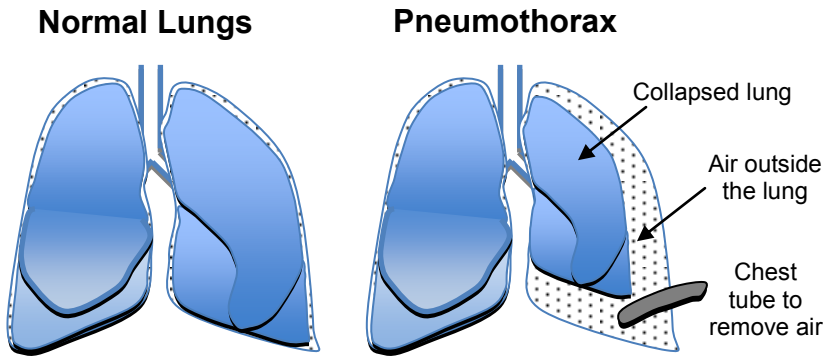
The coating of surfactant within the alveoli helps these sacs to stay open, allowing the maximal amount of air to enter the alveoli. When this air reaches the alveoli, the oxygen in the air can pass from the alveoli into the blood vessels that lie next to the alveoli. Oxygen is then transported through the blood to the rest of the baby's body.

If a baby does not have enough surfactant, some of the air sacs can collapse. If this happens, a baby responds by breathing harder to try to open the air sacs. In this situation, the infant can be described as having *surfactant deficiency*, also known as *respiratory distress syndrome (RDS)* or *hyaline membrane disease (HMD)*. All of these terms are interchangeable. Within a short time, late preterm infants with surfactant deficiency will be able to make enough surfactant to keep their air sacs open.

Different factors during pregnancy can influence when the lungs of an infant mature. For example, the lungs of a baby born to a mother with diabetes may mature later while the lungs of a baby born to a mother with high blood pressure may mature earlier. Tests on the amniotic fluid may help predict if the lungs of a baby are mature. In addition to pregnancy factors that impact lung development, the baby also plays a role in surfactant production. Indeed, each baby is unique and matures on an individual timeline.

A small number of infants with surfactant deficiency may develop a *pneumothorax*. This occurs when one or more alveoli expands

too much, creating a small hole that allows air to leak outside the sac. This displaced air collects outside of the lung, putting pressure on the lung and preventing the remaining air sacs from expanding. Infants can have a pneumothorax involving one or both lungs. A pneumothorax may lead to significant breathing difficulties until the air is either removed or reabsorbed by the infant's body. A diagram of a pneumothorax is shown below.



When an infant has a pneumothorax, air outside the lung prevents the lung from expanding, leading to a collapsed lung. A chest tube can be placed to drain the extra air and allow the lung to re-expand.

Another cause of breathing difficulty is *transient tachypnea of the newborn*, known as TTN. TTN is caused by fluid remaining in the infant's lungs. In utero, all babies have fluid in their airways and air sacs. After delivery, this fluid needs to be reabsorbed by the body so that the lungs can fill with air. Sometimes, this reabsorption happens soon after birth. Infants can develop TTN if

this process takes a longer period of time (several hours to a few days).

TTN can occur in full-term as well as preterm infants. Infants born by Cesarean delivery to mothers who did not experience labor are more likely to develop TTN. Infants with TTN typically have less severe respiratory distress than babies with immature lungs. Affected infants usually have tachypnea (an increase in the respiratory rate) that improves by 72 hours of age.

Additional causes of respiratory distress in a baby include pneumonia, a bloodstream infection, and abnormal structure of the heart or lungs. Babies with any of these issues often need additional tests to identify the cause of the breathing difficulty.

Evaluation of Breathing Difficulty

To determine the cause of respiratory distress in the late preterm infant, a chest x-ray is sometimes helpful. In infants with RDS, the collapsed alveoli will appear as tiny dots on an x-ray. A chest x-ray may also show that the lungs are not fully expanded.

In infants with TTN, the fluid remaining in the lung can be seen as lines on a chest x-ray. Infants with pneumonia may have x-rays that show one or more areas of the lung that lack air because of an infection. Some abnormalities of the heart or lung have specific patterns that can also be identified on a chest x-ray.

Unlike the chest x-ray of a baby with RDS, TTN or pneumonia, the chest x-ray of an infant with a pneumothorax shows a pocket of air

outside of the lung. *Transillumination* is another way to assess for a pneumothorax. This technique involves placing a bright light directly onto the infant's chest wall. When air is present outside the lungs, the light shows this air under the skin.

Some infants with breathing difficulties have an initial chest x-ray that helps pinpoint a diagnosis. However, other infants may require additional x-rays over the first few hours or days of life to clarify the cause of respiratory distress.

A *blood gas* is a blood test that measures how well the baby's lungs are working. This test measures the amount of oxygen and carbon dioxide in the blood. The blood can be collected from an infant's vein (*venous blood gas*), artery (*arterial blood gas*) or heel (*capillary blood gas*). If a baby's lungs are not working well, the oxygen level will be low and the carbon dioxide level will be increased. The results of a blood gas can help determine the type of treatment that the baby will need.

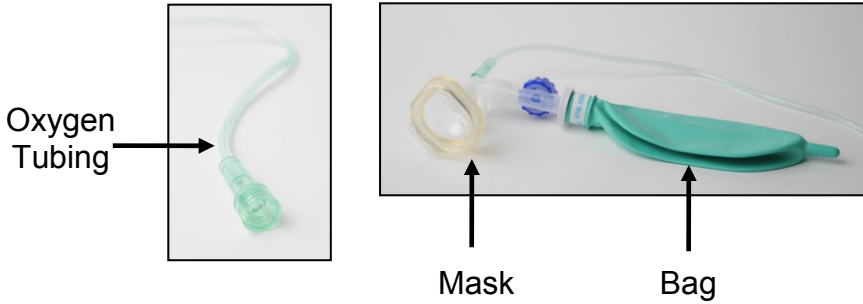
Treatment of Breathing Difficulty

The treatment of an infant with breathing difficulty will depend on many things, such as the:

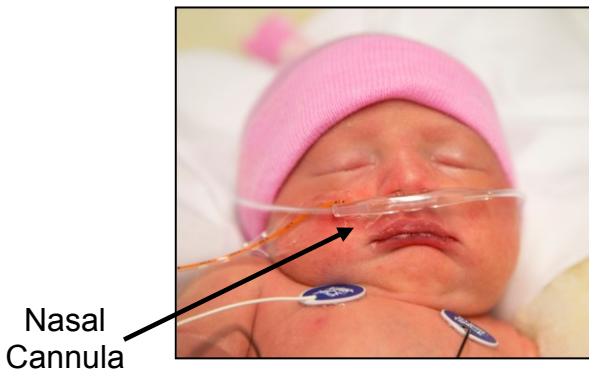
- Cause of the respiratory distress,
- Severity of the respiratory distress, and
- Results of the blood gas.

Infants who have respiratory distress will be observed closely. Babies with respiratory distress will often be monitored with a pulse oximeter to determine if the baby needs extra oxygen or more breathing support.

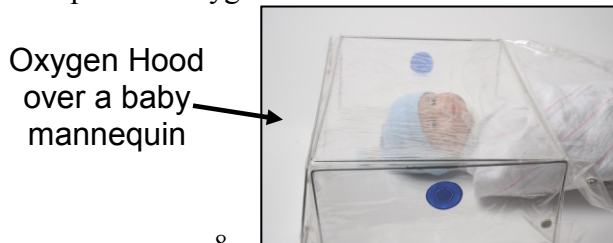
Oxygen can be provided to an infant in many ways. It can flow in front of a baby's face by loose tubing or by a mask attached to a bag with tubing (see the pictures below).



Oxygen can also be provided to an infant by a small soft plastic tubing placed directly into the infant's nose, called a *nasal cannula*.

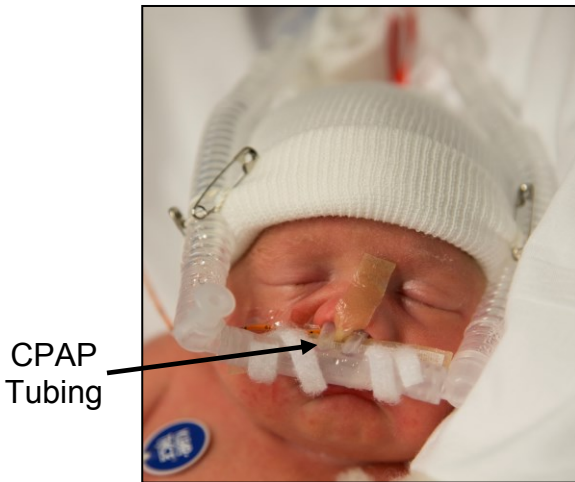


Sometimes a large plastic shield called an *oxygen hood* is placed over a baby's head to provide oxygen.



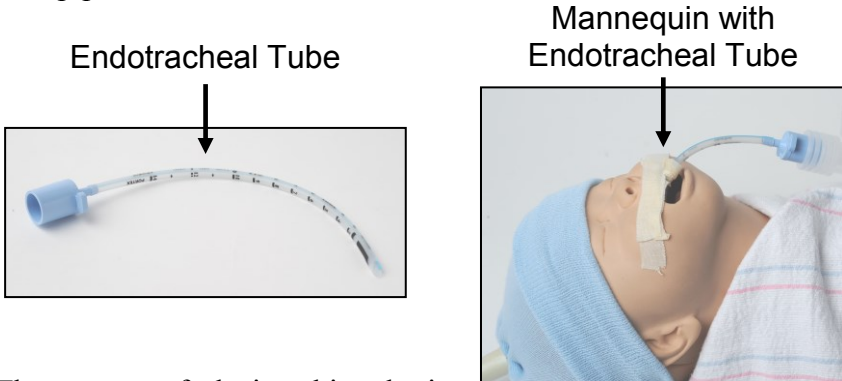
When receiving extra oxygen by any of these methods, the baby is still doing all the breathing on his/her own.

If an infant requires more support, *continuous positive airway pressure* (CPAP) can be used. CPAP provides the infant's lungs with a small amount of pressure and oxygen to help keep the small air sacs continuously open. CPAP is delivered to a baby by small prongs or a tube placed in the infant's nose, which is connected to larger tubing.

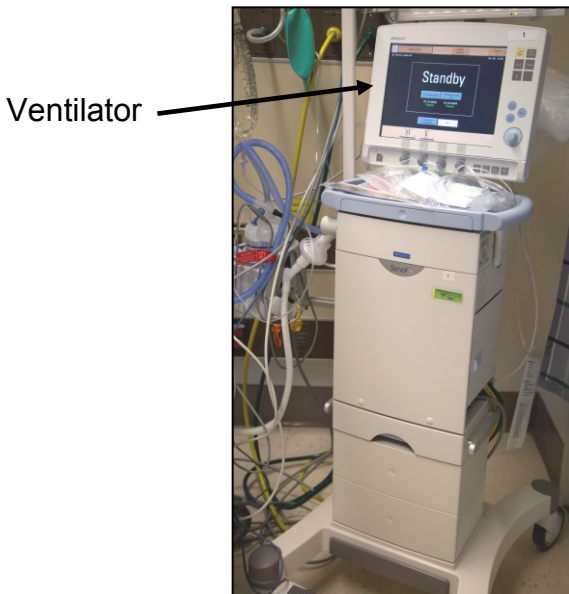


The CPAP provides a constant flow of air and extra oxygen using a bubble set-up or by using the CPAP mode on a ventilator. CPAP ensures that there is always a small amount of air left in the lungs at all times to prevent collapse of the air sacs. When an infant is receiving CPAP, he/she continues to do most of the work of breathing on his/her own.

For infants who require even more breathing support, mechanical ventilation is used. A small, soft tube, called an *endotracheal tube* (ETT), is placed through the infant's mouth or nose and into the windpipe, called the *trachea*.



The process of placing this tube into the infant's trachea is called *intubation*. This tube then extends outside of the mouth or nose to a longer piece of tubing that connects to a *ventilator*.



Similar to CPAP, a ventilator provides extra oxygen and a small amount of pressure to the lungs at all times to prevent the air sacs from collapsing. But, a ventilator does even more work than CPAP by providing some breaths with a higher pressure to help inflate the air sacs.

Infants who have surfactant deficiency and need the help of a ventilator are often given artificial surfactant through their endotracheal tube. This medication helps to keep the infant's air sacs open until the infant's lungs are making enough surfactant. As the infant's lungs mature, the infant will need less support from the ventilator.

When the infant is doing most of the work to breathe, the breathing tube can be removed. This removal process is called *extubation*.

We have described three different ways of helping a baby to breathe more effectively: (1) oxygen, (2) CPAP, and (3) a ventilator. Some babies may need one of these and others may require all three types of support at different times during their hospital stay. For example, an infant may first be placed on CPAP in the first few hours of life but then may require a change to a ventilator because of increasing respiratory distress and/or need for more oxygen. On the other hand, an infant may require intubation shortly after birth and need the ventilator for a day or two. After the breathing tube is removed, the baby may still need CPAP or supplemental oxygen for days to weeks.

Other Treatments

When a newborn first develops respiratory distress, the cause is not always clear. Because infections are common in preterm infants, the doctors and nurses may consider infection as a possible cause of a baby's breathing difficulties. In this case, they will order blood tests to evaluate for a possible infection and may start antibiotics. The length of the antibiotic treatment will depend on the baby's laboratory tests, chest x-ray findings, and final diagnosis.

If a baby is requiring additional support to help with his/her breathing, the infant may not be able to eat. During this time, the baby will receive sugar and fluids from a soft catheter placed in the baby's vein. This fluid is called *intravenous fluid* or IV fluid. If an infant is ready to start feedings but still needs some support with breathing, feedings of breast milk or formula can be given through a soft, plastic temporary feeding tube (See Feeding Chapter).

If an infant has a pneumothorax, the baby may not require treatment because the air reabsorbs spontaneously. Other babies may need treatment to remove the air outside of the lungs. In this case, the air can be removed by inserting a small needle over one of the infant's ribs and into the space outside of the lung where the air has collected. Once the needle is in the appropriate space, the air can be withdrawn using a syringe. This procedure may need to be repeated if the air accumulates again. If air continues to collect outside of the lung, a small soft plastic drainage tube known as a *chest tube* can be placed through a small incision over a rib and into the same collection of air (see Figure on page 20). This tube is then connected to a gentle suction system to continuously drain the air until the lung heals. While a chest tube is in place, infants may

need more frequent x-rays to evaluate how well the lungs are healing.

Breathing Immaturity

When babies are born early, their breathing patterns are often immature. This means that infants sometimes take shallow breaths or have some pauses in their breathing. If these pauses are short, this is known as *periodic breathing*. Longer pauses are called *apnea*. Each infant's breathing pattern matures at a different pace. Some late preterm infants have mature breathing patterns when they are born while others may take several weeks to achieve maturity. Most infants have a mature breathing pattern by their due date.

When infants have apnea, this can lead to a decrease in their heart rate (called *bradycardia*) and/or a decrease in their oxygen saturation (called a *desaturation*). Other terms used for these episodes are: brady, desat, or *spell*. The medical term for this is *apnea of prematurity*. These events can be recorded on a monitor that measures the infant's heart rate, breathing rate, and oxygen saturation (see Hospital Care Chapter).

A late preterm infant may need to be observed in the hospital for a period of time before being discharged home until he/she demonstrates a mature breathing pattern. The infant's breathing pattern is mature when he/she is no longer having these events.

A few late preterm babies may have persistent spells or many episodes of bradycardia or desaturation and may need to be treated

with *caffeine*. Caffeine is a medication that is a variant of the kind of caffeine found in coffee and soda and it can be given to a baby by mouth, in a feeding tube, or in an IV. Caffeine helps infants to “remember to breathe” and take deeper breaths. Although caffeine treatment does not stop all of the spells, infants typically respond by having a fewer number of episodes per day. Caffeine will be discontinued when the infant is having fewer episodes and closer to term gestation.

Some late preterm infants have episodes of bradycardia and/or desaturations when they are breast or bottle feeding. This occurs because their reflexes are immature and they are not able to coordinate sucking, swallowing, and breathing at the same time. Some infants may need to be observed for a period of time in the hospital until they demonstrate mature eating patterns along with mature breathing patterns.

When an infant requires an extended period of observation in the hospital, it is often frustrating for families because the baby otherwise appears healthy and ready to go home. This additional time in the hospital is important because the health care team wants to be confident that your baby is mature and therefore safe, to go home.

Conclusion

Late preterm infants have a wide range of breathing abilities in their first few days or weeks after birth. Some babies may need further assistance with their breathing or other medical treatments. Babies may need to be observed in a SCN/NICU until their

breathing pattern is mature. While it's difficult for parents to have their baby remain in the hospital, be reassured that these breathing concerns will resolve and will not impact the baby's long-term breathing abilities. These breathing issues are actually quite common in late preterm infants and the health care team will follow your baby's cues to determine when he or she is mature and ready to go home.