Cerebral Palsy

What is Cerebral Palsy?
Doctors use the term cerebral palsy to refer to any one of a number of neurological disorders that appear in infancy or early childhood and **permanently affect body movement and muscle coordination but are not progressive**, in other words, they do not get worse over time.

- **Cerebral** refers to the motor area of the brain's outer layer (called the cerebral cortex), the part of the brain that directs muscle movement.
- **Palsy** refers to the loss or impairment of motor function.

Even though cerebral palsy affects muscle movement, it is not caused by problems in the muscles or nerves. It is caused by abnormalities inside the brain that disrupt the brain's ability to control movement and posture.

In some cases of cerebral palsy, the cerebral motor cortex has not developed normally during fetal growth. In others, the damage is a result of injury to the brain either before, during, or after birth. In either case, the damage is not repairable and the **disabilities that result are permanent**.

Patients with cerebral palsy exhibit a wide variety of **symptoms**, including:
- Lack of muscle coordination when performing voluntary movements (ataxia);
- Stiff or tight muscles and exaggerated reflexes (spasticity);
- Walking with one foot or leg dragging;
- Walking on the toes, a crouched gait, or a "scissored" gait;
- Variations in muscle tone, either too stiff or too floppy;
- Excessive drooling or difficulties swallowing or speaking;
- Shaking (tremor) or random involuntary movements; and
- Difficulty with precise motions, such as writing or buttoning a shirt.

The symptoms of cerebral palsy differ in type and severity from one person to the next, and may even change in an individual over time. Some people with cerebral palsy also have other medical disorders, including mental retardation, seizures, impaired vision or hearing, and abnormal physical sensations or perceptions.

Cerebral palsy does not always cause profound disabilities. While one patient with severe cerebral palsy might be unable to walk and need extensive, lifelong care, another with mild cerebral palsy might be only slightly awkward and require no special assistance.

Cerebral palsy is not a disease. It is not contagious and it cannot be passed from one generation to the next. There is no cure for cerebral palsy, but supportive treatments, medications, and surgery can help many individuals improve their motor skills and ability to communicate with the world.

How Many People Have Cerebral Palsy?

The United Cerebral Palsy (UCP) Foundation estimates that nearly 800,000 children and adults in the United States are living with one or more of the symptoms of cerebral palsy. According to the federal government's Centers for Disease Control and Prevention, each year about 10,000 babies born in the United States will develop cerebral palsy.

What are the Early Signs?

The **early signs** of cerebral palsy:

- Usually appear before a child reaches 3 years of age.
- Parents are often the first to suspect that their baby's motor skills are not developing normally.
- Infants with cerebral palsy frequently have developmental delay, in which they are slow to reach developmental milestones such as learning to roll over, sit, crawl, smile, or walk.
- Some infants with cerebral palsy have abnormal muscle tone as infants.
- Decreased muscle tone (hypotonia) can make them appear relaxed, even floppy.
- Increased muscle tone (hypertonia) can make them seem stiff or rigid.
- In some cases, an early period of hypotonia will progress to hypertonia after the first 2 to 3 months of life.
- Children with cerebral palsy may also have unusual posture or favor one side of the body when they move.

What Causes Cerebral Palsy?

The majority of patients with cerebral palsy are born with it, although it may not be detected until months or years later. This is called **congenital cerebral palsy**. In the past, if doctors could not identify another cause, they credited most cases of congenital cerebral palsy to problems or complications during labor that caused a lack of oxygen (asphyxia) during

birth. Birth complications, including asphyxia, are estimated to account for only 5 to 10 percent of the babies born with congenital cerebral palsy.

A small number of patients have **acquired cerebral palsy**, which means the disorder began after birth. In these cases, doctors can often pinpoint a specific reason for the problem, such as brain damage in the first few months or years of life, brain infections such as bacterial meningitis or viral encephalitis, or head injury from a motor vehicle accident, a fall, or child abuse.

What causes the remaining 90 to 95 percent? There are multiple reasons why cerebral palsy happens: as the result of genetic abnormalities, maternal infections or fevers, or fetal injury.

In **all cases, the disorder is the result of four types of brain damage** that cause its characteristic symptoms:

Damage to the white matter of the brain (periventricular leukomalacia [PVL])	• The white matter is responsible for transmitting signals inside the brain and to the rest of the body. • PVL damage looks like tiny holes in the white matter of an infant's brain. • These gaps in brain tissue interfere with the normal transmission of signals. • There are a number of events that can cause PVL, including maternal or fetal infection. • White matter is particularly sensitive to insults and injury between 26 and 34 weeks of gestation.
Abnormal development of the brain (cerebral dysgenesis)	• Any interruption of the normal process of brain growth during fetal development can cause brain malformations that interfere with the transmission of brain signals. • The fetal brain is particularly vulnerable during the first 20 weeks of development. • Gene mutations, infections, fevers, trauma, or other conditions that cause unhealthy conditions in the womb all may affect brain development.

Bleeding in the brain (intracranial hemorrhage)	• Caused by blocked or broken blood vessels. • Some babies suffer a stroke while still in the womb because of blood clots in the placenta that block blood flow. Other types of fetal stroke are caused by malformed or weak blood vessels in the brain or by blood-clotting abnormalities. • Maternal hypertension or pelvic inflammatory disease may also cause fetal stroke.
Brain damage caused by a lack of oxygen in the brain (hypoxic-ischemic encephalopathy or intrapartum asphyxia)	• Caused by an interruption in breathing or poor oxygen supply, is common in babies due to the stress of labor and delivery. • Can also be caused by severe maternal low blood pressure, rupture of the uterus, detachment of the placenta, or problems involving the umbilical cord.

What are the Risk Factors?

If a mother or her baby has any of these risk factors, it does not mean that cerebral palsy is inevitable, but it does increase the chance for the kinds of brain damage that cause it.

Low birth weight and premature birth	• Higher among babies who weigh less than 5½ pounds at birth or are born less than 37 weeks. • Risk increases as birth weight falls or weeks of gestation shorten.
Multiple births	• Twins, triplets, and other multiple births – even those born at term – are linked to increased risk of cerebral palsy. • The death of a baby's twin or triplet further increases the risk.
Infections during pregnancy	• Inflammatory response to infection releases Cytokines (immune system cells). • Inflammation may cause central nervous system damage in an unborn baby.

Blood type incompatibility	• A mother's Rh blood type (either positive or negative) is different from the blood type of her baby. • Mother's body will begin to make antibodies that will attack and kill her baby's blood cells.
Exposure to toxic substances	• Exposure to toxic substances during pregnancy, such as methyl mercury, heightens the risk of having a baby with cerebral palsy.
Mothers with thyroid abnormalities, mental retardation, or seizures	• Mothers with any of these conditions are slightly more likely to have a child with cerebral palsy.

Warning signs of CP include:

Breech presentation	• Babies with cerebral palsy are more likely to be in a breech position (feet first) instead of head first at the beginning of labor.
Complicated labor and delivery	• A baby who has vascular or respiratory problems during labor and delivery may already have suffered brain damage or abnormalities.
Small for gestational age	• Risk because of factors that kept them from growing naturally in the womb.
Low Apgar score	• A low score at 10-20 minutes after delivery is often considered an important sign of potential problems such as cerebral palsy.
Jaundice	• Severe, untreated jaundice can cause a neurological condition known as kernicterus, which kills brain cells and can cause deafness and cerebral palsy.
Seizures	• An infant who has seizures faces a higher risk of being diagnosed later in childhood with cerebral palsy.

What are the Different Forms?

The specific forms of cerebral palsy are determined by the extent, type, and location of a patient's abnormalities. Classification is according to the type of movement disorder involved – spastic (stiff muscles), athetoid (writhing movements), or ataxic (poor balance and coordination) – plus any additional symptoms.

Spastic hemiplegia/ hemiparesis	• Typically affects the arm and hand on one side of the body, but it can also include the leg. • Generally walk later and on tip-toe because of tight heel tendons. • May develop scoliosis or seizures. • Speech will be delayed. • Intelligence is usually normal.
Spastic diplegia/ diparesis	• Muscle stiffness is predominantly in the legs and less severely affects the arms and face. • Hands may be clumsy. • Tendon reflexes are hyperactive. Toes point up. • Tightness in certain leg muscles makes the legs move like the arms of a scissor. • May require a walker or leg braces. • Intelligence and language skills are usually normal.
Spastic quadriplegia/ quadriparesis	• Most severe form of cerebral palsy, often associated with moderate-to-severe mental retardation. • Caused by widespread damage to the brain or significant brain malformations. • Often have severe stiffness in their limbs but a floppy neck. • Hard to understand and be understood. • Seizures can be frequent and hard to control.

Dyskinetic cerebral palsy	• Characterized by slow and uncontrollable writhing movements of the hands, feet, arms, or legs. • In some patients, hyperactivity in the muscles of the face and tongue makes them grimace or drool. • Difficult to sit straight or walk. • Have problems coordinating the muscle movements required for speaking. • Intelligence is rarely affected.
Ataxic cerebral palsy	• Rare type of cerebral palsy affects balance and depth perception. • Often have poor coordination and walk unsteadily with a wide-based gait, placing their feet unusually far apart. • May also have intention tremor, in which a voluntary movement, such as reaching for a book, is accompanied by trembling that gets worse the closer their hand gets to the object.
Mixed types	• Common for patients to have symptoms that do not correspond to any single type of cerebral palsy.

What Other Conditions are Associated with Cerebral Palsy?
Many individuals will have no additional medical disorders. However, because cerebral palsy involves the brain and the brain controls so many of the body's functions, cerebral palsy can also cause:

Mental retardation	• Two-thirds of individuals with cerebral palsy will be intellectually impaired.
Seizure disorder	• As many as half of all patients with cerebral palsy have seizures.
Delayed growth and development	• A syndrome called failure to thrive is common in children with moderate-to-severe cerebral palsy, especially those with spastic quadriparesis. • Muscles and limbs affected by cerebral palsy tend to be smaller than normal.

Spinal deformities	• Curvature (scoliosis), humpback (kyphosis), and saddle back (lordosis). • Spinal deformities can make sitting, standing, and walking difficult and cause chronic back pain.
Impaired vision, hearing, or speech	• A large number of patients with cerebral palsy have strabismus, commonly called "cross eyes." • Untreated, this can lead to poor vision in one eye and can interfere with the ability to judge distance. • Patients with hemiparesis may have hemianopia, defective vision or blindness that blurs the normal field of vision in one eye. • Hearing impairment is frequent. • More than a third have speech and language disorders.
Drooling	• Occurs due to poor control of the muscles of the throat, mouth, and tongue.
Incontinence	• Caused by poor control of the muscles that keep the bladder closed. • Can take the form of bed-wetting, uncontrolled urination during physical activities, or slow leaking of urine throughout the day.
Abnormal sensations and perceptions	• May have difficulty feeling simple sensations, such as touch. • May have stereognosia, which makes it difficult to perceive and identify objects using only the sense of touch.

Coping with these disabilities may be even more of a challenge than coping with the motor impairments of cerebral palsy.

How Does a Doctor Diagnose Cerebral Palsy?

Doctors diagnose cerebral palsy by evaluating a person's motor skills and taking a careful and thorough look at their medical history. In addition to checking for the most characteristic symptoms – slow development, abnormal muscle tone, and unusual posture – a doctor also has to rule out other disorders that could cause similar symptoms. Most important, a

doctor has to determine that the condition is not getting worse. Although symptoms may change over time, cerebral palsy by definition is not progressive. If a person is continuously losing motor skills, the problem more likely begins elsewhere – such as a genetic or muscle disease, metabolism disorder, or tumors in the nervous system.

How is Cerebral Palsy Managed?

Cerebral palsy cannot be cured, but treatment will often improve a person's capabilities. Many people go on to enjoy near-normal adult lives if their disabilities are properly managed. In general, the earlier treatment begins the better chance of overcoming developmental disabilities or learning new ways to accomplish the tasks that challenge them.

Addressing the needs of parents and caregivers is also an important component of the treatment plan. The well-being of an individual with cerebral palsy depends upon the strength and well-being of his or her family.

A comprehensive management plan will pull in a combination of health professionals with expertise in the following:

Physical therapy	• To improve walking and gait, stretch spastic muscles, and prevent deformities from contractures. • **Resistive exercise programs** (also called strength training) and other types of exercise are often used to increase muscle performance, especially in children and adolescents with mild cerebral palsy.
Occupational therapy	• To develop compensating tactics for everyday activities such as dressing, going to school, and participating in day-to-day activities. • Helps master the basic activities of daily living, such as eating, dressing, and using the bathroom alone.
Speech therapy	• To address swallowing disorders, speech impediments, and other obstacles to communication.
Counseling and behavioral therapy	• To address emotional and psychological needs and help children and their families cope emotionally with their disabilities.
Drugs	• To control seizures, relax muscle spasms, and alleviate pain.
Surgery	• To correct anatomical abnormalities or release tight muscles.

Braces and other orthotic devices	• To compensate for muscle imbalance, improve posture and walking, and increase independent mobility.
Mechanical aids	• Such as wheelchairs and rolling walkers for individuals who are not independently mobile.
Communication aids	• Such as computers, voice synthesizers, or symbol boards to allow severely impaired individuals to communicate with others.

Recreational therapies. Recreational therapies, such as therapeutic horseback riding (also called hippotherapy), are sometimes used with the mildly impaired to improve gross motor skills. Parents of children who participate in recreational therapies usually notice an improvement in their child's speech, self-esteem, and emotional well-being.

Treatments for problems with eating and drooling are often necessary when patients with cerebral palsy have difficulty eating and drinking because they have little control over the muscles that move their mouth, jaw, and tongue putting them at risk for breathing food or fluid into the lungs. Some patients develop gastroesophageal reflux disease (GERD, commonly called heartburn) in which a weak diaphragm cannot keep stomach acids from spilling into the esophagus. The irritation of the acid can cause bleeding and pain. Individuals with cerebral palsy are also at risk for malnutrition.

Treatments:

- Tube feeding either via naso-gastric tube or gastrostomy.
- Anticholinergic drugs – such as glycopyrolate – can reduce the flow of saliva but may cause unpleasant side effects, such as dry mouth, constipation, and urinary retention.
- Surgery, while sometimes effective, carries the risk of complications.
- Some benefit from biofeedback techniques that help them recognize more quickly when their mouths fall open and they begin to drool.
- Intraoral devices (devices that fit into the mouth) that encourage better tongue positioning and swallowing are still being evaluated, but appear to reduce drooling.

Drug Treatments

Oral medications	• Usually used as the first line of treatment to relax stiff, contracted, or overactive muscles. • Diazepam, baclofen, dantrolene sodium, and tizanidine. • Easy to use, dosages high enough to be effective often have side effects, among them drowsiness, upset stomach, high blood pressure, and possible liver damage with long-term use. • Most appropriate for those who need only mild reduction in muscle tone or who have widespread spasticity.
Botulinum toxin (BT-A)*	• Injected locally, has become a standard treatment for overactive muscles. • Relaxes contracted muscles by keeping nerve cells from over-activating muscle. • Lasts about 3 months; undesirable side effects are mild and short-lived (injection site pain, mild flu-like symptoms). • Works best for those who have some control over their motor movements and have a limited number of muscles to treat, none of which is fixed or rigid. *Because BT-A does not have FDA approval to treat spasticity in children, parents and caregivers should make sure that the doctor giving the injection is trained in the procedure and has experience using it in children.
Intrathecal baclofen	• Uses an implantable pump to deliver baclofen, a muscle relaxant, into the fluid surrounding the spinal cord. • Decreases the excitability of nerve cells in the spinal cord, which then reduces muscle spasticity throughout the body. • Intrathecal dose can be as low as 1/100th of the oral dose. • The pump is the size of a hockey puck and is implanted in the abdomen. It contains a refillable reservoir connected to an alarm that beeps when the reservoir is low. • As a muscle-relaxing therapy, is most appropriate for individuals with chronic, severe stiffness or

	uncontrolled muscle movement throughout the body. • Undesirable, but infrequent, side effects include overrelaxation of the muscles, sleepiness, headache, nausea, vomiting, dizziness, and constipation.

Assistive Technology
Devices that help individuals move about more easily and communicate successfully at home, at school, or in the workplace can help a child or adult with cerebral palsy overcome physical and communication limitations. There are a number of devices that help individuals stand straight and walk, such as postural support or seating systems, open-front walkers, quadrapedal canes (lightweight metal canes with four feet), and gait poles. Electric wheelchairs let more severely-impaired adults and children move about successfully.

The computer is probably the most dramatic example of a communication device that can make a big difference in the lives of people with cerebral palsy. Equipped with a computer and voice synthesizer, a child or adult with cerebral palsy can communicate successfully with others. For example, a child who is unable to speak or write but can make head movements may be able to control a computer using a special light pointer that attaches to a headband.

Alternative Therapies:

Therapeutic (subthreshold) electrical stimulation, also called neuromuscular electrical stimulation (NES), pulses electricity into the motor nerves to stimulate contraction in selective muscle groups. Many studies have demonstrated that NES appears to increase range of motion and muscular strength.

Threshold electrical stimulation, which involves the application of electrical stimulation at an intensity too low to stimulate muscle contraction, is a controversial therapy. Studies have not been able to demonstrate its effectiveness or any significant improvement with its use.

Hyperbaric oxygen therapy. Some children have cerebral palsy as the result of brain damage from oxygen deprivation. Proponents of hyperbaric oxygen therapy propose that the brain tissue surrounding the damaged area can be “awakened” by forcing high concentrations of oxygen into the body under greater than atmospheric pressure.

Adults with Cerebral Palsy: Special Health Challenges

Before the mid-twentieth century, few children with cerebral palsy survived to adulthood. Now, because of improvements in medical care, rehabilitation, and assistive technologies, 65 to 90 percent of children with cerebral palsy live into their adult years. This increase in life expectancy is often accompanied by a rise in medical and functional problems – some of them beginning at a relatively early age – including the following:

Premature aging because of the extra stress and strain the disease puts upon their bodies. The developmental delays that often accompany cerebral palsy keep some organ systems from developing to their full capacity and level of performance. As a consequence, organ systems such as the cardiovascular system (the heart, veins, and arteries) and pulmonary system (lungs) have to work harder and they age prematurely.

Functional issues at work. The day-to-day challenges of the workplace are likely to increase as an employed individual with cerebral palsy reaches middle age. Some individuals will be able to continue working with accommodations such as an adjusted work schedule, assistive equipment, or frequent rest periods. Early retirement may be necessary for others.

Depression. Mental health issues can also be of concern as someone with cerebral palsy grows older. The rate of depression is three to four times higher in people with disabilities such as cerebral palsy. It appears to be related not so much to the severity of their disabilities, but to how well they cope with them. The amount of emotional support someone has, how successful they are at coping with disappointment and stress, and whether or not they have an optimistic outlook about the future all have a significant impact on mental health.

Post-impairment syndrome. Most adults with cerebral palsy experience what is called post-impairment syndrome, a combination of pain, fatigue, and weakness due to muscle abnormalities, bone deformities, overuse syndromes (sometimes also called repetitive motion injuries), and arthritis. Fatigue is often a challenge, since individuals with cerebral palsy use three to five times the amount of energy that able-bodied people use when they walk and move about.

Osteoarthritis and degenerative arthritis. Abnormalities and muscles and bones that may not produce discomfort during childhood can cause pain in adulthood. For example, excessive joint compression can lead to the early development of painful osteoarthritis and degenerative arthritis.

Individuals with cerebral palsy also have limited strength and restricted patterns of movement, which puts them at risk for overuse syndromes and pinched nerves.

Pain. Issues related to pain often go unrecognized by health care providers since individuals with cerebral palsy may not be able to describe the extent or location of their pain. Pain can be acute or chronic, and is experienced most commonly in the hips, knees, ankles, and the upper and lower back. Individuals with spastic cerebral palsy have an increased number of painful sites and worse pain than those with other types of cerebral palsy. The best treatment for pain due to musculoskeletal abnormalities is preventive – correcting skeletal and muscle abnormalities early in life to avoid the progressive accumulation of stress and strain that causes pain. Dislocated hips, which are particularly likely to cause pain, can be surgically repaired. If it is managed properly, pain does not have to become a chronic condition.

Other medical conditions. Adults have higher than normal rates of other medical conditions secondary to their cerebral palsy, such as hypertension, incontinence, bladder dysfunction, and swallowing difficulties. Curvature of the spine (scoliosis) is likely to worsen after puberty, when bones have matured into their final shape and size. People with cerebral palsy also have a higher incidence of bone breaks, occurring most frequently during physical therapy sessions. A combination of mouth breathing, poor hygiene, and abnormalities in tooth enamel increase the risk of cavities and gum disease. Twenty-five to 39 percent of adults with cerebral palsy have vision problems; 8-18 percent have hearing problems.

Glossary of Terms:

acquired cerebral palsy – cerebral palsy that occurs as a result of injury to the brain after birth or during early childhood.

Apgar score – a numbered scoring system doctors use to assess a baby's physical state at the time of birth.

anticholinergic drugs – a family of drugs that inhibit parasympathetic neural activity by blocking the neurotransmitter acetylcholine.

asphyxia – a lack of oxygen due to trouble with breathing or poor oxygen supply in the air.

ataxia (ataxic) – the loss of muscle control.

athetoid – making slow, sinuous, involuntary, writhing movements, especially with the hands.

bilirubin – a bile pigment produced by the liver of the human body as a byproduct of digestion.
bisphosphonates – a family of drugs that strengthen bones and reduce the risk of bone fracture in elderly adults.
botulinum toxin – a drug commonly used to relax spastic muscles; it blocks the release of acetylcholine, a neurotransmitter that energizes muscle tissue.
cerebral – relating to the two hemispheres of the human brain.
cerebral dysgenesis – defective brain development.
chemodenervation – a treatment that relaxes spastic muscles by interrupting nerve impulse pathways via a drug, such as botulinum toxin, which prevents communication between neurons and muscle tissue.
choreoathetoid – a condition characterized by aimless muscle movements and involuntary motions.
computed tomography (CT) scan – an imaging technique that uses X-rays and a computer to create a picture of the brain's tissues and structures.
congenital cerebral palsy – cerebral palsy that is present at birth from causes that have occurred during fetal development.
contracture – a condition in which muscles become fixed in a rigid, abnormal position, which causes distortion or deformity.
cytokines – messenger cells that play a role in the inflammatory response to infection.
developmental delay – behind schedule in reaching the milestones of early childhood development.
disuse atrophy – muscle wasting caused by the inability to flex and exercise muscles.
dyskinetic – the impairment of the ability to perform voluntary movements, which results in awkward or incomplete movements.
dystonia (dystonic) – a condition of abnormal muscle tone.
electroencephalogram (EEG) – a technique for recording the pattern of electrical currents inside the brain.
electromyography – a special recording technique that detects muscle activity.
failure to thrive – a condition characterized by a lag in physical growth and development.
focal (partial) seizure – a brief and temporary alteration in movement, sensation, or autonomic nerve function caused by abnormal electrical activity in a localized area of the brain.
gait analysis – a technique that uses cameras, force plates, electromyography, and computer analysis to objectively measure an individual's pattern of walking.

gastroesophageal reflux disease (GERD) – also known as heartburn, which happens when stomach acids back up into the esophagus.
gastrostomy – a surgical procedure that creates an artificial opening in the stomach for the insertion of a feeding tube.
gestation – the period of fetal development from the time of conception until birth.
hemianopia – defective vision or blindness that impairs half of the normal field of vision.
hemiparesis – paralysis affecting only one side of the body.
homonymous – having the same description, name, or term.
hypertonia – increased muscle tone.
hypotonia – decreased muscle tone.
hypoxic-ischemic encephalopathy – brain damage caused by poor blood flow or insufficient oxygen supply to the brain.
intracranial hemorrhage – bleeding in the brain.
intrapartum asphyxia – the reduction or total stoppage of oxygen circulating in a baby's brain during labor and delivery.
intrathecal baclofen – baclofen that is injected into the cerebrospinal fluid of the spinal cord to reduce spasticity.
intrauterine infection – infection of the uterus, ovaries, or fallopian tubes (see pelvic inflammatory disease for a more detailed explanation).
jaundice – a blood disorder caused by the abnormal buildup of bilirubin in the bloodstream.
kernicterus – a neurological syndrome caused by deposition of bilirubin into brain tissues. Kernicterus develops in extremely jaundiced infants, especially those with severe Rh incompatibility.
kyphosis – a humpback-like outward curvature of the upper spine.
lordosis – an increased inward curvature of the lower spine.
magnetic resonance imaging (MRI) – an imaging technique that uses radio waves, magnetic fields, and computer analysis to create a picture of body tissues and structures.
nerve entrapment – repeated or prolonged pressure on a nerve root or peripheral nerve.
neuronal migration – the process in the developing brain in which neurons migrate from where they are born to where they settle into neural circuits. Neuronal migration, which occurs as early as the second month of gestation, is controlled in the brain by chemical guides and signals.
neuroprotective – describes substances that protect nervous system cells from damage or death.
neurotrophins – a family of molecules that encourage survival of nervous system cells.

off-label drugs – drugs prescribed to treat conditions other than those that have been approved by the Food and Drug Administration.
orthotic devices – special devices, such as splints or braces, used to treat posture problems involving the muscles, ligaments, or bones.
osteopenia – reduced density and mass of the bones.
overuse syndrome (also called repetitive strain injury) – a condition in which repetitive movements or constrained posture cause nerve and muscle damage, which results in discomfort or persistent pain in muscles, tendons, and other soft tissues. This can happen in various parts of the body, but is most likely to happen in the arms, legs, or hands.
palsy – paralysis, or the lack of control over voluntary movement.
paresis or -plegia – weakness or paralysis. In cerebral palsy, these terms are typically combined with other phrases that describe the distribution of paralysis and weakness. For example, quadriplegia means paralysis of all four limbs.
pelvic inflammatory disease (PID, also sometimes called pelvic infection or intrauterine infection) – an infection of the upper genital tract (the uterus, ovaries, and fallopian tubes) caused by sexually transmitted infectious microorganisms. Symptoms of PID include fever, foul-smelling vaginal discharge, abdominal pain and pain during intercourse, and vaginal bleeding. Many different organisms can cause PID, but most cases are associated with gonorrhea and chlamydia.
periventricular leukomalacia (PVL) – “peri" means near; "ventricular" refers to the ventricles or fluid spaces of the brain; and "leukomalacia" refers to softening of the white matter of the brain. PVL is a condition in which the cells that make up white matter die near the ventricles. Under a microscope, the tissue looks soft and sponge-like.
placenta – an organ that joins a mother with her unborn baby and provides nourishment and sustenance.
post-impairment syndrome – a combination of pain, fatigue, and weakness due to muscle abnormalities, bone deformities, overuse syndromes, or arthritis.
quadriplegia – paralysis of both the arms and legs.
respite care – rest or relief from caretaking obligations.
Rh incompatibility – a blood condition in which antibodies in a pregnant woman's blood attack fetal blood cells and impair an unborn baby’s supply of oxygen and nutrients.
rubella – (also known as German measles) a viral infection that can damage the nervous system of an unborn baby if a mother contracts the disease during pregnancy.
scoliosis – a disease of the spine in which the spinal column tilts or curves to one side of the body.

selective dorsal rhizotomy – a surgical procedure in which selected nerves are severed to reduce spasticity in the legs.
selective vulnerability – a term that describes why some neurons are more vulnerable than others to particular diseases or conditions. For example, motor neurons are selectively vulnerable to the loss or reduction in levels of the neurotransmitter dopamine, which results in the weakness and paralysis of amyotrophic lateral sclerosis (ALS, commonly called Lou Gehrig's disease).
spastic (or spasticity) – describes stiff muscles and awkward movements.
spastic diplegia (or diparesis) – a form of cerebral palsy in which spasticity affects both legs, but the arms are relatively or completely spared.
spastic hemiplegia (or hemiparesis) – a form of cerebral palsy in which spasticity affects an arm and leg on one side of the body.
spastic quadriplegia (or quadriparesis) – a form of cerebral palsy in which all four limbs are paralyzed or weakened equally.
stereognosia – difficulty perceiving and identifying objects using the sense of touch.
strabismus – misalignment of the eyes, also known as cross eyes.
telemetry wand – a hand-held device that acts as a remote control, directing the dosing level of a drug via a pump implanted beneath the skin.
tonic-clonic seizure – a type of seizure that results in loss of consciousness, generalized convulsions, loss of bladder control, and tongue biting followed by confusion and lethargy when the convulsions end.
tremor – an involuntary trembling or quivering.
ultrasound – a technique that bounces sound waves off tissue and bone and uses the pattern of echoes to form an image, called a sonogram.

Adapted from "Cerebral Palsy: Hope Through Research," National Institute of Neurological Disorders and Stroke (NINDS), NIH. Retrieved from www.ninds.nih.gov/disorders/cerebral_palsy**,** October 2013.