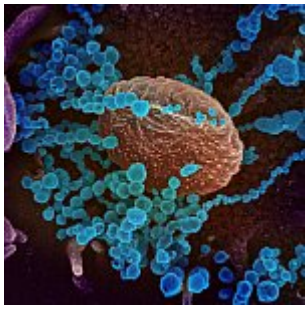
2020 Research Highlights

With NIH support, scientists across the United States and around the world conduct wide-ranging research to discover ways to enhance health, lengthen life, and reduce illness and disability. Groundbreaking NIH-funded research often receives top scientific honors. In 2020, these honors included one of NIH's own scientists and another NIH-supported scientist who received Nobel Prizes. Here's just a small sample of the NIH-supported research accomplishments in 2020. For more health and medical research findings from NIH, visit *NIH Research Matters*.

Human Health Advances

Disease Prevention, Diagnosis, and Treatment



COVID-19 vaccines and treatments

Since first appearing in China late last year, COVID-19 has become an ongoing global pandemic. NIH researchers quickly began testing potential treatments to help reduce the severity of the disease. Remdesivir, a broad-spectrum antiviral treatment, showed early promise. Results from the completed trial in October showed that it shortened recovery time for patients hospitalized with COVID-19. NIH research was also instrumental in determining which treatments, such as hydroxychloroquine, were ultimately not effective. Meanwhile, NIH researchers began developing vaccine candidates to protect against the disease. The first COVID-19 vaccine candidate tested in people, co-developed by NIH and the biotech company Moderna, Inc., triggered an immune response against the virus without serious side effects. An analysis in November found the vaccine was safe and well-tolerated, with a vaccine efficacy rate of 94.5%. The FDA approved it for emergency use in December. NIH also launched the Rapid Acceleration of Diagnostics (RADx[SM]) initiative to speed innovation in COVID-19 testing. An NIH-funded COVID-19 home test was the first to receive over-the-counter authorization from the FDA.

Comparing heart disease treatments

People with moderate to severe but stable heart disease may undergo invasive procedures, such as bypass surgery and stenting, or manage their condition with medication and lifestyle changes alone. A study showed that invasive procedures may offer better symptom relief and quality of life for some patients with chest pain. But for those who didn't have any symptoms, it was safe to begin treatment with non-invasive approaches. The findings may change clinical practice and official guidelines for treating patients.

Combining tests more accurately diagnoses prostate cancer

The type of biopsy traditionally used to diagnose prostate cancer takes systematically spaced tissue samples from the prostate gland. This method isn't targeted and can lead to uncertainty about whether a man has aggressive prostate cancer. Researchers found that adding MRI-targeted biopsies to the traditional prostate biopsy created a more accurate diagnosis and prediction of the course of prostate cancer. The approach is poised to help reduce both overtreatment and undertreatment of the disease.

Early detection of Alzheimer's disease

Having a simple blood test to detect Alzheimer's disease before symptoms develop would aid the study of treatments to slow or stop its progression. Studies found that a protein called ptau181, which can be measured in the blood, was as good as invasive or expensive tests at diagnosing Alzheimer's early. Another protein, called ptau217, was even better at predicting who would later develop the disease. A type of brain imaging could also play a role in tracking disease development. These approaches could help identify people to participate in trials of early treatments or preventive strategies.

Number of steps per day more important than step intensity

Walking is an easy way for many inactive people to ease into better health. A goal of 10,000 steps a day is common. A study found that adults who took at least 8,000 steps a day had a reduced risk of death over the following decade than those who only walked 4,000 steps a day. Step intensity (number of steps per minute) didn't influence the risk of death, suggesting that the total number of steps per day is more important than intensity.

Harnessing the health benefits of bacteria

Some types of bacteria cause disease, but others can help protect human health. A strain of bacteria called *Lactobacillus crispatus* was used as a treatment to prevent recurring bacterial vaginosis. In another study, treatment with the bacterium *Roseomonas mucosa,* taken from healthy human skin, improved eczema in children. These findings show the potential of harnessing the healthy human microbiome to prevent or treat disease.

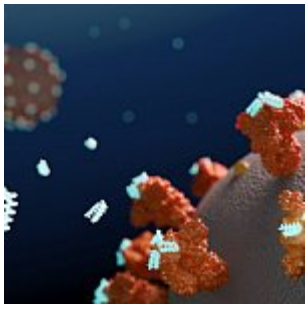
Multifocal contact lenses slow myopia progression in children

Myopia, also called nearsightedness, is a common vision problem, where close objects can be seen clearly but objects farther away appear blurry. In the U.S., myopia typically begins in childhood. Researchers found that children who wore certain multifocal contact lenses had slower progression of their myopia, or nearsightedness, over three years. The findings support using multifocal contacts to treat myopia in children, which could also help prevent other vision problems later in life.

Biomarkers predict recovery from brain injury
More than a million people in the U.S. experience a mild traumatic brain injury, or concussion, every year. Researchers found that military veterans with higher blood levels of a protein released by injured neurons were more likely to report long-term symptoms. More study is needed to confirm whether this could be used to predict who is at risk of long-term health problems after concussion. Two blood proteins were linked to the time needed by college athletes to return to play following a concussion. These biomarkers may help doctors predict when athletes can return to play.

Promising Medical Findings

Results with Potential for Enhancing Human Health



New approaches to COVID-19
As the global pandemic unfolded, researchers worked at unprecedented speed to develop new treatments and vaccines. Scientists studied antibodies from the blood of people who recovered from COVID-19 and identified potent, diverse ones that neutralize SARS-CoV-2. Some antibody treatments have now been given emergency use authorization by the FDA, with many others in development. However, such antibodies—called monoclonal antibodies—are difficult to produce and must be given intravenously. NIH-researchers have been pursuing other approaches, including using antibodies from llamas, which are only about a quarter of the size of a typical human antibody and could be delivered directly to the lungs using an inhaler. Computer-designed "miniproteins" and other antiviral compounds are also under investigation.

Universal mosquito vaccine tested
Most mosquito bites are harmless. But some mosquitoes carry pathogens, like bacteria and viruses, that can be deadly. A small trial showed that a vaccine against mosquito saliva—designed to provide broad protection against mosquito-borne diseases—is safe and causes a strong immune response in healthy volunteers. More studies are needed to test its effectiveness against specific diseases.

Machine learning detects early signs of osteoarthritis
Osteoarthritis is the most common type of arthritis. It results when cartilage, the tissue that cushions the ends of the bones, breaks down. People with osteoarthritis can have joint pain, stiffness, and swelling. Some develop serious pain and disability from the disease. Using artificial intelligence and MRI scans, scientists identified signs of osteoarthritis three years before diagnosis. The results suggest a way to identify people who may benefit from early interventions.

Advances in restoring vision

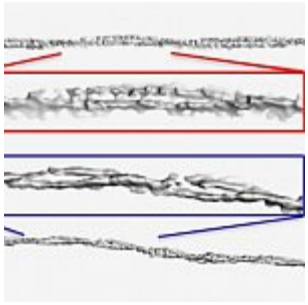
Several common eye diseases, such as age-related macular degeneration and retinitis pigmentosa, damage the retina, the light-sensitive tissue in the eye. They can eventually lead to vision loss. Two studies looked at ways to restore vision in mouse models. Researchers reprogrammed skin cells into light-sensing eye cells that restored sight in mice. The technique may lead to new approaches for modeling and treating eye diseases. Other scientists restored vision in blind mice by using gene therapy to add a novel light-sensing protein to cells in the retina. The therapy will soon be tested in people.

Blood protein signatures change across lifespan

The bloodstream touches all the tissues of the body. Because of the constant flow of proteins through the body, some blood tests measure specific proteins to help diagnose diseases. Researchers determined that the levels of nearly 400 proteins in the blood can be used to determine people's age and relative health. More research is needed to understand if these protein signatures could help identify people at greater risk of age-related diseases.

Understanding HIV's molecular mechanisms

More than a million people nationwide are living with HIV, the virus that causes AIDS. HIV attacks the immune system by destroying immune cells vital for fighting infection. Researchers uncovered key steps in HIV replication by reconstituting and watching events unfold outside the cell. The system may be useful for future studies of these early stages in the HIV life cycle. In other work, experimental treatments in animal models of HIV led to the viruses emerging from their hiding places inside certain cells—a first step needed to make HIV vulnerable to the immune system.



Test distinguishes Parkinson's disease from related condition

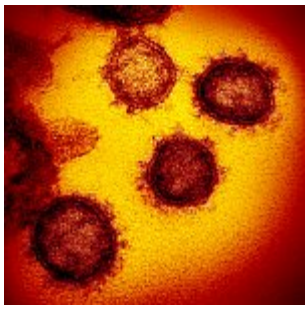
A protein called alpha-synuclein plays a major role in Parkinson's disease as well as other brain disorders. Early symptoms of Parkinson's disease and another disease involving alpha-synuclein, multiple system atrophy, can be similar. Researchers created a test using cerebrospinal fluid that can distinguish between these two diseases with 95% accuracy. The results have implications for the early diagnosis and treatment of these conditions and may help in the development of new targeted therapies.

Understanding allergic reactions to skin care products

Personal care products like makeup, skin cream, and fragrances commonly cause rashes called allergic contact dermatitis. It's not well understood how chemical compounds in personal care products trigger such allergic reactions. Scientists gained new insight into how personal care products may cause immune responses that lead to allergic responses in some people. Understanding how compounds in these products trigger immune reactions could lead to new ways to prevent or treat allergic contact dermatitis.

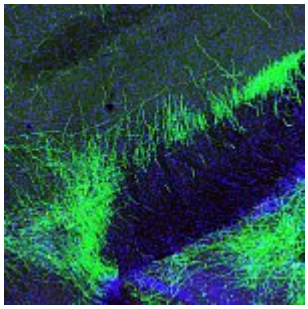
Basic Research Insights

Noteworthy Advances in Fundamental Research



Understanding SARS-CoV-2
The first reports of an unknown, sometimes fatal respiratory infection emerged from Wuhan, China in late 2019. NIH researchers quickly moved to understand the source of that infection, a novel coronavirus called SARS-CoV-2. By February, they produced a detailed picture of the virus spike protein, which allows the virus to infect human cells. This helped to identify targets for potential vaccines and treatments. Further work gave detail into how the virus enters and exits cells, which may help guide new approaches to combatting infections and stopping transmission. A genomic analysis helped explain why SARS-CoV-2 is more deadly than many other coronaviruses. Immune system studies showed how existing immune cells may help account for the wide range of symptoms among the infected and shed light on the antibody levels and immune cells needed to protect against SARS-CoV-2.

Exercise-induced protein may reverse age-related cognitive decline
Physical activity can play an important role in maintaining cognitive health, but it hasn't been clear why. Researchers identified an exercise-induced protein that generated new brain cells and improved memory in mice. The protein was also found in higher levels in the blood and plasma of older adults who were active. The findings suggest new approaches to combat age-related cognitive decline.

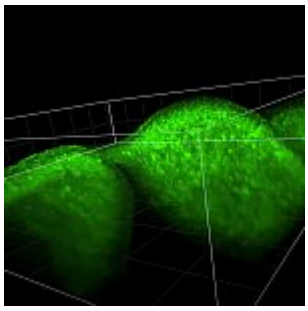


Scientists find new pain-suppression center in the brain
More than 50 million Americans suffer from chronic pain, and many are prescribed opioid medications as treatment. Researchers are searching for more effective treatments for chronic pain. A study identified a group of neurons in mice that blunt pain by dampening the activity of multiple pain-processing regions of the brain. The neurons could be promising targets for new non-addictive therapies for chronic pain.

Poor immune response impairs diabetic wound healing
Diabetes can impair the skin's ability to heal itself. Even small cuts on the feet can develop into diabetic foot ulcers—chronic, non-healing wounds that are vulnerable to infection. These ulcers are a major cause of lower limb amputations, disability, and death in people with diabetes. Researchers found that diabetic foot ulcers don't recruit the immune cells needed for normal wound healing. Understanding this impaired immune response could lead to better therapies.

How stress causes gray hair

A study confirmed that stress can turn hair prematurely gray—and discovered how. Scientists found that stress affects the stem cells responsible for regenerating hair pigment. Chemicals involved in the body's fight-or-flight response cause permanent loss of these stem cells so that new hair appears gray or white. The findings give insights for future research into how stress affects stem cells and tissue regeneration.

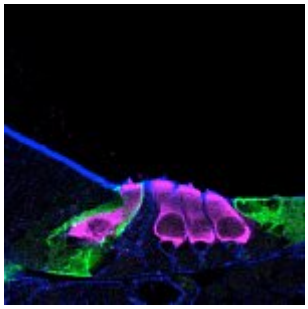


How the nose decodes complex odors

The nose contains millions of specialized neurons that allow it to smell different odors. Simple odors activate a particular combination of neurons that send a coded message to the brain. Researchers used an advanced 3D imaging technique in mice to reveal how receptors in the nose help decode the smell of complex odor mixtures. The findings shed light on how the brain perceives odors and may help reveal why some diseases cause a loss of smell.

Hairy human skin generated from stem cells

Scientists have been able to grow human skin outside the body for over 40 years. However, skin grown in cultures lacked the embedded structures, like hair follicles and sweat glands, found in real skin. Researchers were able to create hair-growing skin from human stem cells and graft it to mice. The lab-grown skin could aid in the study of skin diseases and skin reconstruction after burns and wounds.



Researchers create developmental map of mouse cochlea

Hearing involves thousands of tiny hair cells inside the cochlea, a snail-shaped organ in the inner ear. In humans, hair cells can't regenerate when they're damaged. Loud sounds, disease, injury, and aging can all damage hair cells and result in permanent hearing loss. Scientists mapped how these sensory cells develop in the mouse cochlea. Understanding cochlear development could help researchers working on therapies for several forms of hearing loss.