# Sleep Studies

Sleep studies are tests that measure how well you sleep and how your body responds to sleep problems. These tests can help your doctor find out whether you have a sleep disorder and how severe it is.

Sleep studies are important because untreated sleep disorders can raise your risk for heart disease, high blood pressure, stroke, and other medical conditions. Sleep disorders also have been linked to an increased risk of injury, such as falling (in the elderly) and car accidents.

People usually aren't aware of their breathing and movements while sleeping. They may never think to talk to their doctors about issues that might be related to sleep problems.

However, sleep disorders can be treated. Talk with your doctor if you snore regularly or feel very tired while at work or school most days of the week.

You also may want to talk with your doctor if you often have trouble falling or staying asleep, or if you wake up too early and aren't able to go back to sleep. These are common signs of a sleep disorder.

Your doctor might be able to diagnose a sleep disorder based on your sleep schedule and habits. However, he or she also might need the results from sleep studies and other medical tests to diagnose a sleep disorder.

Sleep studies can help diagnose:

- Sleep-related breathing disorders, such as sleep apnea
- Sleep-related seizure disorders
- Sleep-related movement disorders, such as periodic limb movement disorder
- Sleep disorders that cause extreme daytime tiredness, such as narcolepsy

Doctors might use sleep studies to help diagnose or rule out restless legs syndrome (RLS). However, RLS usually is diagnosed based on signs and symptoms, medical history, and a physical exam.

You can find more information about sleep and sleep disorders in the National Heart, Lung, and Blood Institute's "Your Guide to Healthy Sleep."

# Types of Sleep Studies - Sleep Studies

To diagnose sleep-related problems, doctors may use one or more of the following sleep studies:

- Polysomnogram (pol-e-SOM-no-gram), or PSG
- Multiple sleep latency test, or MSLT
- Maintenance of wakefulness test, or MWT
- Home-based portable monitor

Your doctor may use actigraphy if he or she thinks you have a circadian (ser-KA-de-an) rhythm disorder. This is a disorder that disrupts your body's natural sleep–wake cycle.

## Polysomnogram

For a PSG, you usually will stay overnight at a sleep center. This study records brain activity, eye movements, heart rate, and blood pressure.

A PSG also records the amount of oxygen in your blood, air movement through your nose while you breathe, snoring, and chest movements. The chest movements show whether you're making an effort to breathe.

PSG results are used to help diagnose:

- Sleep-related breathing disorders, such as sleep apnea
- Sleep-related seizure disorders
- Sleep-related movement disorders, such as periodic limb movement disorder
- Sleep disorders that cause extreme daytime tiredness, such as narcolepsy (PSG and MSLT results will be reviewed together)

Your doctor also may use a PSG to find the right setting for you on a CPAP (continuous positive airway pressure) machine. CPAP is a treatment for sleep apnea.

Sleep apnea is a common disorder in which you have one or more pauses in breathing or shallow breaths while you sleep. In obstructive sleep apnea, the airway collapses or becomes blocked during sleep. A CPAP machine uses mild air pressure to keep your airway open while you sleep.

If your doctor thinks that you have sleep apnea, he or she might schedule a split-night sleep study. During the first half of the night, your sleep is checked without a CPAP machine. This will show whether you have sleep apnea and how severe it is.

If the PSG shows that you have sleep apnea, you'll use a CPAP machine during the second half of the split-night study. A technician will help you select a CPAP mask that fits and is comfortable.

While you sleep, the technician will check the amount of oxygen in your blood and whether your airway stays open. He or she will adjust the flow of air through the mask to find the setting that's right for you. This process is called CPAP titration.

Sometimes the entire study isn't done during the same night. Some people need to go back to the sleep center for the CPAP titration study.

Also, some people might need more than one PSG. For example, your doctor may recommend a followup PSG to:

- Adjust your CPAP settings after weight loss or weight gain
- Recheck your sleep if symptoms return despite treatment with CPAP
- Find out how well surgery has worked to correct a sleep-related breathing disorder

## Multiple Sleep Latency Test

This daytime sleep study measures how sleepy you are. It typically is done the day after a PSG. You relax in a dark, quiet room for about 30 minutes while a technician checks your brain activity.

The MSLT records whether you fall asleep during the test and what types and stages of sleep you're having. Sleep has two basic types: rapid eye movement (REM) and non-REM. Non-REM sleep has three distinct stages. REM sleep and the three stages of non-REM sleep occur in regular cycles throughout the night.

The types and stages of sleep you have can help your doctor diagnose sleep disorders such as narcolepsy, idiopathic hypersomnia (id-ee-o-PATH-ick HI-per-SOM-ne-ah), and other sleep disorders that cause daytime tiredness.

An MSLT takes place over the course of a full day. This is because your ability to fall asleep changes throughout the day.

## Maintenance of Wakefulness Test

This daytime sleep study measures your ability to stay awake and alert. It's usually done the day after a PSG and takes most of the day.

Results can show whether your inability to stay awake is a public or personal safety concern. Results also can show how you're responding to treatment.

## Home-Based Portable Monitor

Your doctor may recommend a home-based sleep test with a portable monitor. The portable monitor will record some of the same information as a PSG. For example, it may record:

- The amount of oxygen in your blood
- Air movement through your nose while you breathe
- Your heart rate
- Chest movements that show whether you're making an effort to breathe

A sleep specialist might use the results from a home-based sleep test to help diagnose sleep apnea. He or she also might use the results to see how well some treatments for sleep apnea are working.

Home-based testing is appropriate only for some people. Talk with your doctor to find out whether a portable monitor is an option for you. If your doctor recommends this test, you'll need to visit a sleep center or your doctor's office to pick up the equipment and learn how to use it.

If you're diagnosed with sleep apnea, your doctor may prescribe treatment with CPAP. If so, he or she will need to find the correct airflow setting for your CPAP machine. To do this, you may need to go to a sleep center to have a PSG. Or, you may be able to find the correct setting at home with an autotitrating CPAP machine.

An autotitrating CPAP machine automatically finds the right airflow setting for you. These machines work well for some people who have sleep apnea. A technician or a doctor will teach you how to use the machine.

## Actigraphy

Actigraphy is a test that's done while you do your normal daily routine. This test is useful for all age groups and doesn't require an overnight stay at a sleep center.

An actigraph is a simple device that's usually worn like a wristwatch. Your doctor may ask you to wear the device for several days and nights, except when bathing or swimming.

Actigraphy gives your doctor a better idea about your sleep schedule, such as when you sleep or nap and whether the lights are on while you sleep.

Doctors can use actigraphy to help diagnose many sleep disorders, including circadian rhythm disorders (such as jet lag and shift work disorder). Doctors also may use the test to check how well sleep treatments are working.

Actigraphy might be used with a PSG or alone.

# Who Needs a Sleep Study? - Sleep Studies

Your doctor might not detect a sleep problem during a routine office visit because you're awake. Thus, you should let your doctor know if you or a family member/sleep partner thinks you might have a sleep problem.

For example, talk with your doctor if you:

- Have chronic (ongoing) snoring
- Often feel sleepy during the day, even though you've spent enough time in bed to be well rested
- Don't wake up feeling refreshed and alert
- Have trouble adapting to shift work

Your doctor might be able to diagnose a sleep disorder based on your sleep schedule and habits. However, he or she also might need the results from sleep studies and other medical tests to diagnose a sleep disorder.

Sleep studies often are used to diagnose sleep-related breathing disorders, such as sleep apnea. Signs of these disorders include loud snoring, gasping, or choking sounds while you sleep or pauses in breathing during sleep.

Other common signs and symptoms of sleep disorders include the following:

- It takes you more than 30 minutes to fall asleep at night.
- You often wake up during the night and then have trouble falling asleep again, or you wake up too early and aren't able to go back to sleep.
- You feel sleepy during the day and fall asleep within 5 minutes if you have a chance to nap, or you fall asleep at inappropriate times during the day.
- You have creeping, tingling, or crawling feelings in your legs that you can relieve by moving or massaging them, especially in the evening and when you try to fall asleep.
- You have vivid, dreamlike experiences while falling asleep or dozing.
- You have episodes of sudden muscle weakness when you're angry, fearful, or when you laugh.
- You feel as though you can't move when you first wake up.
- Your bed partner notes that your legs or arms jerk often during sleep.
- You regularly feel the need to use stimulants, such as caffeine, to stay awake during the day.

Many of the same signs and symptoms of sleep disorders can occur in infants and children. If your child snores or has other signs or symptoms of sleep problems, talk with his or her doctor.

If you've had a sleep disorder for a long time, you may not notice how it affects your daily routine. Using a sleep diary, such as the one found in "Your Guide to Healthy Sleep," might be helpful.

Your doctor will work with you to decide whether you need a sleep study. A sleep study allows your doctor to observe sleep patterns and diagnose a sleep disorder, which can then be treated.

Certain medical conditions have been linked to sleep disorders, such as heart failure, kidney disease, high blood pressure, diabetes, stroke, obesity, and depression.

If you have or have had one of these conditions, ask your doctor whether it would be helpful to have a sleep study.

# What To Expect Before a Sleep Study - Sleep

# Studies

Before a sleep study, your doctor may ask you about your sleep habits and whether you feel well rested and alert during the day.

Your doctor also may ask you to keep a sleep diary. You'll record information such as when you went to bed, when you woke up, how many times you woke up during the night, and more.

You can find a sample sleep diary in the National Heart, Lung, and Blood Institute's "Your Guide to Healthy Sleep."

## What To Bring With You

Depending on what type of sleep study you're having, you may need to bring:

- Notes from your sleep diary. These notes may help your doctor.
- Pajamas and a toothbrush for overnight sleep studies.
- A book or something to do between testing periods if you're having a maintenance of wakefulness test (MWT) or multiple sleep latency test (MSLT).

## How To Prepare

Your doctor may advise you to stop or limit the use of tobacco, caffeine, and other stimulants before having a sleep study.

Your doctor also may ask whether you're taking any medicines. Make sure you tell your doctor about all of the medicines you're taking, including over-the-counter products. Some medicines can affect the sleep study results.

Your doctor also may ask about any allergies you have.

You should try to sleep well for 2 nights before having a sleep study. If you're being tested as a requirement for a transportation- or safety-related job, you might be asked to take a drug-screening test.

If you're going to have a home-based sleep test with a portable monitor, you'll need to visit a sleep center or your doctor's office to pick up the equipment. Your doctor or a technician will show you how to use the equipment.

# Sleep Studies - What To Expect During a Sleep Study

Sleep studies are painless. The polysomnogram (PSG), multiple sleep latency test (MSLT), and maintenance of wakefulness test (MWT) usually are done at a sleep center.

The room the sleep study is done in may look like a hotel room. A technician makes the room comfortable for you and sets the temperature to your liking.

Most of your contact at the sleep center will be with nurses or technicians. They can answer questions about the test itself, but they usually can't give you the test results.

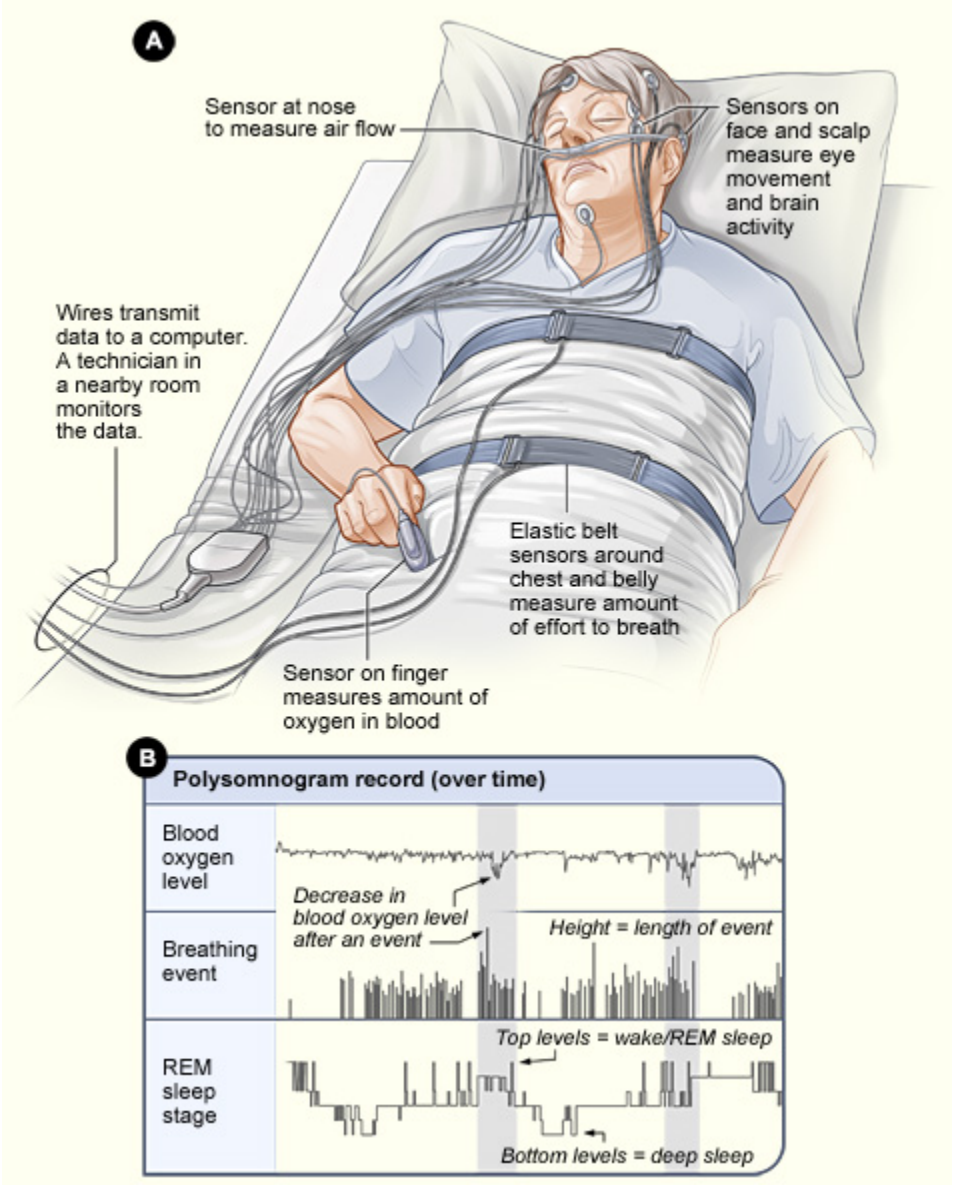
# During a Polysomnogram

Sticky patches with sensors called electrodes are placed on your scalp, face, chest, limbs, and a finger. While you sleep, these sensors record your brain activity, eye movements, heart rate and rhythm, blood pressure, and the amount of oxygen in your blood.

Elastic belts are placed around your chest and belly. They measure chest movements and the strength and duration of inhaled and exhaled breaths.

Wires attached to the sensors transmit the data to a computer in the next room. The wires are very thin and flexible. They are bundled together so they don't restrict movement, disrupt your sleep, or cause other discomfort.

## Polysomnogram




The image shows the standard setup for a polysomnogram. In figure A, the patient lies in a bed with sensors attached to the body. In figure B, the polysomnogram recording shows the blood oxygen level, breathing event,

and rapid eye movement (REM) sleep stage over time.

If you have signs of sleep apnea, you may have a split-night sleep study. During the first half of the night, the technician records your sleep patterns. At the start of the second half of the night, he or she wakes you to fit a CPAP (continuous positive airway pressure) mask over your nose and/or mouth.

A small machine gently blows air through the mask. This creates mild pressure that keeps your airway open while you sleep.

The technician checks how you sleep with the CPAP machine. He or she adjusts the flow of air through the mask to find the setting that's right for you.

At the end of the PSG, the technician removes the sensors. If you're having a daytime sleep study, such as an MSLT, some of the sensors might be left on for that test.

Parents usually are required to spend the night with their child during the child's PSG.

## During a Multiple Sleep Latency Test

The MSLT is a daytime sleep study that's usually done after a PSG. This test often involves sensors placed on your scalp, face, and chin. These sensors record brain activity and eye movements. They show various stages of sleep and how long it takes you to fall asleep. Sometimes your breathing is checked during an MSLT.

A technician in another room watches these recordings as you sleep. He or she fixes any problems that occur with the recordings.

About 2 hours after you wake from the PSG, you're asked to relax and try to fall asleep in a dark, quiet room. The test is repeated four or five times throughout the day. This is because your ability to fall asleep changes throughout the day.

You get 2-hour breaks between tests. You need to stay awake during the breaks.

The MSLT records whether you fall asleep during the test and what types and stages of sleep you have. Sleep has two basic types: rapid eye movement (REM) and non-REM. Non-REM sleep has three distinct stages. REM sleep and the three stages of non-REM sleep occur in regular cycles throughout the night.

The types and stages of sleep you have during the day can help your doctor diagnose sleep disorders such as narcolepsy, idiopathic hypersomnia, and other sleep disorders that cause daytime tiredness.

## During a Maintenance of Wakefulness Test

This sleep study usually is done the day after a PSG, and it takes most of the day. Sensors on your scalp, face, and chin are used to measure when you're awake and asleep.

You sit quietly on a chair in a comfortable position and look straight ahead. Then you simply try to stay awake for a period of time.

An MWT typically includes four trials lasting about 40 minutes each. If you fall asleep, the technician will wake you after about 90 seconds. There usually are 2-hour breaks between trials. During these breaks, you can read, watch television, etc.

If you're being tested as a requirement for a transportation- or safety-related job, you may need a drug-screening test before an MWT.

## During a Home-Based Portable Monitor Test

If you're having a home-based portable monitor test, you'll need to set up the equipment at home before you go to sleep.

When you pick up the equipment at the sleep center or your doctor's office, someone will show you how to use it. In some cases, a technician will come to your home to help you prepare for the study.

## During Actigraphy

You don't have to go to a sleep center for this test. An actigraph is a small device that's usually worn like a wristwatch. You can do your normal daily routine while you wear it. You remove it while bathing or swimming.

The actigraph measures your sleep–wake behavior over 3 to 14 days and nights. Results give your doctor a better idea about your sleep habits, such as when you sleep or nap and whether the lights are on while you sleep.

Your doctor may ask you to keep a sleep diary while you wear an actigraph. You can find a sample sleep diary in the National Heart, Lung, and Blood Institute's "Your Guide to Healthy Sleep."

About 1.5 to 3 hours after you wake from the PSG, you're asked to relax in a quiet room for about 30 minutes. The test is repeated four or five times throughout the day. This is because your ability to fall asleep changes throughout the day.

You get 2-hour breaks between tests. You need to stay awake during the breaks.

The MSLT records whether you fall asleep during the test and what types and stages of sleep you have. Sleep has two basic types: rapid eye movement (REM) and non-REM. Non-REM sleep has three distinct stages. REM sleep and the three stages of non-REM sleep occur in patterns throughout the night.

The types and stages of sleep you have during the day can help your doctor diagnose sleep disorders such as narcolepsy and idiopathic hypersomnia.

## During a Maintenance of Wakefulness Test

This sleep study occurs during the day. It's usually done after a PSG and takes most of the day. Sensors on your scalp, face, and chin are used to measure when you're awake or asleep.

You sit quietly on a bed in a comfortable position and look straight ahead. Then you simply try to stay awake for a period of time.

An MWT typically includes four trials lasting about 40 minutes each. If you fall asleep, the technician will wake you after about 90 seconds. There usually are 2-hour breaks between trials. During these breaks, you can read, watch television, etc.

If you're being tested as a requirement for a transportation- or safety-related job, you may need a drug-screening test before a MWT.

## During a Home-Based Portable Monitor Test

If you're having a home-based portable monitor test, you'll need to set up the equipment at home before

you go to sleep. When you pick up the equipment at the sleep center or your doctor's office, someone will tell you how to use it.

### During Actigraphy

You don't have to go to a sleep center for this test. An actigraph is a small device that's usually worn like a wristwatch. You can go about your normal routine while you wear it. You remove it while bathing or swimming.

The actigraph measures your sleep–wake behavior over 3 to 7 days and nights. Results give your doctor a better idea about your sleep habits, such as when you sleep or nap and whether the lights are on while you sleep.

You may be asked to keep a sleep diary while you wear an actigraph.

## What To Expect After a Sleep Study - Sleep Studies

Once the sensors are removed after a polysomnogram (PSG), multiple sleep latency test, or maintenance of wakefulness test, you can go home. If you used an actigraph or a home-based portable monitor, you'll return the equipment to a sleep center or your doctor's office.

You won't receive a diagnosis right away. A sleep specialist and your primary care doctor will review the results of your sleep study. They will use your medical history, your sleep history, and the test results to make a diagnosis.

You may not get the sleep study results for a couple of weeks. Usually, your doctor, nurse, or sleep specialist will explain the test results and work with you to develop a treatment plan.

## What Do Sleep Studies Show? - Sleep Studies

Sleep studies allow doctors to look at sleep patterns and note sleep-related problems that patients don't know about or can't describe during routine office visits. Sleep studies are needed to diagnose certain sleep disorders, such as sleep apnea and narcolepsy.

Your sleep study results might include information about sleep and wake times, sleep stages, abnormal breathing, the amount of oxygen in your blood, and any movement during sleep.

Your doctor will use your sleep study results and your medical history to make a diagnosis and create a treatment plan.

### Results From a Polysomnogram

Polysomnogram (PSG) results are used to help diagnose:

- Sleep-related breathing disorders, such as sleep apnea
- Sleep-related seizure disorders
- Sleep-related movement disorders, such as periodic limb movement disorder
- Sleep disorders that cause extreme daytime tiredness, such as narcolepsy (PSG and MSLT results

will be reviewed together)

If you have sleep apnea, your doctor also may use a PSG to find the correct setting for you on a CPAP (continuous positive airway pressure) machine.

A CPAP machine supplies air to your nose and/or mouth through a special mask. Finding the right setting involves adding just enough extra air to create mild pressure that keeps your airway open while you sleep.

Your doctor may recommend a followup PSG to:

- Adjust your CPAP settings after weight loss or weight gain
- Recheck your sleep if symptoms return despite treatment with CPAP
- Find out how well surgery has worked to correct a sleep-related breathing disorder

Technicians also use PSGs to record the number of abnormal breathing events that occur with sleep-related breathing disorders, such as sleep apnea. These events include pauses in breathing or dips in the level of oxygen in your blood.

## Results From a Multiple Sleep Latency Test

MSLT results are used to help diagnose narcolepsy, idiopathic hypersomnia, and other sleep disorders that cause daytime sleepiness.

For narcolepsy, technicians study how quickly you fall asleep. The MSLT also shows how long it takes you to reach different types and stages of sleep.

Sleep has two basic types: rapid eye movement (REM) and non-REM. Non-REM sleep has three distinct stages. REM sleep and the three stages of non-REM sleep occur in regular cycles throughout the night.

People who fall asleep in less than 5 minutes or quickly reach REM sleep may need treatment for a sleep disorder.

## Results From a Maintenance of Wakefulness Test

Maintenance of wakefulness test (MWT) results can show whether your inability to stay awake is a public or personal safety concern. This study also is used to show how well treatment for a sleep disorder is working.

## Results From a Home-Based Portable Monitor Test

Home-based portable monitors might be used to help diagnose sleep apnea. Portable monitors also can show how well some treatments for sleep apnea are working.

Sometimes, home-based monitors don't record enough information. If this happens, you might have to take the monitor home again and repeat the test, or your sleep specialist may ask you to have a PSG.

## Results From Actigraphy

Actigraphy results give your doctor a better idea about your sleep habits, such as when you sleep or nap and whether the lights are on while you sleep. This test also is used to help diagnose circadian rhythm disorders.

# What Are the Risks of Sleep Studies? - Sleep Studies

Sleep studies are painless. There's a small risk of skin irritation from the sensors. The irritation will go away once the sensors are removed.

Although the risks of sleep studies are minimal, these studies take time (at least several hours). If you're having a daytime sleep study, bring a book or something to do during the test.

# Clinical Trials - Sleep Studies

The National Heart, Lung, and Blood Institute (NHLBI) is strongly committed to supporting research aimed at preventing and treating heart, lung, and blood diseases and conditions and sleep disorders.

NHLBI-supported research has led to many advances in medical knowledge and care. For example, this research has uncovered some of the causes of various sleep disorders and ways to diagnose and treat these disorders.

The NHLBI continues to support research aimed at learning more about sleep and sleep disorders. In November 2011, the National Institutes of Health (NIH) released its "2011 NIH Sleep Disorders Research Plan."

The plan expands upon previous and current research programs and identifies new research opportunities. The NHLBI's National Center on Sleep Disorders Research will coordinate this research across the NIH and other Federal agencies.

The research will focus on sleep and the body's natural 24-hour cycle, the role of genes and the environment on sleep health, and ways to improve the prevention, diagnosis, and treatment of sleep disorders.

Much of this research depends on the willingness of volunteers to take part in clinical trials. Clinical trials test new ways to prevent, diagnose, or treat various diseases, conditions, and health problems.

For example, new treatments for a disease or condition (such as medicines, medical devices, surgeries, or procedures) are tested in volunteers who have the illness. Testing shows whether a treatment is safe and effective in humans before it is made available for widespread use.

By taking part in a clinical trial, you may gain access to new treatments before they're widely available. You also will have the support of a team of health care providers, who will likely monitor your health closely. Even if you don't directly benefit from the results of a clinical trial, the information gathered can help others and add to scientific knowledge.

If you volunteer for a clinical trial, the research will be explained to you in detail. You'll learn about treatments and tests you may receive, and the benefits and risks they may pose. You'll also be given a chance to ask questions about the research. This process is called informed consent.

If you agree to take part in the trial, you'll be asked to sign an informed consent form. This form is not a contract. You have the right to withdraw from a study at any time, for any reason. Also, you have the right to learn about new risks or findings that emerge during the trial.

For more information about clinical trials related to sleep studies or sleep disorders, talk with your doctor.

You also can visit the following Web sites to learn more about clinical research and to search for clinical trials:

- http://clinicalresearch.nih.gov
- www.clinicaltrials.gov
- www.nhlbi.nih.gov/studies/index.htm
- www.researchmatch.org

For more information about clinical trials for children, visit the NHLBI's Children and Clinical Studies Web page.

# Links to Other Information About Sleep Studies - Sleep Studies

## NHLBI Resources

- CPAP (Health Topics)
- Narcolepsy (Health Topics)
- Restless Legs Syndrome (Health Topics)
- Sleep Apnea (Health Topics)
- Sleep Deprivation and Deficiency (Health Topics)
- Sleep Disorders Information
- "Your Guide to Healthy Sleep"

## Non-NHLBI Resources

- Idiopathic Hypersomnia (MedlinePlus)
- Sleep and Sleep Disorders Fact Sheets (Centers for Disease Control and Prevention)
- Sleep Studies (MedlinePlus)

## Clinical Trials

- Children and Clinical Studies
- Clinical Trials (Health Topics)
- Current Research (ClinicalTrials.gov)
- NHLBI Clinical Trials
- NIH Clinical Research Trials and You (National Institutes of Health)
- ResearchMatch (funded by the National Institutes of Health)