# Improving Health

## Table of Contents

# Table of Contents (continued)

# Improving Health

Discoveries emerging from NIH-supported research have led to new ways to prevent, diagnose, and treat illness, ultimately improving the health of the nation and the world.

## Brain and Mental Health

### Couples Therapy

*Image credit: Daniel Soñé/NCI*

Based on over 30 years of research funded by the NIH, the Prevention and Relationship Enhancement Program is the most widely used, empirically based approach to helping couples build emotional safety and effectively manage issues and conflict.

- The Program works with couples to build and strengthen relationship skills, including communication and conflict management.
- Couples who complete the Program report up to 90% reductions in physical aggression through a 10-month follow-up compared to couples who received an alternative approach.
- Other outcomes of the Program include reductions in high-risk sexual behaviors, substance use, and weapon-carrying, and increases in relationship satisfaction and well-being.

### Obsessive Compulsive Disorder

*Image credit: National Institute on Aging, NIH*

NIH-funded research led to the development of exposure and response prevention (ERP) treatment for obsessive-compulsive disorder (OCD), which was once thought to be untreatable. With improvement in symptoms in over half of patients, ERP is now the first treatment therapists turn to for OCD.

- OCD is a common, chronic, and long-lasting disorder in which a person has uncontrollable, reoccurring thoughts (obsessions) and/or behaviors (compulsions) that they feel the urge to repeat over and over.
- In ERP, people with OCD are gradually exposed to fear-provoking or discomforting stimuli related to their obsessions to help them practice resisting the urge to engage in compulsive behaviors.
- ERP can be used in parallel with medication and can also be helpful for people who do not respond to medication.

## Psychosis

*Image credit: Darryl Leja, National Human Genome Research Institute, NIH*

NIH-supported research led to more effective methods of treatment for early-stage psychosis and schizophrenia. More than 14,000 people per year in the U.S., are treated for schizophrenia using these best practices, and they experience substantially improved quality of life.

- NIH research shows that early treatment of psychosis increases the chance of successful recovery.
- In addition to greater improvement in symptoms, quality of life, and work/school participation, this research also demonstrates that these treatment programs can be implemented in community-based settings.
- These best practices developed by NIH researchers are now the standard treatment for early psychosis, per the American Psychiatric Association's Practice Guideline on Treatment of Patients with Schizophrenia.

## Phobias

*Image credit: National Institute on Aging, NIH*

Developed in part thanks to NIH research, exposure therapy is now considered the gold standard for treating phobias. For those who complete treatment, 80–90% report their fear significantly reduced or completely eliminated.

- Exposure therapy enables patients to overcome anxieties by gradually introducing them to feared scenarios or objects in a safe environment, often starting with small, indirect exposures, before progressing to more direct exposures.
- Behavior changes in response to a specific phobia is often maintained long-term, with 90% of patients still showing significant reduction in fear, avoidance, and overall level of impairment after 4 years and 65% no longer having a specific phobia.

## Depression

*Image credit: Viviana Siless, Ph.D., Anastasia Yendiki, Ph.D., MGH/ Harvard, Boston Adolescent Neuroimaging of Depression and Anxiety (BANDA)*

Through NIH-funded research and clinical trials, Cognitive Behavioral Therapy (CBT) is now the gold standard behavioral treatment for depression.

- About 1 out of every 6 adults will have depression at some time in their life, and depression affects about 16 million American adults every year.
- NIH has funded over a thousand clinical trials on CBT and depression since the 1970s.
- CBT has been studied and adapted for children, adolescents, couples, and families.
- Other forms of CBT, such as Mindfulness-Based Cognitive Therapy, have also been developed and used to treat depression.
- Components of CBT have been found to be as effective as antidepressant medication in treating depression.

## Mood Stabilizers

*Image credit: National Institute on Aging, NIH*

NIH played a significant role in the development of the mood stabilizer lithium carbonate—one of the first medications used successfully to treat several psychiatric disorders—that continues to be used around the world today. Informed by NIH-supported research, current practice guidelines for bipolar disorder now include mood stabilizer medication as the first-line treatment.

- Mood stabilizers are typically used to treat bipolar disorder and mood changes associated with other mental disorders.
- In 1969, a seminal study at NIH showed the effectiveness of lithium carbonate treatment in depression and mania.
- Lithium is on the WHO's List of Essential Medicines and continues to be used widely—especially in the treatment of bipolar disorder—impacting the lives of countless people around the world.
- The NIH Systematic Treatment Enhancement Program for Bipolar Disorder (STEP-BD) program showed the importance of mood stabilizer medication as the first-line treatment for bipolar disorder.

## Addiction Treatment

*Image credit: Photo by Fortune Vieyra on Unsplash*

NIH-supported research on addiction has informed public health policies, such as the *Mental Health Parity and Addiction Equity Act of 2008* (MPHAEA), which requires insurance providers to give the same coverage for substance use disorders and other mental illnesses as for other medical illnesses.

- Decades of NIH-funded research has led to understanding addiction as a chronic, relapsing brain disorder.
- Rather than a moral weakness or a lack of willpower, we now know that addiction is characterized by changes in brain circuitry that interfere with the ability to exert self-control over substance use.
- NIH research has informed public health policies, such as MPHAEA, which are associated with increased enrollment and use of outpatient treatment services and reduced spending on emergency department visits and hospital stays among patients with substance use disorders.

## Deep Brain Stimulation

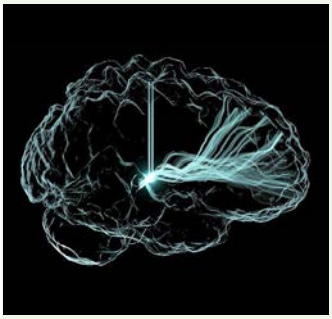

*Image credit: Andrew Janson, Butson Lab, University of Utah*

NIH made significant contributions to the development of deep brain stimulation (DBS), a treatment that can offer patients relief from symptoms in Parkinson's disease and other brain disorders. By 2021, more than 200,000 DBS devices were estimated to have been implanted worldwide.

- NIH-supported research contributed to the development and clinical application of DBS, and a major clinical trial showed DBS for Parkinson's disease was superior to L-DOPA, the current gold standard treatment alone.
- FDA approved the first DBS device for Parkinson's disease in 2002, and devices are also approved or used experimentally for essential tremor, dystonia, epilepsy, Tourette syndrome, treatment-resistant depression, and chronic pain.
- In 2009, FDA approved DBS for treatment-resistant obsessive-compulsive disorder under a Humanitarian Device Exemption.

## Stroke Treatment

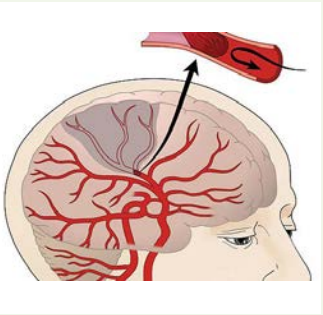

*Image credit: National Institute of Neurological Disorders and Stroke, NIH*

NIH played a major role in the development of the clot-busting medicine tissue plasminogen activator (tPA), which was the first treatment for strokes caused by blood clots and remains a frontline therapy. Approved by FDA in 1996, tPA transformed stroke care to enable rapid intervention and was an impetus for future treatments.

- Ischemic stroke is caused by the blockage of a vessel supplying blood to the brain.
- When administered quickly after stroke onset, tPA helps to restore blood flow to brain regions affected by an ischemic stroke, limiting the risk of damage and impairment.
- Hundreds of hospitals around the U.S. now have resources and protocols to rapidly diagnose a stroke with brain imaging and administer tPA.
- NIH research also contributed to the development of endovascular thrombectomy (EVT), a minimally invasive surgery to treat ischemic stroke up to 24 hours after a stroke starts, long after tPA can be effective.

## Dementia Biomarkers

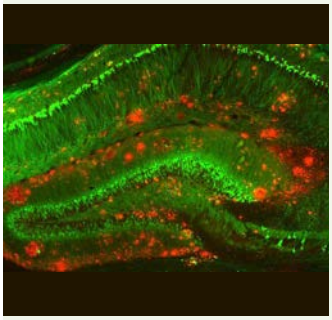

*Image credit: Strittmatter Laboratory, Yale University*

Before the early 2000s, the only sure way to know whether a person had Alzheimer's disease or another form of dementia was after death through autopsy. Thanks to NIH-supported research, tests are now available to help doctors measure biomarkers—biological indicators of disease—associated with dementia in a living person.

- Biomarkers are measurable indicators of what's happening in the body, and can be found in blood, other body fluids, organs, and tissues.
- Biomarkers can be analyzed through brain imaging and genetic, cerebrospinal fluid, and blood testing.
- NIH supported the initial development of the PrecivityAD™ blood test, a commercially available tool for detecting biomarkers for beta-amyloid plaques, a hallmark of Alzheimer's disease.
- As treatments for dementia emerge, these tests will help doctors deliver the right treatment in the right place at the right time to patients.

## Stroke Awareness


*Image credit: National Institute of Neurological Disorders and Stroke, NIH*

Each year in the U.S. people have more than 800,000 strokes. NIH has worked to increase public awareness around stroke through the *Know Stroke* campaign, which has reached millions of people.

- Stroke is a leading cause of death in the U.S. and is a major cause of serious disability for adults.
- NIH developed the *Know Stroke. Know the Signs. Act in Time*. campaign to help educate the public about the symptoms of stroke and the importance of getting to the hospital quickly. NIH also launched the related *Mind Your Risks*® campaign, focused on blood pressure control for the prevention of stroke and dementia.
- These campaigns include public outreach using mass media, grassroots outreach, partnerships, and community education.

## COUPLES THERAPY


1. Preventing Intimate Partner Violence Across the Lifespan: A Technical Package of Programs, Policies, and Practices: https://www.cdc.gov/violenceprevention/pdf/ipv-technicalpackages.pdf.
2. Braithwaite SR, et al. *Behav Res Ther*. 2014;54:12-21. PMID: 24463577.


## OBSESSIVE COMPULSIVE DISORDER


1. Law C, et al. *Psychol Res Behav Manag*. 2019;12:1167-1174. PMID: 31920413.
2. Foa EB. *Dialogues Clin Neurosci*. 2010;12(2):199-207. PMID: 20623924.
3. Abramowitz JS. *Can J Psychiatry*. 2006;51(7):407-16. PMID: 16838822.
4. Motivala SJ, et al. *Int J Psychiatry Clin Pract*. 2018;22(1):40-46. PMID: 28691550.
5. Foa EB, et al. *Am J Psychiatry*. 2005;162(1):151-61. PMID: 15625214.
6. Obsessive-Compulsive Disorder: https://www.nimh.nih.gov/health/topics/obsessive-compulsive-disorder-ocd.
7. Obsessive-Compulsive Disorder and Substance Use Disorders: https://store.samhsa.gov/sites/default/files/d7/priv/sma16-4977.pdf.
8. Strauss C, et al. *J Anxiety Disord*. 2018;57:39-47. PMID: 29739634.


## PSYCHOSIS


1. Kane J, et al. *American Journal of Psychiatry* 2016; 173(4):362-372. PMID: 26481174.
2. Addington J, et al. *Psychiatric Services* 2015;66(7):753-756. PMID: 25588418.
3. Marino L, et al. *Early Interv Psychiatry* 2020;14:544-52. PMID: 31502409.
4. Substance Abuse and Mental Health Services Administration. 2021 Uniform Reporting System (URS) Output Tables. 2022. Available at https://www.samhsa.gov/data/report/2021-uniform-reporting-system-urs-output-tables.


## PHOBIAS


1. Choy Y, et al. *Clin Psychol Rev*. 2007;27(3):266-86. PMID: 17112646.
2. Craske MG, et al. *Behav Res Ther*. 2014;58:10-23. PMID: 24864005.
3. Zlomke K, et al. *Behav Ther*. 2008;39(3):207-23. PMID: 18721635.
4. Raeder F, et al. *Sci Rep*. 2020;10(1):4288. PMID: 32152429.


## DEPRESSION


1. Dimidjian S, et al. *J Consult Clin Psychol*. 2006;74(4):658-70. PMID: 16881773.
2. Kessler RC, et al. *Arch Gen Psychiatry*. 2005;62(6):593-602. PMID: 15939837.
3. Results from the 2013 National Survey on Drug Use and Health: Mental Health Findings: https://www.samhsa.gov/data/sites/default/files/NSDUHmhfr2013/NSDUHmhfr2013.pdf.


## MOOD STABILIZERS


1. Goodwin FK. *Arch Gen Psychiatry*. 1969;21(4):486-96. PMID: 4896983.
2. The Veterans Administration/Department of Defense. Clinical Practice Guideline for Management of Bipolar Disorder in Adults. 2010. https://www.healthquality.va.gov/guidelines/MH/bd/bd_306_sum.pdf.
3. Bipolar Disorder: https://www.nimh.nih.gov/health/topics/bipolar-disorder.

## ADDICTION TREATMENT


1. Article: A Scientific Discovery Revolutionizes Our View of Addiction: https://www.bbrfoundation.org/content/scientific-discovery-revolutionizes-our-view-addiction.
2. Volkow ND, et al. *N Engl J Med*. 2016;374(4):363-71. PMID: 26816013.
3. Leshner AI. *Science*. 1997;278(5335):45-7. PMID: 9311924.
4. McGinty EE, et al. *Health Aff (Millwood)*. 2015;34(8):1331-9. PMID: 26240247.
5. Government Accountability Office: Mental Health and Substance Use: Employers' Insurance Coverage Maintained or Enhanced Since Parity Act, but Effect of Coverage on Enrollees Varied. 2011. https://www.gao.gov/assets/gao-12-63.pdf.


## DEEP BRAIN STIMULATION


1. Deep Brain Stimulation for Movement Disorders: https://www.ninds.nih.gov/health-information/disorders/deep-brain-stimulation-movement-disorders.
2. Deep brain stimulation (DBS) for the treatment of Parkinson's disease and other movement disorders: https://www.ninds.nih.gov/about-ninds/impact/ninds-contributions-approved-therapies/deep-brain-stimulation-dbs-treatment-parkinsons-disease-and-other-movement-disorders.
3. Neurostimulation Technologies Harnessing Electricity to Treat Lost Neural Function: https://www.nih.gov/sites/default/files/about-nih/impact/neurostimulation-technologies-case-study.pdf
4. Weaver FM, et al. *JAMA*. 2009;301(1):63-73. PMID: 19126811.
5. Vitek JL, et al. *Lancet Neurol*. 2020;19(6):491-501. PMID: 32470421.
6. Indications for Medtronic DBS: http://professional.medtronic.com/pt/neuro/dbs-md/eff/data-and-clinical-outcomes.
7. Rizzone MG, et al. *Parkinsonism Relat Disord*. 2014;20(4):376-81. PMID: 24508574.
8. Bove F, et al. *Neurology*. 2021:10.1212/WNL.0000000000012246. PMID: 34078713.
9. Article: Self-tuning brain implant could help treat patients with Parkinson's disease: https://www.nih.gov/news-events/news-releases/self-tuning-brain-implant-could-help-treat-patients-parkinsons-disease.
10. Article: Researchers wirelessly record human brain activity during normal life activities: https://www.ninds.nih.gov/news-events/news/press-releases/researchers-wirelessly-record-human-brain-activity-during-normal-life-activities.
11. GBD 2016 Parkinson's Disease Collaborators. *Lancet Neurol*. 2018;17(11):939-953. PMID: 30287051.
12. Vedam-Mai V, et al. *Front Hum Neurosci*. 2021;15:644593. PMID: 33953663.
13. Humanitarian Device Exemption for Medtronic (Activa) Deep Brain Stimulation for OCD Therapy: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfhde/hde.cfm?id=H050003.


## STROKE TREATMENT


1. Tissue Plasminogen Activator for Acute Ischemic Stroke: https://www.ninds.nih.gov/about-ninds/impact/ninds-contributions-approved-therapies/tissue-plasminogen-activator-acute-ischemic-stroke-alteplase-activaser.
2. Lees KR, et al. *Stroke*. 2016;47(9):2373-9. PMID: 27507856.
3. Joo H, et al. *Stroke Vasc Neurol*. 2017;2(2):73-83. PMID: 28736623.
4. Tung CE, et al. *Stroke*. 2011;42(8):2257-62. PMID: 21719767.
5. Johnston SC. *Stroke*. 2010;41(10 Suppl):S59-62. PMID: 20876507.

6. Demaerschalk BM, et al. *Stroke*. 2005;36(11):2500-3. PMID: 16224087.
7. Boudreau DM, et al. *Stroke*. 2014;45(10):3032-9. PMID: 25190439.
8. Fagan SC, et al. *Neurology*. 1998;50(4):883-90. PMID: 9566367.
9. Optimizing endovascular therapy for ischemic stroke: https://www.ninds.nih.gov/about-ninds/what-we-do/impact/ninds-contributions-approved-therapies/optimizing-endovascular-therapy-ischemic-stroke.

## DEMENTIA BIOMARKERS

1. Alzheimer's Disease & Related Dementias: https://www.nia.nih.gov/health/alzheimers.
2. Video: Biomarkers and How They Help Diagnose Dementia: https://www.youtube.com/watch?v=n5m_qOy14VQ.
3. How Biomarkers Help Diagnose Dementia: https://www.nia.nih.gov/health/how-biomarkers-help-diagnose-dementia.
4. Biomarkers: https://www.nia.nih.gov/news/topics/biomarkers.
5. Article: Small Business Spotlight: $C_2$N Diagnostics' blood test detects Alzheimer's: https://www.nia.nih.gov/news/small-business-spotlight-c2n-diagnostics-blood-test-detects-alzheimers.
6. PrecivityAD™ blood test: https://precivityad.com/news/alzheimers-breakthrough.

## STROKE AWARENESS

1. Know Stroke: Know The Signs. Act In Time.: https://www.stroke.nih.gov/.
2. Tissue Plasminogen Activator for Acute Ischemic Stroke: https://www.ninds.nih.gov/about-ninds/impact/ninds-contributions-approved-therapies/tissue-plasminogen-activator-acute-ischemic-stroke-alteplase-activaser.
3. CDC Stroke: https://www.cdc.gov/stroke/.
4. Mind Your Risks®: https://www.mindyourrisks.nih.gov/.

# Substance Use

## Opioid Use Disorder

*Image credit: Scott Housley*

NIH-supported research led to the development of buprenorphine, a medication treatment for opioid addiction. In people who experienced a non-fatal overdose, long-term buprenorphine reduces their likelihood of dying from overdose in the future by 38%.

- In 2017, the opioid crisis was declared a public health emergency by HHS.
- In 2022, 6.1 million Americans had an opioid use disorder and opioid overdose was the leading cause of death for Americans ages 18-49. For every fatal overdose, it is estimated that there are 15 non-fatal overdoses, which have the potential to cause long-term brain injury.
- Buprenorphine, approved by FDA in 2002 to treat addiction to opioids, works by helping reduce withdrawal symptoms and drug craving.

## Overdose Reversal


*Image credit: National Institute on Drug Abuse, NIH*

NIH research led to the development of easy-to-use naloxone nasal spray, a life-saving tool that rapidly reverses the effects of opioid overdose. By 2014, over 30 states had naloxone access laws in place, and in those states opioid overdose deaths decreased by 14%.

- In 2015, FDA approved the first naloxone nasal spray—Narcan®—developed as a result of NIH-funded research.
- Naloxone is now the standard treatment to reverse opioid overdose and can be used by both medical professionals and laypersons without formal training.
- High rates of naloxone distribution among laypersons and emergency personnel could avert 21% of opioid overdose deaths, and the majority of overdose death reduction would result from increased distribution to laypersons.
- In 2023, FDA approved the first non-prescription versions of naloxone and approved a new opioid overdose reversal medication—nalmefene—that lasts longer than naloxone.

## Tobacco Smoking

*Image credit: Gianandrea Villa on Unsplash*

NIH-funded research on tobacco use has informed public policy interventions and health practices, supporting a two-thirds reduction in smoking over the past 50 years and contributing to a sharp drop in lung cancer rates.

- Smoking in U.S. adults hit an all-time low of 11.5% in 2021—down 75% since the U.S. Surgeon General issued a landmark report on the health consequences of smoking in 1964.
- Smoke-free policies decrease smoking rates, help to promote quitting, de-normalize tobacco use, and reduce exposure to secondhand smoke.
- Increasing the price of tobacco products through taxation prevents smoking initiation, promotes quitting, and reduces prevalence and intensity of tobacco use among youth and adult users.
- NIH-funded programs provide tools and tips to the public on quitting smoking.

## E-Cigarettes

*Image credit: Drew Walker on Unsplash*

In an effort to curb tobacco use in children and teenagers, in 2020 FDA released a policy—informed by NIH-supported research—to restrict the sale of e-cigarette flavors that appeal to kids, including fruit and mint flavors. This has led FDA to deny marketing applications for over 55,000 flavored e-cigarette products.

- The NIH-supported Population Assessment of Tobacco and Health (PATH) study findings indicate that flavored e-cigarette products appeal to youth and promote initiation of vaping.
- The NIH-supported Monitoring the Future (MTF) study findings indicate that youth are particularly attracted to cartridge-based e-cigarette flavors such as fruit and mint.
- Data from MTF show that, prior to 2020, there were dramatic increases in teen vaping, which leveled off in 2020 and decreased in 2021.

## OPIOID USE DISORDER


1. Medication-Assisted Treatment for Opioid Use Disorder: https://www.nationalacademies.org/our-work/medication-assisted-treatment-for-opioid-use-disorder.
2. Article: As Opioid Deaths Surge, Biden Team Moves To Make Buprenorphine Treatment Mainstream: https://www.npr.org/2021/04/27/990997759/as-opioid-deaths-surge-biden-team-moves-to-make-buprenorphine-treatment-mainstre#:~:text=As%20Opioid%20Deaths%20Surge%2C%20Biden%20Team%20Moves%20To,the%20country%20where%20the%20drug%20is%20rarely%20prescribed.
3. Article: Research to Address the Real-Life Challenges of Opioid Crisis: https://directorsblog.nih.gov/tag/buprenorphine/.
4. Opioid Addiction: https://www.nih.gov/about-nih/what-we-do/nih-turning-discovery-into-health/opioid-addiction.
5. Article: Taking Stock of NIDA's Achievements and Looking to the Future: https://archives.drugabuse.gov/about-nida/noras-blog/2017/01/taking-stock-nidas-achievements-looking-to-future.
6. Larochelle MR, et al. *Ann Intern Med*. 2018;169(3):137-145. PMID: 29913516.
7. National Opioids Crisis: Help and Resources: https://www.hhs.gov/opioids/index.html.
8. CDC. Wide-ranging ONline Data for Epidemiologic Research, Multiple Causes of Death 1999-2022. https://wonder.cdc.gov/wonder/help/mcd.html.
9. SAMHSA. 2021 National Survey on Drug Use and Health, 2022. https://www.samhsa.gov/data/report/2021-nsduh-annual-national-report.
10. U.S. Government Accountability Office. Opioid Crisis: Status of Public Health Emergency Authorities, 2018. https://www.gao.gov/products/gao-18-685r.
11. Casillas SM, et al. *Injury Prevention*, 2024. PMID: 38290778.


## OVERDOSE REVERSAL


1. McClellan C, et al. *Addict Behav*. 2018;86:90-95. PMID: 29610001.
2. Townsend T, et al. *Int J Drug Policy*. 2020;75:102536. PMID: 31439388.
3. U.S. Surgeon General's Advisory on Naloxone and Opioid Overdose: https://www.hhs.gov/surgeongeneral/priorities/opioids-and-addiction/naloxone-advisory/index.html.
4. Article: NARCAN Nasal Spray: Life-Saving Science at NIDA: https://archives.drugabuse.gov/about-nida/noras-blog/2015/11/narcan-nasal-spray-life-saving-science-nida.
5. Article: Taking Stock of NIDA's Achievements and Looking to the Future: https://archives.drugabuse.gov/about-nida/noras-blog/2017/01/taking-stock-nidas-achievements-looking-to-future.
6. Article: Surgeon general urges more Americans to carry overdose antidote naloxone: https://www.chicagotribune.com/nation-world/ct-surgeon-general-naloxone-20180405-story.html.
7. Article: Teaching Children How to Reverse an Overdose. https://www.nytimes.com/2020/02/23/us/opioids-tennessee-narcan-training.html.
8. Drug Overdose Deaths in the U.S. Top 100,000 Annually: https://www.cdc.gov/nchs/pressroom/nchs_press_releases/2021/20211117.htm.
9. Article: FDA moves quickly to approve easy-to-use nasal spray to treat opioid overdose: https://wayback.archive-it.org/7993/20180125101447/https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm473505.htm.

10. Article: FDA Approves First Over-the-Counter Naloxone Nasal Spray: https://www.fda.gov/news-events/press-announcements/fda-approves-first-over-counter-naloxone-nasal-spray.
11. Article: FDA Approves Second Over-the-Counter Naloxone Nasal Spray Product: https://www.fda.gov/news-events/press-announcements/fda-approves-second-over-counter-naloxone-nasal-spray-product.
12. Article: FDA Approves Prescription Nasal Spray to Reverse Opioid Overdose: https://www.fda.gov/news-events/press-announcements/fda-approves-prescription-nasal-spray-reverse-opioid-overdose.

## TOBACCO SMOKING

1. Tobacco Policy Viewer: https://gis.cancer.gov/tobaccopolicy/.
2. Calo WA, et al. *Curr Cardiovasc Risk Rep*. 2013;7(6):446-452. PMID: 24634706.
3. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014. PMID: 24455788.
4. Smoking Cessation: Fast Facts: https://www.cdc.gov/tobacco/php/data-statistics/smoking-cessation/index.html.

## E-CIGARETTES

1. Enforcement Priorities for Electronic Nicotine Delivery Systems (ENDS) and Other Deemed Products on the Market Without Premarket Authorization: Guidance for Industry: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/enforcement-priorities-electronic-nicotine-delivery-system-ends-and-other-deemed-products-market.
2. Rostron BL, et al. *Am J Health Behav*. 2020;44(1):76-81. PMID: 31783934.
3. Leventhal AM, et al. *JAMA.* 2019;322(21):2132-2134. PMID: 31688891.
4. Article: Study: Surge of teen vaping levels off, but remains high as of early 2020: https://www.drugabuse.gov/news-events/news-releases/2020/12/study-surge-of-teen-vaping-levels-off-but-remains-high-as-of-early-2020.

# Eye and Ear Health

## Imaging the Eye

*Image credit: National Eye Institute, NIH*

There are many diseases that cause vision loss. NIH funded the development of optical coherence tomography (OCT) technology to diagnose these diseases non-invasively, and there are now over 30 million OCT procedures performed annually in eye clinics worldwide.

- OCT assessment is fast, painless, and noninvasive, and OCT-based devices are now standard in eye care clinics.
- OCT is a noninvasive technology that enables imaging of the eye's light-sensing retina to help clinicians identify early signs of disease, monitor disease progression, and evaluate treatment response.
- The most common vision-threatening diseases in the U.S. affect the retina. These include age-related macular degeneration, diabetic retinopathy, and glaucoma.
- OCT has also been shown to be effective for monitoring progression of non-vision related diseases such as Alzheimer's and Parkinson's disease.

## Preventing Blindness

*Image credit: National Eye Institute, NIH*

Thanks to NIH, there are now standard treatments for common causes of blindness, including diabetic retinopathy (DR)—a complication affecting a majority of people with diabetes—and both wet and dry age-related macular degeneration (AMD). Drug therapies have become essential for stopping disease progression, reducing blindness caused by wet AMD by 50%.

- Wet AMD and DR are two leading causes of blindness; both involve abnormal growth of leaky blood vessels in the retina.
- Early treatments sealed vessels with lasers, which have damaging side effects. Now there are multiple drug options that block vessel formation in wet AMD and DR.
- NIH clinical trials compared drug safety and effectiveness of these therapies, and NIH supported the development of imaging tools to monitor disease progression and inform dosing.
- NIH research also led to the development of the first two drugs approved by FDA for late-stage dry AMD in 2023.

## Treatments for Lazy Eye

*Image credit: National Eye Institute, NIH*

Roughly 1.5% of U.S. children have amblyopia, known as lazy eye. NIH-supported research informed the guidelines for early treatment of amblyopia, resulting in decreased treatment burden and better outcomes.

- Amblyopia is a condition where the brain favors visual input from one eye, weakening sensory input from the other. Due to a loss of brain plasticity, treatment becomes increasingly less effective by adolescence, resulting in permanent unilateral vision loss.
- NIH-funded research has defined the standard for treating amblyopia in children with eyedrops or by temporarily patching the stronger eye.
- Studies revealed that a large proportion of children with amblyopia can be successfully treated with less intense treatment regimens than previously thought.

## Gene Therapy for Eye Disease

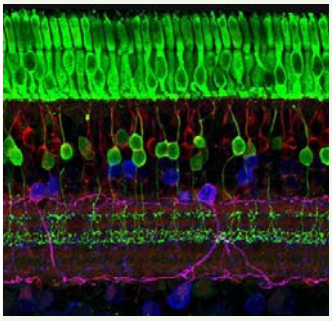

*Image credit: Wei Li, National Eye Institute, National Institutes of Health*

NIH-funded scientists helped develop the first FDA-approved gene therapy for a degenerative eye disease, Leber Congenital Amaurosis (LCA). This therapy can safely restore normal function and vision in patients, paving the way for other gene-based therapies to treat eye diseases.

- LCA is caused by defects in a gene essential for normal retinal function.
- This new gene therapy, Luxturna, was found to be safe, and patients receiving this therapy reported having brighter and clearer vision within weeks of treatment.
- Luxturna is the first FDA-approved gene-replacement therapy of any kind to be approved.

## Cochlear Implants

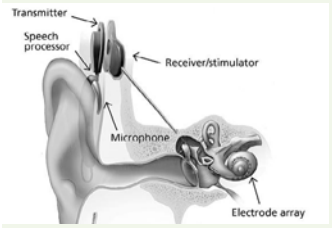


*Image credit: National Institute on Deafness and Other Communication Disorders, NIH*

NIH research contributed to the development of cochlear implants, which have become the most common and successful intervention for children who are profoundly deaf or severely hard-of-hearing. Over 80% of children implanted before 18 months of age develop spoken language skills comparable to children with normal hearing.

- A cochlear implant is a small electronic device that provides a sense of sound to a person who is profoundly deaf or severely hard-of-hearing.
- FDA first approved cochlear implants in the mid-1980s to treat hearing loss in adults. Today, cochlear implants are approved for use in children ages 9 months and older.
- As of December 2019, approximately 736,900 cochlear implants had been implanted worldwide. In the U.S., roughly 118,100 devices have been implanted in adults and 65,000 in children.

## Hearing Loss Screening

*Image credit: CanStockPhoto*

As a result of NIH efforts, nearly all infants born in the U.S. today are screened for hearing loss, compared to under 10% screened prior to the universal newborn hearing screening program launched in the 1990s. Early screening allows infants to receive interventions and services during their developmental years when the interventions will be most effective.

- Approximately two to three in every 1,000 children in the U.S. are born with a detectable level of hearing loss in one or both ears.
- Around 98% of newborns are now screened for hearing loss in the U.S. through a program developed by Congress as a joint effort by NIH, HRSA, and CDC, with methods and technology developed by NIH-supported researchers.
- Early identification of hearing loss allows children to receive early interventions and services for healthy language, social, and behavioral development.

## Hearing Aid Access

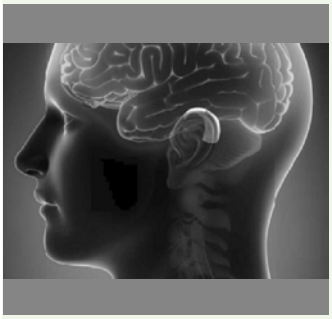

*Image credit: Department of Speech and Hearing Sciences, University of Washington*

In 2022, FDA allowed for the first time over the counter (OTC) sales of hearing aids, enabling adults with mild to moderate hearing loss to buy them directly. This ruling increases access and decreases costs of hearing aids and FDA made this ruling based on decades of NIH-funded research.

- One-third of people over the age of 65, and half of those 75 years and older, have hearing loss.
- Prior to this FDA decision, only one in five people who could benefit from hearing aids used them.
- NIH-supported research has shown that hearing loss is associated with an increased risk of dementia, falls, depression, social isolation, anxiety, and reduced mobility.
- Treatment of hearing loss, in part through hearing aids, can improve communication, sociability, and overall quality of life.

## IMAGING THE EYE


1. Fujimoto J, et al. *Invest Ophthalmol Vis Sci.* 2016;57(9):OCTi-OCTii. PMID: 27419359.
2. Special Issue: 25 years of optical coherence tomography. *Invest Ophthalmol Vis Sci. 2016.* https://iovs.arvojournals.org/ss/octissue.aspx.
3. Doustar J, et al. Front Neurol. 2017;8:701. PMID: 29312125.


## PREVENTING BLINDNESS


1. Article: NIH study finds Avastin and Lucentis are equally effective in treating age-related macular degeneration: https://www.nei.nih.gov/about/news-and-events/news/nih-study-finds-avastin-and-lucentis-are-equally-effective-treating-age-related-macular-degeneration.
2. Bloch SB, et al. *Am J Ophthalmol*. 2012;153(2):209-213.e2. PMID: 22264944.
3. Article: Comparison of AMD Treatments Trials (CATT): Lucentis — Avastin Trial: https://www.nih.gov/news-events/news-releases/comparison-amd-treatments-trials-catt-lucentis-avastin-trial.
4. CATT Research Group. *N Engl J Med*. 2011;364(20):1897-908. PMID: 21526923.
5. Diabetic Retinopathy Clinical Research Network. *N Engl J Med*. 2015;372(13):1193-203. PMID: 25692915.
6. Eye Health Data and Statistics: https://www.nei.nih.gov/learn-about-eye-health/eye-health-data-and-statistics.
7. Solomon SD, et al. *Cochrane Database Syst Rev*. 2019;3(3):CD005139. PMID: 30834517.
8. Common Eye Disorders and Diseases: https://www.cdc.gov/vision-health/about-eye-disorders/.
9. Diabetic Retinopathy: https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/diabetic-retinopathy.
10. Article: Story of discovery: NEI-funded research paves way for new dry AMD drugs: https://www.nei.nih.gov/about/news-and-events/news/story-discovery-nei-funded-research-paves-way-new-dry-amd-drugs.


## TREATMENT FOR LAZY EYE


1. Pineles SL, et al. *Ophthalmic Epidemiol*. 2022;29(5):537-544. PMID: 34459319.
2. Statement on the Success of Reduced Daily Eye Patching to Treat Severe Amblyopia: https://www.nei.nih.gov/about/news-and-events/news/statement-success-reduced-daily-eye-patching-treat-severe-amblyopia.


## GENE THERAPY FOR EYE DISEASE


1. Article: NIH vision researcher T. Michael Redmond recognized with Champalimaud Vision Award: https://www.nei.nih.gov/about/news-and-events/news/nih-vision-researcher-t-michael-redmond-recognized-champalimaud-vision-award.


## COCHLEAR IMPLANTS


1. Cochlear Implants: http://www.nidcd.nih.gov/health/hearing/pages/coch.aspx.
2. Semenov YR, et al. *Ear Hear*. 2013;34(4):402-12. PMID: 23558665.
3. Crowson MG, et al. *Audiol Neurootol*. 2017;22(4-5):236-258. PMID: 29262414.
4. Bond M, et al. *Health Technol Assess*. 2009;13(44):1-330. PMID: 19799825.

5. Semenov YR, et al. *Otolaryngol Clin North Am*. 2012;45(5):959-81. PMID: 22980678.
6. Quick Statistics About Hearing: https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing.
7. Nucleus 24 Cochlear Implant System: https://www.fda.gov/medical-devices/recently-approved-devices/nucleus-24-cochlear-implant-system-p970051s205.

## HEARING LOSS SCREENING

1. Article: New law to strengthen early hearing screening program for infants and children: https://www.nidcd.nih.gov/news/2017/new-law-early-hearing-screening-infants-and-children.
2. Hearing Program: https://www.nidcd.nih.gov/research/extramural/hearing-program.
3. National Institute on Deafness and Other Communication Disorders: https://www.nih.gov/about-nih/what-we-do/nih-almanac/national-institute-deafness-other-communication-disorders-nidcd.
4. Early identification of hearing impairment in infants and young children. NIH Consensus Statement. 1993;11(1):1-24. PMID: 8401641.
5. Olusanya BO. *Int J Pediatr Otorhinolaryngol*. 2011;75(3):316-21. PMID: 21211856.
6. van Dyk M, et al. *Int J Pediatr Otorhinolaryngol*. 2015;79(7):1034-40. PMID: 25921078.
7. Data and Statistics About Hearing Loss in Children: https://www.cdc.gov/hearing-loss-children/data.
8. Joint Committee on Infant Hearing 1994 Position Statement: http://www.jcih.org/JCIH1994.pdf.
9. World Health Organization: Global costs of unaddressed hearing loss and cost-effectiveness of interventions. 2017. https://apps.who.int/iris/bitstream/handle/10665/254659/9789241512046-eng.pdf.
10. Grosse SD. *Volta Voices.* 2007;14(6):38-40.
11. Quick Statistics About Hearing: https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing.

## HEARING AID ACCESS

1. Medical Devices; Ear, Nose, and Throat Devices; Establishing Over-the-Counter Hearing Aids: https://www.federalregister.gov/documents/2022/08/17/2022-17230/medical-devices-ear-nose-and-throat-devices-establishing-over-the-counter-hearing-aids.
2. Milestones to OTC Hearing Aid Final Rule: https://www.nidcd.nih.gov/news/multimedia/milestones-to-otc-hearing-aid-final-rule.
3. Over-the-Counter Hearing Aids: https://www.nidcd.nih.gov/health/over-counter-hearing-aids.
4. Quick Statistics About Hearing, Balance, & Dizziness: https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing.
5. Age-Related Hearing Loss (Presbycusis): https://www.nidcd.nih.gov/health/age-related-hearing-loss.
6. Article: FDA's new category of hearing aids advances hearing health care: https://www.nidcd.nih.gov/about/nidcd-director-message/fdas-new-category-hearing-aids-advances-hearing-health-care.
7. Article: Hearing aids slow cognitive decline in people at high risk: https://www.nia.nih.gov/news/hearing-aids-slow-cognitive-decline-people-high-risk.

# Cancer

## Lung Cancer

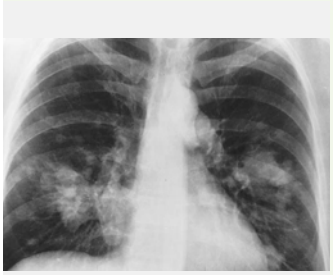

*Image credit: National Cancer Institute, NIH*

NIH-funded research on the prevention and treatment of lung cancer, including development of screening interventions and clinical guidelines, has contributed to a decline in U.S. lung cancer deaths by 54% since 1990 in men and by 30% since 2002 in women.

- NIH-supported advances in CT scans enable earlier lung cancer detection, and this influenced the U.S. Preventive Services Task Force's recommendation that middle-aged and older adults with a history of heavy smoking be screened with spiral CT.
- NIH supported the development of new treatments for lung cancer, including targeted therapies and immunotherapies.
- Reductions in smoking reached an all-time low of 13.7% of U.S. adults in 2018, also contributing to declines in lung cancer deaths.

## BRCA Mutations


*Image credit: Ernesto del Aguila III, NHGRI*

NIH research led to the identification and characterization of BRCA gene mutations in breast, ovarian, prostate, and pancreatic cancers. Families with a history of these cancers can now use genetic test results to make informed decisions about screening, prevention activities, and treatments.

- A patient's lifetime risk of developing breast and/or ovarian cancer is greatly increased if they inherit a harmful mutation in genes BRCA1 or BRCA2.
- Understanding this link has saved patient lives through changes to cancer screening, prevention, and treatment:
  - ◊ Guidelines for screening for patients with BRCA mutations are different than for average-risk patients.
  - ◊ Risk lowering drugs and prophylactic mastectomy are prevention options.
  - ◊ A class of drugs known as PARP inhibitors are recommended treatments for patients with BRCA mutations.

## Breast Cancer

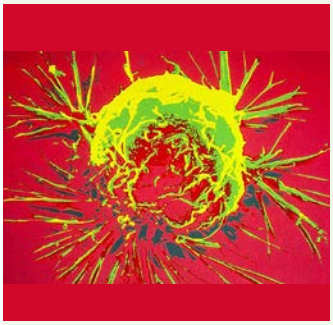

*Image credit: Bruce Wetzel and Harry Schaefer, National Cancer Institute, NIH*

NIH-supported research has helped identify major breast cancer subtypes based on tumors' molecular features, which enables treatments to be tailored to the cancers' specific molecular profiles. This has contributed to the 41% drop in breast cancer death rates for patients between 1990 and 2019.

- Nearly 300,000 people are diagnosed with breast cancer each year, and about 44,000 people die from the disease annually.
- In the U.S., one in eight women will develop breast cancer in her lifetime.
- Targeted treatments exist for HER-2-positive breast cancer, breast cancers with BRCA gene mutations, and some triple-negative breast cancers.

## Cervical Cancer

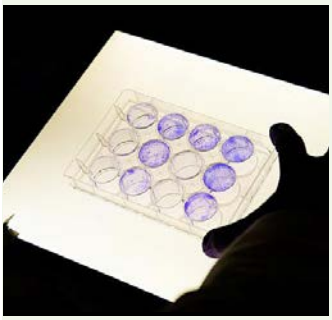

*Image credit: National Cancer Institute, NIH*

Between 1975 and 2018, the incidence rate of cervical cancer in the U.S. dropped 55%, and the death rate dropped 60%. This is in part due to NIH-supported research that led to screening and prevention approaches, including the development of HPV testing and vaccines.

- Routine Pap tests allow doctors to find and treat precancerous lesions caused by human papillomavirus (HPV) infection, preventing cervical cancer from developing.
- HPV vaccines have been shown to reduce infections from the types of HPV that cause cancer and prevent cervical precancers and cancers.
- Because of the availability of HPV vaccines, screening, and treatments, in 2020 WHO announced that 194 countries have committed to ending cervical cancer—the first global commitment to eliminate a cancer.

## Melanoma

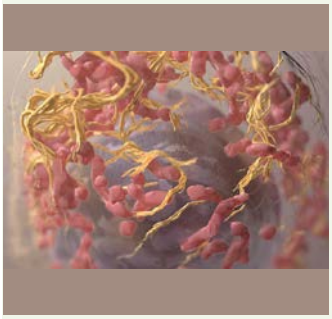

*Image credit: Sriram Subramaniam, NCI*

The death rate due to melanoma—the most serious type of skin cancer—has dropped almost 18% from 2013 to 2016, due in part to NIH-supported research that has led to the development of new therapies.

- Melanoma is a rare form of skin cancer, though rates have been increasing over the last 30 years. It is more likely to invade nearby tissues and spread to other parts of the body than other types of skin cancer, and it causes the most skin cancer deaths.
- Until 2011, there were no effective treatments for advanced (metastatic) melanoma. Building on NIH-supported research on disease mechanisms, targeted therapies for common molecular changes in melanoma and immunotherapies have dramatically changed these outcomes.

## Colorectal Cancer

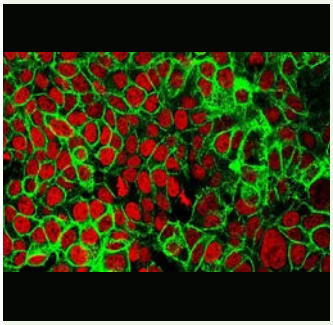

*Image credit: NCI Center for Cancer Research*

NIH-funded research on colorectal cancer has improved the prevention, early detection, and treatment of this cancer, contributing to a 55% drop in death rates from 1970 to 2018.

- NIH-supported research on the biology of colorectal cancer and ways to detect its precursors has led to a number of screening tests, contributing to its early detection and prevention.
- NIH-funded research has contributed to surgical and systemic therapies for patients with colorectal cancer.
- The colorectal cancer death rate has dropped by 55%, from 29.2 per 100,000 in 1970 to 13.1 per 100,000 in 2018, due to prevention and earlier detection through screening and improvements in treatment.

## Cisplatin Chemotherapy

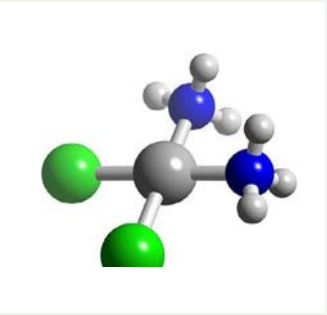

*Image credit: Karl Harrison 3DChem.com*

NIH-supported research led to the development of Cisplatin, a type of chemotherapy commonly used to treat testicular, ovarian, cervical, lung, and bladder cancers. Millions of people have benefited from cisplatin treatment and, when used with other chemotherapy drugs, its cure rate for testicular cancer is more than 90%.

- While studying the effects of electrical fields on bacteria, an NIH-funded researcher discovered that platinum chemicals inhibited bacterial growth. Of these platinum-containing compounds, cisplatin was found to stop or slow the growth of certain cancer cells.
- Cisplatin was first approved in the U.S. for clinical use to treat cancer in 1978. Today, research is actively ongoing to discover better ways to use cisplatin in the fight against cancer.
- Cisplatin and similar platinum-based drugs are prescribed for an estimated 10-20% of all cancer patients.

## Precision Therapy

*Image credit: Rhoda Baer/NCI*

Thanks to NIH-supported development of the precision cancer treatment, imatinib (Gleevec®), patients with chronic myelogenous leukemia (CML) now have a nearly normal life expectancy.

- One of the first precision cancer treatments to receive FDA approval in 2001, Gleevec® specifically blocks an abnormal protein that causes CML and is not found in healthy cells. It is now the standard therapy for CML patients.
- Due in part to targeted treatments like Gleevec®, the 5-year survival rate for CML has more than tripled from 22% in the mid-1970s to 67% for those diagnosed between 2008 and 2014.
- CML patients are now expected to live 30 years post-diagnosis, essentially a normal lifespan.

## Chemotherapy

*Image credit: National Cancer Institute, NIH*

Since the 1950s, researchers at NIH have played a large role in developing chemotherapy for cancer and testing various combinations of chemotherapy drugs. This led to effective treatments for many forms of cancer and a dramatic increase in childhood cancer survival rates from 5% before 1950 to 85% today.

- Of note, in 1958, chemotherapy drugs were used at the NIH Clinical Center to treat solid tumor cancers, such as lung, breast, or prostate cancers (rather than leukemia or lymphoma). At the time this was a unique way to treat cancer, and the study showed that chemotherapy could be effective.
- Chemotherapy is now a standard treatment for solid tumor cancers, and each year about 650,000 cancer patients receive chemotherapy in outpatient oncology clinics in the U.S.

## Neuroblastoma

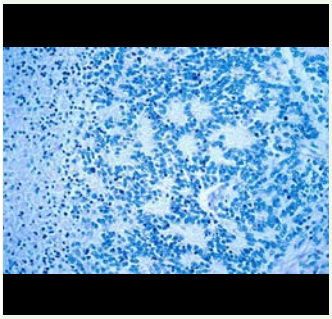

*Image credit: Dr. Maria Tsokos, National Cancer Institute*

More than 30 years of research by NIH-supported scientists led to the development of Unituxin™ (dinutuximab or monoclonal antibody ch14.18), a treatment that is now a first-line therapy for aggressive neuroblastoma. Neuroblastoma is a rare cancer that most often occurs in young children, and this treatment has increased the 5-year survival rate by 20%.

- Approved by FDA in 2015, Unituxin™ resulted from 30 years of NIH-funded research on antibody-based immunotherapy—from discovery through phase 3 clinical trials.
- Before Unituxin™, fewer than 40% of children with aggressive neuroblastoma lived 5 years after diagnosis. Used in combination with a treatment that helps turn on the patient's immune system, this is the first effective immunotherapy for neuroblastoma shown to reduce the risk of recurrence and improve survival.

## Childhood Leukemia

*Image credit: Bill Branson/NCI*

Prior to the 1950s, childhood acute lymphocytic leukemia (ALL) was a fatal disease, and little was known about its biology. Long-term NIH investments in cancer research have transformed outcomes for children with ALL—as a result of treatments available today, more than 90% of children with ALL are cured.

- ALL treatment regimens, which involve combination chemotherapy, radiation, stem cell transplant, and immunotherapy, have improved thanks to NIH-funded research.
- NIH's clinical trials networks have contributed to a culture in which around 60% of children with cancer participate in clinical trials, compared to around 5% of adult patients with cancer. These networks and this level of participation has enabled many of these advances for children with cancer.

## Immunotherapy

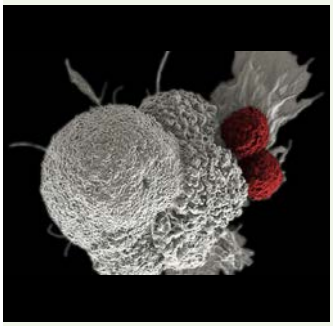

*Image credit: Rita Elena Serda, Duncan Comprehensive Cancer Center at Baylor College of Medicine, National Cancer Institute, NIH*

Decades of NIH-funded research on the immune system and cancer has led to the development of immunotherapies for over 15 different cancer types and counting. Research shows that 52% of patients with metastatic melanoma who received immunotherapy are still alive after five years, up from just 5% before immunotherapy was developed.

- Immunotherapy is a treatment that uses the patient's own immune system to fight cancer by enhancing or restoring the immune system's ability to fight the disease.
- Immune checkpoint inhibitors, a specific type of immunotherapy, facilitate the immune system's ability to kill cancer cells more effectively by removing naturally occurring barriers, or "immune checkpoints.
- In another kind of immunotherapy, called CAR T cells, a patient's own immune cells are engineered to target and destroy cancerous cells. These have been most effective for blood cancers so far.

## Declining Death Rates

*Image credit: Bill Branson/NCI*

Long-term NIH investments in cancer research have contributed to a decline in death rates for all cancers in the U.S. The overall cancer death rate dropped 33% from 1991 to 2021.

- This decline in deaths due to cancer is a result of advances in prevention (particularly reductions in smoking), early detection, and improved treatments for cancer.
- It is estimated that the drop in cancer death rates translates into almost 4.1 million fewer deaths from 1991 to 2021.

## LUNG CANCER


1. Cancer Stat Facts: Lung and Bronchus Cancer: https://seer.cancer.gov/statfacts/html/lungb.html.
2. National Lung Screening Trial: https://www.cancer.gov/types/lung/research/nlst.
3. Howlader N, et al. *N Engl J Med*. 2020;383(7):640-649. PMID: 32786189.
4. Article: Cigarette Smoking Among U.S. Adults Hits All-Time Low: https://archive.cdc.gov/#/details?url=https://www.cdc.gov/media/releases/2019/p1114-smoking-low.html.
5. Moyer VA, et al. *Ann Intern Med*. 2014;160(5):330-8. PMID: 24378917.
6. Klabunde CN, et al. *Am J Prev Med*. 2022;62(2):e77-e86. PMID: 34657771.


## BRCA MUTATIONS


1. BRCA Gene Mutations: Cancer Risk and Genetic Testing: https://www.cancer.gov/about-cancer/causes-prevention/genetics/brca-fact-sheet.
2. Enhancing Breast and Ovarian Cancer Care: The Discovery of BRCA1 and BRCA2: https://www.cancer.gov/research/progress/discovery/brca.
3. BRCA-Related Cancer: Risk Assessment, Genetic Counseling, and Genetic Testing: https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/brca-related-cancer-risk-assessment-genetic-counseling-and-genetic-testing.
4. Hadar T, et al. *JAMA Oncol*. 2020;6(9):1460-1463. PMID: 32644100.


## BREAST CANCER


1. Report: Breast Cancer Death Rates Down 40% Since 1989: https://www.cancer.org/latest-news/report-breast-cancer-death-rates-down-40-percent-since-1989.html.
2. Breast Cancer Facts: https://www.nationalbreastcancer.org/breast-cancer-facts?gclid=Cj0KCQjwg7KJBhDyARIsAHrAXaFs7_vbKd1BHP_CVds81wVE7TYryvCosb7huenkNn4tV7agpP8zdlkaApNSEALw_wcB.
3. Breast Cancer Treatment: https://www.cancer.gov/types/breast/patient/breast-treatment-pdq.


## CERVICAL CANCER


1. Cancer Stat Facts: Cervical Cancer: https://seer.cancer.gov/statfacts/html/cervix.html.
2. Cervical Cancer Screening: https://www.cancer.gov/types/cervical/screening.
3. Cervical Cancer Prevention: https://www.cancer.gov/types/cervical/hp/cervical-prevention-pdq.
4. Article: An Estimated 92% of Cancers Caused by HPV Could be Prevented by Vaccine: https://www.cdc.gov/media/releases/2019/p0822-cancer-prevented-vaccine.html.
5. What Is Cervical Cancer?: https://www.cancer.gov/types/cervical.
6. Article: NCI's Douglas R. Lowy and John T. Schiller to receive 2017 Lasker Award: https://www.nih.gov/news-events/news-releases/ncis-douglas-r-lowy-john-t-schiller-receive-2017-lasker-award.


## MELANOMA


1. Skin Cancer (Including Melanoma): https://www.cancer.gov/types/skin.
2. Melanoma Treatment: https://www.cancer.gov/types/skin/patient/melanoma-treatment-pdq.

3. Melanoma of the Skin: Recent Trends in U.S. Age-Adjusted Mortality Rates, 2000-2020: https://seer.cancer.gov/explorer/application.html?site=53&data_type=2&graph_type=2&compareBy=sex&chk_sex_1=1&chk_sex_3=3&chk_sex_2=2&race=1&age_range=1&advopt_precision=1&advopt_show_ci=on&advopt_display=2.
4. Deaths from Metastatic Melanoma Drop Substantially in the United States: https://www.cancer.gov/news-events/cancer-currents-blog/2020/metastatic-melanoma-deaths-drop.

## COLORECTAL CANCER

1. Cancer Facts & Figures 2021: https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2021.html.
2. Article: Advances in Colorectal Cancer: https://www.webmd.com/colorectal-cancer/features/advances-in-colorectal-cancer.
3. Screening Tests to Detect Colorectal Cancer and Polyps: https://www.cancer.gov/types/colorectal/screening-fact-sheet.

## CISPLATIN CHEMOTHERAPY

1. Curiosity Creates Cures: The Value and Impact of Basic Research: https://www.nigms.nih.gov/education/fact-sheets/Pages/curiosity-creates-cures.aspx.
2. The “Accidental” Cure—Platinum-based Treatment for Cancer: The Discovery of Cisplatin: https://www.cancer.gov/research/progress/discovery/cisplatin.

## PRECISION THERAPY

1. Gambacorti-Passerini C, et al. *Am J Hematol*. 2015;90(2):156-61. PMID: 25370814.
2. Druker BJ, et al. *N Engl J Med*. 2006;355(23):2408-17. PMID: 17151364.
3. Druker B. *Keio J Med*. 2010;59(1):1-3. PMID: 20375651.

## CHEMOTHERAPY

1. Zubrod CG, et al. *Cancer Chemother*. Rep 1966; 50: 349–540.
2. DeVita VT Jr, et al. *Cancer Res*. 2008;68(21):8643-53. PMID: 18974103.
3. Information for Health Care Providers: https://www.cdc.gov/cancer/preventinfections/providers.

## NEUROBLASTOMA

1. Harnessing the Power of Our Immune Systems to Treat Neuroblastoma: Discovery of Ch14.18 Immunotherapy: https://www.cancer.gov/research/progress/discovery/neuroblastoma.
2. Investments in Basic Research for Pediatric Cancers: https://visualsonline.cancer.gov/details.cfm?imageid=11963.

## CHILDHOOD LEUKEMIA

1. Childhood Cancer Research Highlights: https://www.cancer.org/research/acs-research-highlights/childhood-cancer-research-highlights.html.
2. Children’s Oncology Group: What is a Clinical trial?: https://www.childrensoncologygroup.org/clinicaltrials-136.
3. Smith MA, et al. *Cancer*. 2014;120(16):2497-506. PMID: 24853691.

4. National Academy of Sciences. Curing Childhood Leukemia. 1997. http://www.nasonline.org/publications/beyond-discovery/curing-childhood-leukemia.pdf.

## IMMUNOTHERAPY

1. Larkin J, et al. *N Engl J Med*. 2019;381(16):1535-1546. PMID: 31562797.
2. Immune Checkpoint Inhibitors: https://www.cancer.gov/about-cancer/treatment/types/immunotherapy/checkpoint-inhibitors.
3. Melanoma Treatment: https://www.cancer.gov/types/skin/patient/melanoma-treatment-pdq.
4. CAR T Cells: Engineering Patients' Immune Cells to Treat Their Cancers: https://www.cancer.gov/about-cancer/treatment/research/car-t-cells.

## DECLINING DEATH RATES

1. Siegel RL. et al. *CA Cancer J Clin*. 2024 Jan;74(1):12-49. PMID: 38230766.

# Technology and Patient Care

## Supercomputing

*Image credit: Shutterstock*

NIH-funded supercomputing instruments enabled researchers to determine the efficacy of four COVID-19 vaccines. Advanced computations conducted using these instruments helped inform timely decisions on the initial authorizations of COVID-19 vaccines, which later received FDA approval and were critical to saving lives during the COVID-19 pandemic.

- NIH supports cost-effective investments in cutting-edge instruments like supercomputers that are shared among multiple researchers to maximize their benefit nationwide.
- Supercomputing, a type of high-performance computing that uses multiple central processing units, allows researchers to perform numerous complex calculations simultaneously.
- Researchers use supercomputers to analyze and visualize many different biomedical data sets, from the intricate structures of proteins to complex genetic characteristics across global populations.
- This technology paves the way for supercomputing to be used in future public health emergency responses.

## Collaborative Care

*Image credit: Daniel Soñé/NCI*

NIH-supported research has informed clinical care guidelines by demonstrating the effectiveness of collaborative care—a service delivery model for treating mental/behavioral health conditions in primary care settings—for treating depression, and it has paved the way for collaborative care services in routine practice, as seen today.

- NIH-supported clinical trials demonstrated improvements in quality of care and depression outcomes with collaborative care techniques.
- This research also led to the development of billing codes to reimburse providers for services furnished through the collaborative care model in Medicare and a growing number of commercial and public payers.
- Collaborative care has also been shown to be effective for treating PTSD, anxiety, alcohol use disorder, opioid use disorder, and co-occurring medical conditions.

## Mobile Health

*Image credit: Daniel Soñé/NCI*

NIH has supported the development of many behavioral interventions that are now available via popular health-focused smartphone applications. These apps, used by millions of users across the U.S., serve as digital health interventions ranging from reminding people to take medications to engaging in mindfulness practices.

- Smartphone apps are becoming increasingly popular as digital interventions in almost all sectors of healthcare.
- NIH funds the development, testing, and implementation of mobile health interventions like smartphone apps.
- For example, Calm, Inc., is scientifically advised by NIH awardees and contains guided meditations and sleep-promoting sounds.
- NIH also supported development of the FODMAP Diet app, which empowers people to shop for groceries, cook meals, and manage their food consumption to alleviate irritable bowel syndrome (IBS) based on ingredients that may trigger their symptoms.

## Automatic Blood Counter

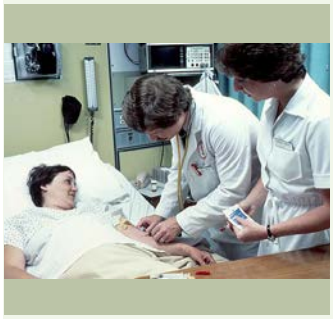

*Image credit: Linda Bartlett/NCI*

Anyone who has had diagnostic blood testing done has likely benefitted from use of an automatic blood counter, which was developed by NIH-supported researchers in the 1950s and is widely used to this day in hospitals and labs around the world.

- In 1957, the Coulter Model S, an automatic blood counter, was developed at the NIH Clinical Center.
- The automatic blood counter allows hospital laboratories to characterize and count human blood cells, leading to countless diagnoses and treatments.

## Liver Transplants

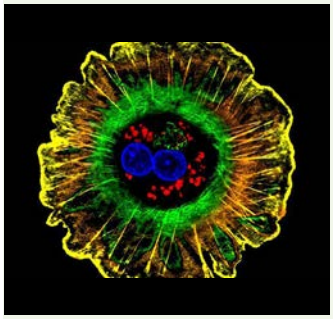

*Image credit: Donna Beer Stolz, University of Pittsburgh*

The first successful human liver transplantation was performed by an NIH grantee in 1967. Liver transplants are now routinely used to save the lives of people whose livers fail due to disease or injury, with over 7,000 performed in the U.S. per year.

- The survival rate within the first year after a liver transplant is now up to 86%.
- Common reasons for needing a liver transplant are alcoholic liver disease, cancers that start in the liver, fatty liver disease, and cirrhosis caused by chronic hepatitis C.

## Knee Surgery

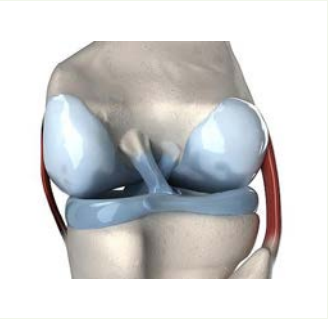

*Image credit: iStock*

NIH supported research on a new approach to surgically repair tears of the anterior cruciate ligament (ACL) by using a patient's own tissue. This has led to changes in clinical practice, with surgeons no longer using donor tissue in young athletes.

- ACL tears remain one of the most severe knee injuries, and a fully torn ACL cannot heal on its own.
- ACL reconstruction surgeries using the patient's own tissue, called autografts, experience better outcomes and are less likely to rupture and require additional surgery than surgeries using cadaver donor tissue. This difference is most significant for competitive athletes under the age of 25.
- NIH research also supported the development of the FDA-approved bridge-enhanced ACL restoration (BEAR) implant, which is the first-ever implant to stimulate ACL healing, restore the ligament, and keep surrounding muscles intact.

## Ommaya Reservoir

*Image credit: NIH*

In 1963, researchers at the NIH Clinical Center invented the Ommaya reservoir, a device placed under the scalp that provides direct access to cerebrospinal fluid (CSF). This device is used to this day in hospitals across the world to diagnose and treat a range of cancers and infections.

- Named for its inventor, the Ommaya reservoir comprises two parts: a reservoir to hold liquid that sits on top of the skull under the scalp, and a catheter that is connected to the reservoir and placed in an open space within the brain, called a ventricle.
- This device is used by doctors to get sterile access to CSF samples for diagnostic tests or to deliver medications to the CSF.
- It is used to diagnose and treat a range of conditions such as cancers and infections, including brain tumors, leukemia, lymphoma, and meningeal disease.

## Functional Brain Imaging

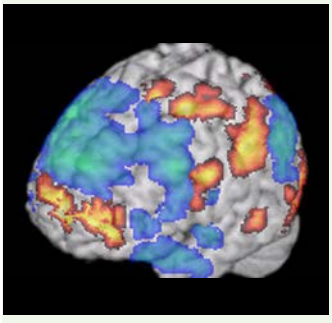

*Image credit: National Institute on Deafness and Other Communication Disorders, NIH*

NIH-funded researchers pioneered imaging techniques of the living human brain, including positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). These are widely used in healthcare settings today to detect and diagnose a range of brain disorders, from epilepsy to Alzheimer's disease and related dementias.

- Beginning with the work of NIH-funded researchers in the 1960s and 1970s, innovations in brain imaging enabled a paradigm shift in understanding brain disorders—such as addiction, epilepsy, and Alzheimer's disease—as treatable with medication.
- MRI and PET brain imaging is now essential in detecting and managing major disorders and diseases of the brain, including schizophrenia, epilepsy, drug addiction, and dementia.

## Global Health

*Image credit: NIH*

An NIH-funded cellphone application for clinicians caring for HIV patients in Uganda has been harnessed for different diseases and on multiple continents to improve public health. For example, in the U.S., the app has helped increase adherence to tuberculosis treatment from 50% to 90%, saving lives.

- Within six years of its development, the NIH-supported platform—called emocha, which stands for electronic mobile comprehensive health application—was deployed in 20 countries, including India, South Africa, Bolivia, and Australia, and expanded its portfolio of applications.
- The app allows health workers to use cellphones to control dengue; screen for HIV, cancer, or diabetes; track the insects that transmit Chagas disease; and more.
- In the U.S., this app has supported tackling the opioid epidemic and treating diseases such as tuberculosis.
- In 2022, emocha was rebranded as Scene.

## Osteoporosis

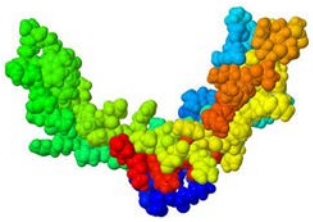

*Image credit: RCSB Protein Data Bank www.rcsb.org/3d-view/jsmol/2kd3, created by Alisa Machalek (NIAMS)*

The osteoporosis treatment romosozumab was developed thanks to foundational work supported by NIH to understand the mechanisms of bone formation. Approved by FDA in 2019, this medicine is prescribed to prevent bone fractures, which are common in people with osteoporosis.

- Osteoporosis is a bone disease that develops when bone mineral density and bone mass decreases, or when the quality or structure of bone changes. This can lead to a decrease in bone strength that can increase the risk of fractures.
- NIH-funded work helped to establish proteins as therapeutic targets for osteoporosis and other skeletal diseases.
- Romosozumab is an antibody treatment that increases bone formation through inhibiting sclerostin, a protein that regulates bone metabolism.

## At-Home Pregnancy Test

*Image credit: National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), CDC*

NIH researchers developed the first at-home pregnancy test, which is now the most used type of self-diagnostic test. These tests allow people to detect their pregnancies earlier, resulting in earlier prenatal care.

- In the 1960s, NIH researchers discovered that the hormone human chorionic gonadotropin (hCG) is produced shortly after a fertilized egg attaches to the lining of the uterus—making hCG the earliest marker of pregnancy.
- In 1977, FDA approved the first at-home pregnancy test, which tested for the presence of hCG, and was developed based on NIH research. The first test became available in 1978 and cost $10.
- Today, some at-home pregnancy tests allow individuals to detect a pregnancy six days before a missed menstrual period.

## Food Poisoning

*Image credit: National Institute of Allergy and Infectious Diseases, NIH*

Each year, 1 in 6 Americans get foodborne illnesses, or food poisoning, leading to approximately 128,000 hospitalizations and 3,000 deaths. NIH and FDA work together to track the germs causing these illnesses, resulting in more than $500 million in public health savings each year.

- The NIH Pathogen Detection Program enables public health researchers to use DNA to rapidly identify what bacteria is causing illness from foods and environmental sources in patients.
- As of 2024, the program provided data on more than 1.8 million isolated microbes.
- In 2021, public health officials used the program to rapidly identify a food product contaminated with Salmonella that was making individuals sick in multiple U.S. states within a month, preventing many additional illnesses.

## Acupuncture for Lower Back Pain

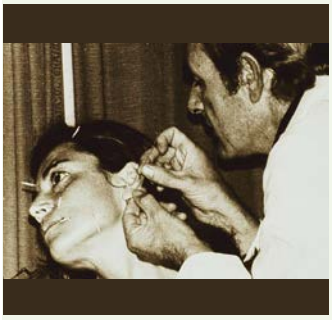

*Image credit: World Health Organization*

In 2020, CMS began covering acupuncture for the treatment of chronic low back pain in Medicare patients, based on NIH-supported research that acupuncture is an effective form of management for this type of pain in adults 65 years or older. Today, many private insurance plans also cover acupuncture for this condition.

- One-third of U.S. adults 65 years of age or older experience lower back pain, but many treatments suitable for young adults are inappropriate for older adults due to them having other existing conditions.
- Acupuncture is safe and effective for older adults with chronic lower back pain, with patients reporting pain-relieving results more effective than non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen.
- CMS made this coverage decision, in part due to research supported by the NIH Pragmatic Trials Collaboratory, which supports research to test how treatments work in real-world healthcare settings.

## SUPERCOMPUTING


1. Gilbert PB, et al. *Science.* 2022;375(6576):43–50. PMID: 34812653.
2. Gilbert PB, et al. *N Engl J Med.* 2022;387(24):2203–2206. PMID: 36507702.
3. Supercomputing Technologies Funded by ORIP Helped Spur Approval of COVID19 Vaccines and Save Lives: https://orip.nih.gov/about-orip/research-highlights/supercomputing-technologies-funded-orip-helped-spur-approval-covid-19.
4. Article: FDA Takes Additional Action in Fight Against Covid-19 By Issuing Emergency Authorization for Second Covid-19 Vaccine: https://www.fda.gov/news-events/press-announcements/fda-takes-additional-action-fight-against-covid-19-issuing-emergency-use-authorization-second-covid.
5. FDA Vaccines and Related Biological Products Advisory Committee Meeting Brief: https://www.fda.gov/media/152953/download.


## COLLABORATIVE CARE


1. Katon WJ, et al. *Gen Hosp Psychiatry*. 2006;28(3):185-8. PMID: 16675360.
2. Katon W, et al. *Gen Hosp Psychiatry*. 2010;32(5):456-64. PMID: 20851265.
3. Kroenke K, et al. *J Gen Intern Med*. 2017;32(4):404-410. PMID: 28243873.
4. Lee-Tauler SY, et al. *Psychiatr Serv*. 2018;69(6):628-647. PMID: 29716446.
5. Angstman KB, et al. *Med Care*. 2015;53(1):32-7. PMID: 25464162.
6. VA/DoD Clinical Practice Guidelines: Management of Major Depressive Disorder. 2022. https://www.healthquality.va.gov/guidelines/MH/mdd/.
7. VA/DoD Clinical Practice Guidelines: Management of Posttraumatic Stress Disorder and Acute Stress Reaction. 2017. https://www.healthquality.va.gov/guidelines/mh/ptsd/.
8. Article: Wider Implementation of Collaborative Care Is Inevitable: https://psychnews.psychiatryonline.org/doi/10.1176/appi.pn.2019.6b7.
9. California Healthcare Foundation. Cracking the Codes: State Medicaid Approaches to Reimbursing Psychiatric Collaborative Care. 2020. https://www.chcf.org/wp-content/uploads/2020/09/CrackingCodesMedicaidReimbursingPsychiatricCollaborativeCare.pdf.
10. Article: Reps. Lizzie Fletcher And Jaime Herrera Beutler Introduce Bipartisan Legislation To Invest In and Improve Mental Health Care: https://fletcher.house.gov/news/documentsingle.aspx?DocumentID=3444.
11. Druss BG, et al. *Med Care*. 2011;49(6):599-604. PMID: 21577183.
12. US Burden of Disease Collaborators, et al. *JAMA*. 2018;319(14):1444-1472. PMID: 29634829.
13. Greenberg PE, et al. *J Clin Psychiatry*. 2015;76(2):155-62. PMID: 25742202.
14. Belsher BE, et al. *Psychiatry*. 2018;81(4):349-360. PMID: 30332346.
15. Schoenbaum M, et al. *JAMA*. 2001;286(11):1325-30. PMID: 11560537.
16. Engel CC, et al. *JAMA Intern Med*. 2016;176(7):948-56. PMID: 27294447.


## MOBILE HEALTH


1. Calm.com: https://www.calm.com.
2. Monash University FODMAP Diet App: https://www.monashfodmap.com/ibs-central/i-have-ibs/get-the-app/.
3. Hansen WB, et al. *JMIR Mhealth Uhealth*. 2019;7(7):e14655. PMID: 31359866.

4. Article: Discover the top 5 mHealth apps landing NIH research grants: https://www.ama-assn.org/practice-management/digital/discover-top-5-mhealth-apps-landing-nih-research-grants.
5. Han M, et al. *Healthc Inform Res*. 2018;24(3):207-226. PMID: 30109154.
6. Kernebeck S, et al. *World J Gastroenterol*. 2020;26(29):4182-4197. PMID: 32848328.

## AUTOMATIC BLOOD COUNTER

1. Brecher G, et al. *American J Clin Path*. 1956;26: 1439-49. PMID: 13394550.

## LIVER TRANSPLANTS

1. Starzl TE, et al. *Ann Surg*. 1968;168(3):392-415. PMID: 4877589.
2. Definition & Facts of Liver Transplant: https://www.niddk.nih.gov/health-information/liver-disease/liver-transplant/definition-facts.

## KNEE SURGERY

1. Lynch TS, et al. *J Am Acad Orthop Surg*. 2015;23(3):154-63. PMID: 25667401.
2. MOON Knee Group: https://acltear.info/.
3. MARS Group. *Am J Sports Med*. 2014;42(10):2301-10. PMID: 25274353.
4. MARS Group. *J Orthop Res*. 2020;38(6):1191-1203. PMID: 31840832.
5. Article: FDA Authorizes Marketing of New Implant to Repair a Torn ACL: https://www.fda.gov/news-events/press-announcements/fda-authorizes-marketing-new-implant-repair-torn-acl.

## OMMAYA RESERVOIR

1. Ommaya AK. *Lancet*. 1963;282: 983-84. PMID: 14059058.

## FUNCTIONAL BRAIN IMAGING

1. Farreras, IG, et al. (eds). *Mind, brain, body, and behavior: foundations of neuroscience and behavioral research at the National Institutes of Health* (Vol 62).IOS Press. 2004.
2. Profiles in Science: Louis Sokoloff: https://profiles.nlm.nih.gov/spotlight/nl.
3. Dr. Louis Sokoloff Oral History 2005: https://history.nih.gov/display/history/Sokoloff%2C+Louis+2005.

## GLOBAL HEALTH

1. Article: Tech designed for Africa helps US fight disease, save money. https://www.fic.nih.gov/News/GlobalHealthMatters/september-october-2017/Pages/emocha-mobile-app.aspx.
2. Scene Health: https://www.scene.health/.

## OSTEOPOROSIS

1. Osteoporosis: https://www.niams.nih.gov/health-topics/osteoporosis.
2. Article: FDA approves new treatment for osteoporosis in postmenopausal women at high risk of fracture: https://www.fda.gov/news-events/press-announcements/fda-approves-new-treatment-osteoporosis-postmenopausal-women-high-risk-fracture.

## AT-HOME PREGNANCY TEST

1. Ralph LJ, et al. *Contraception*. 2022; 107:10-16. PMID: 34748750.
2. Lis K. *Antibodies*. 2023;12(3):56. PMID: 37753970.

3. The Thin Blue Line: The History of the Pregnancy Test: https://history.nih.gov/display/history/Pregnancy+Test+-+A+Thin+Blue+Line+The+History+of+the+Pregnancy+Test.

## FOOD POISONING

1. Pathogen Detection Success Stories: https://www.ncbi.nlm.nih.gov/pathogens/success_stories/.
2. GenomeTrakr Network: https://www.fda.gov/food/whole-genome-sequencing-wgs-program/genometrakr-network.
3. Lewis K, et al. *Morbidity and Mortality Weekly Report.* 2023; 72(21): 589–590. PMC10231938.
4. Brown B, et al. *PLoS One*. 2021; 16(10):e0258262. PMID: 34614029.

## ACUPUNCTURE FOR LOWER BACK PAIN

1. Decision Memo: Acupuncture for Chronic Lower Back Pain: https://www.cms.gov/medicare-coverage-database/view/ncacal-decision-memo.aspx?proposed=N&NCAId=295.
2. Article: Pragmatic Trails Deepen Real-World Understanding of Health Interventions: https://www.nccih.nih.gov/about/offices/od/director/past-messages/pragmatic-trials-deepen-real-world-understanding-of-health-interventions.
3. DeBar LL, et al. *Contemporary Clinical Trials*. 2023; 128:107166. PMID: 36990274.
4. Nielsen A, et al. *Global Adv in Health and Med.* 2021; 10:21649561211007091 PMID: 34104574.
5. Candon M, et al. *JAMA Netw Open*. 2022; 5(1):e2142509. PMID: 35019986.
6. Lee JH, et al. *Clin J Pain*. 2013; 29(2):172-85. PMID: 23269281.

# Heart, Lung, and Kidney Health

## Artificial Heart Valves

*Image credit: NIH*

NIH supported the development of the first artificial heart valves, leading to the first successful artificial replacement of the mitral valve—the valve that connects the left chambers of the heart—at the NIH Clinical Center in 1960. Today, over 182,000 heart valve replacements are performed each year in the U.S. to treat irreparable heart valve disease.

- In 1960, the first successful artificial replacements of two of the four types of heart valves—aortic and mitral—were conducted.
- The first successful artificial mitral valve replacement was carried out by NIH researcher, Dr. Nina Braunwald—the first female cardiac surgeon and the first woman to perform open-heart surgery.
- About 2.5% of the U.S. population has heart valve disease, which occurs when one of the four heart valves is damaged—becoming stiff, narrow, or leaky—disrupting proper blood flow.

## Aspirin Guidance

*Image credit: FlairImages/iStock/Thinkstock*

NIH-funded research on aspirin's risks and potential benefits for preventing heart disease challenged previously held assumptions on its benefits and led to revised usage guidelines. By following the guidelines, physicians are now less likely to prescribe unnecessary daily aspirin to older adults to prevent heart disease.

- In the past, doctors had encouraged adults without existing heart disease to consider taking low-dose aspirin daily to help prevent the first occurrence of a heart attack or stroke.
- NIH-funded research found that in healthy older adults, aspirin did not reduce the risk of heart attack or stroke. Those taking aspirin had an increased risk of bleeding, especially following head trauma, which was already a known risk of regular aspirin use.
- In 2021, based on this research on aspirin, the U.S. Preventive Services Task Force proposed changes in recommendations for aspirin use to prevent heart disease.

## Heart Disease

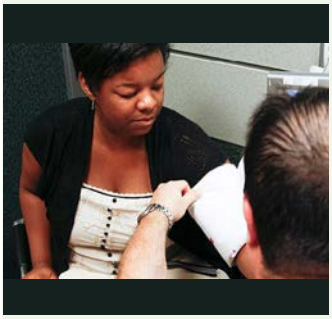

*Image credit: Daniel Soñé/NCI*

Deaths from heart disease fell 67.6% from 1969 to 2015, driven by research advances such as the NIH funded Framingham Heart Study, which identified risk factors for heart disease and led to new prevention strategies.

- The Framingham Heart Study and other NIH-supported research identified risk factors for heart disease, such as cholesterol, smoking, and high blood pressure.
- Approximately half the decline in heart disease deaths since the 1960s are due to changes in lifestyle and from medications developed to reduce these risk factors.
- Despite this decline, heart disease is still the leading cause of death in the U.S.

## Type 1 Diabetes


*Image credit: Tandem Diabetes Care*

NIH-supported research has contributed to technologies that are giving the more than 1.8 million people in the U.S. with type 1 diabetes new options for more easily managing their disease, resulting in improved health and quality of life.

- In the 1990s, NIH-supported research showed that intensive management of blood glucose levels reduced the risk of long-term complications from diabetes.
- Type 1 diabetes affects approximately 5% of the diagnosed diabetes cases in adults and the majority of diagnosed cases in children in the U.S.
- Two FDA-approved technologies to manage type 1 diabetes include continuous glucose monitors (CGMs), which provide real-time data on blood glucose levels without the need for finger sticks, and artificial pancreas systems, which pair a CGM with an insulin pump to adjust insulin dosage automatically.

## Type 2 Diabetes and Obesity

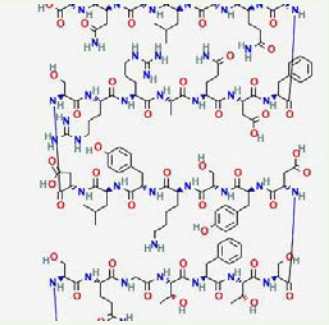

*Image credit: National Center for Biotechnology Information (https://pubchem.ncbi.nlm.nih.gov/compound/Glucagon)*

NIH research led to the development of medications to treat type 2 diabetes—which affects more than 35 million people in the U.S.—by helping to lower blood glucose and reduce the risk of cardiovascular disease. The research also formed the basis of widely used treatments for obesity, which affects nearly 42% of U.S. adults.

- Risk of early death for adults with diabetes is 60% higher than for adults without diabetes, with cardiovascular disease being the number one cause of death in people with diabetes.
- Decades of basic research supported by NIH—including research on hormonal control of blood glucose—laid the foundation for the development of two classes of diabetes drugs, GLP-1 receptor agonists and SGLT2 inhibitors.
- Some drugs such as GLP-1 receptor agonists are also approved to treat obesity, a strong risk factor for type 2 diabetes.
- SGLT2 inhibitors improve blood glucose control and can also reduce kidney and heart complications, two major causes of death in people with diabetes.

## Congenital Heart Disease

*Image credit: Shutterstock*

Decades of NIH-supported research led to advances in diagnosis, treatment, and newborn screening mandates for congenital heart disease (CHD). As a result, over 85% of children born with CHD now survive well into adulthood.

- CHD is the most common type of birth defect, affecting about 8 per 1000 live births in the U.S., and is the leading cause of infant death in the U.S.
- NIH-supported research helped inform the HHS Secretary's decision in 2011 to add CHD to the recommended uniform infant screening panel. Screening is now mandated in D.C. and all states but California, which does require that the screening be offered.

## Diabetes Prevention

*Image credit: Darryl Leja, National Human Genome Research Institute, NIH*

NIH research showed that improvements in diet and physical activity can lower the risk of developing type 2 diabetes by 58% in adults at high risk. NIH support has helped to adapt the Diabetes Prevention Program's (DPP) lifestyle-focused intervention, and it is now available in communities across the U.S. and is covered by Medicare and Medicaid.

- DPP showed that behavioral interventions, such as increased physical activity and healthier eating, could delay type 2 diabetes onset by 15 years.
- NIH-supported research has made it possible to deliver adaptations of the DPP lifestyle intervention to millions of people at risk for diabetes in the U.S.
- DPP contributed to the U.S. Preventive Services Task Force's decision to recommend routine screening for type 2 diabetes in middle-aged and older U.S. adults with overweight or obesity.

## ARTIFICIAL HEART VALVES


1. Collins JJ. *N Engl J Med*. 1991; 324(9)624-6. PMID: 1992323.
2. Harken DE, et al. *J of Thor and Cardio Surg*. 1960; 40:744-62. PMID: 13711583.
3. Braunwald NS, et al. *J of Thor and Cardio Surg.* 1960; 40:1-11. PMID: 13804040.
4. Report: Cardiac Surgery Market Size, Share, and Trend Analysis: https://idataresearch.com/product/cardiac-surgery-market-united-states/.
5. Sabharwal N, et al. *Tex Heart Inst J*. 2017; 44(2)96-100. PMID: 28461793.
6. About Heart Valve Disease: https://www.cdc.gov/heart-disease/about/heart-valve-disease.html.
7. Frankel WC, et al. *JAMA*. 2021; 325(24)2512. PMID: 34156406.
8. Heart Valve Replacement: https://my.clevelandclinic.org/health/treatments/23966-heart-valve-replacement.


## ASPIRIN GUIDANCE


1. Arnett DK, et al. *Circulation*. 2019;140(11):e596-e646. PMID: 30879355.
2. Article: Daily low-dose aspirin found to have no effect on healthy lifespan in older people: https://www.nia.nih.gov/news/daily-low-dose-aspirin-found-have-no-effect-healthy-lifespan-older-people.
3. Article: Daily Aspirin May Not Benefit Healthy Older Adults: https://newsinhealth.nih.gov/2018/11/daily-aspirin-may-not-benefit-healthy-older-adults.
4. U.S. Preventive Services Task Force: Task Force Issues Draft Recommendation Statement on Aspirin Use to Prevent Cardiovascular Disease: https://www.uspreventiveservicestaskforce.org/uspstf/sites/default/files/file/supporting_documents/aspirin-cvd-prevention-final-rec-bulletin.pdf.
5. Final Recommendation Statement: Aspirin Use to Prevent Cardiovascular Disease: Preventive Medication: https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/aspirin-to-prevent-cardiovascular-disease-preventive-medication.
6. Article: Daily low-dose aspirin has little impact on stroke risk and spikes risk of brain bleeding from falls: https://www.nia.nih.gov/news/daily-low-dose-aspirin-has-little-impact-stroke-risk-and-spikes-risk-brain-bleeding-falls.


## HEART DISEASE


1. Weir HK, et al. *Prev Chronic Dis*. 2016;13:E157. PMID: 27854420.
2. Levy D. *Nat Rev Drug Discov*. 2008;7(9):715-715. PMID: 19172683.
3. The Framingham Heart Study: Laying the Foundation for Preventive Health Care: https://www.nih.gov/sites/default/files/about-nih/impact/framingham-heart-study.pdf.
4. Heart Disease Facts: https://www.cdc.gov/heart-disease/data-research/facts-stats/.


## TYPE 1 DIABETES


5. National Diabetes Statistics Report: https://www.cdc.gov/diabetes/php/data-research/index.html.
6. Brown SA, et al. *N Engl J Med*. 2019;381(18):1707-1717. PMID: 31618560.
7. Breton MD, et al. *N Engl J Med*. 2020;383(9):836-845. PMID: 32846062.
8. Article: FDA Approves UVA-Developed Artificial Pancreas: https://newsroom.uvahealth.com/2020/01/02/fda-approves-uva-developed-artificial-pancreas/.

9. Article: Artificial pancreas system better controls blood glucose levels than current technology: https://www.nih.gov/news-events/news-releases/artificial-pancreas-system-better-controls-blood-glucose-levels-current-technology.
10. Article: Artificial pancreas effectively controls type 1 diabetes in children age 6 and up: https://www.nih.gov/news-events/news-releases/artificial-pancreas-effectively-controls-type-1-diabetes-children-age-6.
11. Article: Bionic pancreas improves type 1 diabetes management compared to standard insulin delivery methods: https://www.nih.gov/news-events/news-releases/bionic-pancreas-improves-type-1-diabetes-management-compared-standard-insulin-delivery-methods.
12. Article: Four pivotal NIH-funded artificial pancreas research efforts begin: https://www.nih.gov/news-events/news-releases/four-pivotal-nih-funded-artificial-pancreas-research-efforts-begin.

## TYPE 2 DIABETES AND OBESITY

1. National Diabetes Statistics Report: https://www.cdc.gov/diabetes/php/data-research/index.html.
2. Diabetes Basics: https://www.cdc.gov/diabetes/about/.
3. Prevalence of Obesity and Severe Obesity Among Adults: United States, 2017–2018: https://www.cdc.gov/nchs/products/databriefs/db360.htm.
4. Wadden TA, et al. *JAMA*. 2021;325(14):1403-1413. PMID: 33625476.
5. Article: FDA OKs Injectable Semaglutide for Chronic Weight Management: https://www.medpagetoday.com/endocrinology/obesity/92936?xid=NL_breakingnewsalert_2021-06-04&eun=g950414d0r.
6. Abbasi J. *JAMA*. 2021;326(2):121-123. PMID: 34160581.
7. Article: FDA Approves New Drug Treatment for Chronic Weight Management, First Since 2014: https://www.fda.gov/news-events/press-announcements/fda-approves-new-drug-treatment-chronic-weight-management-first-2014?utm_medium=email&utm_source=govdelivery.
8. Yanovski SZ, et al. *JAMA*. 2021;326(2):129-130. PMID: 34160571.
9. Sanyal AJ, et al. *N Engl J Med*. 2021;385(17):1559-1569. PMID: 34670043.
10. Article: Story of Discovery: SGLT2 inhibitors: harnessing the kidneys to help treat diabetes: https://www.niddk.nih.gov/news/archive/2016/story-discovery-sglt2-inhibitors-harnessing-kidneys-help-treat-diabetes.
11. Overweight & Obesity Statistics: https://www.niddk.nih.gov/health-information/health-statistics/overweight-obesity.

## CONGENITAL HEART DISEASE

1. Gurvitz M, et al. *J Am Coll Cardiol*. 2016;67(16):1956-64. PMID: 27102511.
2. American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. 2018 AHA/ACC Guideline for the Management of Adults With Congenital Heart Disease: Executive Summary. 2018. https://www.ahajournals.org/doi/pdf/10.1161/CIR.0000000000000602.
3. Interagency Coordinating Committee on Newborn and Child Screening (ICC): Screening for Critical Congenital Heart Disease: https://www.hrsa.gov/sites/default/files/hrsa/advisory-committees/heritable-disorders/reports-recommendations/response-congenital-cyanotic.pdf.
4. Actions in Support of Newborn Screening for Critical Congenital Heart Disease — United States, 2011–2018: https://www.cdc.gov/mmwr/volumes/68/wr/mm6805a3.htm?s_cid=6805a3_e.
5. Burns KM, et al. *Pediatr Cardiol*. 2017;38(5):974-980. PMID: 28349207.

6. What are Congenital Heart Defects?: https://www.nhlbi.nih.gov/health-topics/congenital-heart-defects.

## DIABETES PREVENTION

1. National Diabetes Statistics Report: https://www.cdc.gov/diabetes/php/data-research/index.html.
2. Diabetes Prevention Program: https://www.niddk.nih.gov/about-niddk/research-areas/diabetes/diabetes-prevention-program-dpp/Pages/default.aspx.
3. Diabetes Prevention Program Outcomes Study: https://dppos.bsc.gwu.edu/.
4. ClinicalTrials.gov Diabetes Prevention Program page: https://clinicaltrials.gov/ct2/show/NCT00004992.
5. ClinicalTrials.gov Diabetes Prevention Program Outcomes Study page https://clinicaltrials.gov/ct2/show/record/NCT00038727?term=diabetes+prevention+program.
6. NIDDK Central Repository: Diabetes Prevention Program: https://repository.niddk.nih.gov/studies/dpp/.
7. NIDDK Central Repository: Diabetes Prevention Program Outcomes Study: https://repository.niddk.nih.gov/studies/dppos/.
8. dkNET Search for "DPP study": https://dknet.org/Any/search?q=DPP%20study&l=DPP%20study&restarted.
9. dkNET Search Results for "DPPOS study" https://dknet.org/Any/search?q=DPPOS%20study&l=DPPOS%20study.
10. Type 2 Diabetes Knowledge Portal: https://t2d.hugeamp.org/.
11. Article: NIH study finds interventions to prevent type 2 diabetes give good return on investment: https://www.nih.gov/news-events/news-releases/nih-study-finds-interventions-prevent-type-2-diabetes-give-good-return-investment.
12. Siu AL. *Ann Intern Med*. 2015;163(11):861-8. PMID: 26501513.
13. Klabunde CN, et al. *Am J Prev Med*. 2022;62(2):e77-e86. PMID: 34657771.
14. What Are Overweight and Obesity?: https://www.nhlbi.nih.gov/health/overweight-and-obesity.

# Genetic Diseases

## Sickle Cell Disease

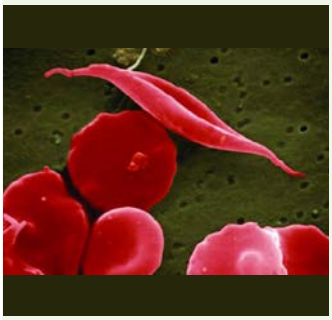

*Image credit: National Center for Advancing Translational Sciences, NIH*

In the early 1970s, most Americans with sickle cell disease (SCD) died in childhood. Today, thanks in part to NIH-supported research to understand the basis of SCD and develop effective interventions, the more than 100,000 individuals in the U.S. with SCD are living into their forties or fifties, and beyond.

- SCD is characterized by the buildup of an abnormal protein in red blood cells causing pain, fatigue, and damage throughout the body.
- NIH-funded research in the late 1940s helped discover how SCD is inherited and led to universal newborn screening for SCD.
- In 1998, hydroxyurea became the first drug approved for treating adults with SCD; in 2017, it was approved for pediatric patients.
- Blood and bone marrow transplants are the only cure for SCD, with a 90% cure rate in patients with a healthy immune-matched donor.

## Neurofibromatosis Type 1

*Image credit: Daniel Soñé/NCI*

More than 30 years of NIH supported research led to the 2020 FDA approval of selumetinib, the first effective treatment for children with neurofibromatosis type 1 (NF1) and associated tumors. In clinical trials, this treatment caused tumors to shrink in 70% of trial participants.

- NF1 is a genetic disorder that affects approximately 1 in 3,000 people. The disease can lead to the development of disfiguring, disabling, and painful benign and malignant tumors, called plexiform neurofibromas (PNs).
- Selumetinib is now the first effective treatment for children with PNs that can't be removed by surgery. Prior to the approval of selumetinib, there were no effective treatment options for inoperable tumors.

## Cystic Fibrosis

*Image credit: Megan Murray, Hazel's Roots Photography*

In the 1980s, most people with cystic fibrosis (CF) died as teenagers. Thanks to NIH-funded research—including identification of the gene responsible for the disorder and subsequent development of therapies—people with CF are living into middle age and beyond, with hope for a cure on the horizon.

- CF is an inherited disorder that causes problems with breathing and digestion, and it affects about 35,000 people in the U.S.
- CF results from mutations in the CFTR gene. These gene mutations were identified in 1989 through a collaborative effort co-led by former NIH Director, Francis Collins.
- In 2019, FDA approved a combination therapy of three drugs that restores the function of the CFTR protein in people with the most common CFTR mutation, which is about 90% of people with CF.

## SICKLE CELL DISEASE


1. What Is Sickle Cell Disease?: https://www.nhlbi.nih.gov/health-topics/sickle-cell-disease.
2. Building on Our Legacy of Excellence in Sickle Cell Disease Research: https://www.nhlbi.nih.gov/health-topics/education-and-awareness/sickle-cell/building-our-legacy-excellence-sickle-cell-disease-research.
3. Hydroxyurea use in sickle cell disease: www.uptodate.com/contents/hydroxyurea-use-in-sickle-cell-disease#H2549716608.
4. ClinicalTrials.gov: Hydroxyurea for the Treatment of Patients With Sickle Cell Anemia: https://clinicaltrials.gov/ct2/show/NCT00001197.
5. Article: FDA approves hydroxyurea for treatment of pediatric patients with sickle cell anemia: www.fda.gov/drugs/resources-information-approved-drugs/fda-approves-hydroxyurea-treatment-pediatric-patients-sickle-cell-anemia.


## NEUROFIBROMATOSIS TYPE 1


1. Article: Selumetinib: The First Effective Treatment for Plexiform Neurofibromas: https://www.cancer.gov/research/progress/discovery/selumetinib-plexiform-neurofibromas.


## CYSTIC FIBROSIS


1. Article: Dare to Dream: The Long Road to Targeted Therapies for Cystic Fibrosis: https://directorsblog.nih.gov/2019/10/31/dare-to-dream-the-long-road-to-targeted-therapies-for-cystic-fibrosis/.
2. Collins FS. *N Engl J Med*. 2019;381(19):1863-1865. PMID: 31670919.
3. About Cystic Fibrosis: https://www.cdc.gov/cystic-fibrosis/about/.

# Immune System

## RSV Vaccine

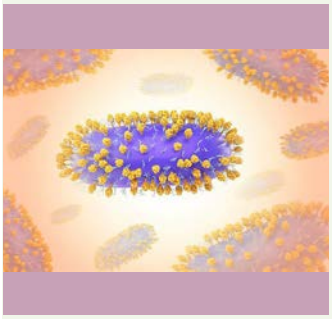

*Image credit: National Institute of Allergy and Infectious Diseases, NIH*

In 2023, due in part to over 60 years of NIH-supported research, FDA approved a safe and effective vaccine for respiratory syncytial virus (RSV), which reduces the risk of severe disease by 94.1% in people over 60. RSV causes up to 160,000 adults over the age of 65 to be hospitalized per year in the U.S.

- RSV usually causes mild symptoms similar to a common cold. However, up to 10,000 adults over 65 die as a result of the virus each year in the U.S.
- In 1957, NIH researchers identified RSV as a virus associated with respiratory illness in children, and through subsequent decades of research, NIH scientists discovered how to help the body elicit a stronger protective immune response against the virus.
- This vaccine is approved for adults over 60 years of age and pregnant people. Vaccines are in development for children and younger adults.

## Vaccines

*Image credit: National Institute of Allergy and Infectious Diseases, National Institutes of Health*

NIH has led the world in the identification of viral pathogens and subsequent development and testing of vaccines. NIH researchers have played an integral role in the development of roughly half of all FDA-approved vaccines currently in use, collectively saving millions of lives each year.

- Vaccines stimulate the immune system to produce immune responses that protect against infection.
- Vaccines provide a safe, cost-effective, and efficient means of preventing illness, disability, and death from infectious diseases.
- NIH has supported vaccine development to address numerous diseases including, most recently COVID-19, and also historically, diphtheria, smallpox, Rocky Mountain spotted fever, rubella, hepatitis A, whooping cough, Type B Haemophilus (Hib), human papillomavirus (HPV), and many more.

## COVID-19 Vaccine

*Image credit: NIH*

NIH-supported research led to the development of mRNA COVID-19 vaccines in record time. As a result, by March 2022, over 577 million vaccine doses had been administered in the U.S., saving an estimated 2.4 million lives and preventing 17 million hospitalizations.

- Decades of NIH-supported research provided the platform to jumpstart development of mRNA vaccines targeting SARS-CoV-2, the virus that causes COVID-19, ensuring a rapid response to the pandemic.
- Community engagement approaches and infrastructure developed for HIV vaccine clinical trials ensured that COVID-19 vaccine trials included people who represent the diversity of the U.S.
- As of July 2022, two vaccines had been approved by FDA, and two had been authorized for emergency use.
- Research shows that COVID-19 vaccines are effective in preventing fully vaccinated people from developing serious disease.

## HPV Vaccine

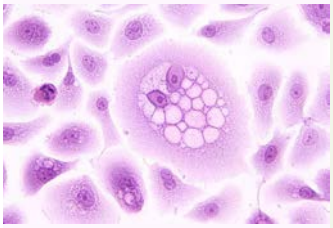

*Image credit: Ewa Krawczyk/ National Cancer Institute/ Georgetown Lombardi Comprehensive Cancer Center*

Decades of NIH research showed how to prevent Human Papillomavirus (HPV) infection through the development of vaccines that are 100% effective against two forms of HPV that cause cervical cancer. Governments across the globe now recommend routine HPV vaccination for all children 11 or 12 years old.

- The first commercially available vaccines that protect against HPV—including the two forms that cause cervical cancer and most HPV-associated cancers—became available in 2006.
- HPV is associated with almost all cases of cervical cancer and some types of other cancers including head and neck, anal, penile, vulvar, and vaginal.
- Most treatments in the field of cancer aim to cure the disease, but this advance is designed to prevent it.

## COVID-19 Diagnostics


*Image credit: Quidel*

NIH played a large role in responding to the COVID-19 pandemic by supporting the rapid development of accurate and reliable testing on an enormous scale, leading to the production of more than 1 billion COVID-19 tests and test products in under 1.5 years.

- NIH launched the Rapid Acceleration of Diagnostics (RADx®) initiative to speed the manufacture of COVID-19 diagnostic technologies in response to the pandemic, increasing testing capacity by 100s of millions in the U.S. in less than 1.5 years.
- Support from RADx has led to more than 45 emergency use authorizations (EUAs) from FDA, including the first EUA for over-the-counter COVID-19 testing.
- Several COVID-19 testing technologies supported by RADx are available to the American public and can be purchased at pharmacies or online for at-home use.

## HIV Prevention

*Image credit: NIH*

An NIH-supported clinical trial was the first to establish the efficacy of preexposure prophylaxis (PrEP) to prevent infection by HIV, the virus that causes AIDS. PrEP reduces the risk of getting HIV from sex by 99% and reduces the risk of getting HIV from injection drug use by at least 74%.

- Since the first AIDS cases were reported in 1981, HIV/AIDS has been one of humanity's deadliest and most persistent epidemics.
- In 2015, WHO recommended oral PrEP for people at substantial risk of HIV infection, paving the way for widespread adoption of PrEP.
- PrEP is currently available in oral pill form that must be taken daily and in a long-acting injectable form.
- HIV prevention efforts have contributed to averting more than 350,000 HIV infections in the U.S.

## COVID-19 Treatments

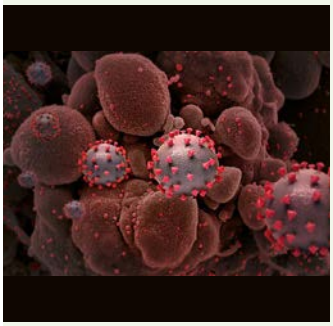

*Image credit: National Institute of Allergy and Infectious Diseases, NIH*

NIH-supported research has enabled the rapid development of treatments for COVID-19, including the antiviral Paxlovid. Paxlovid, which has been authorized by FDA for those with mild-to-moderate symptoms, can be taken at home and has been shown to reduce the risk of hospitalization and death by 89%.

- Paxlovid is an antiviral combination therapy of nirmatrelvir and ritonavir, and it targets specific parts of the virus to stop it from multiplying in the body.
- NIH has developed treatment guidelines for healthcare providers to help them work with their patients and determine the best treatment options for them. Several options, including Paxlovid, are now available for treating COVID-19 at home or in an outpatient setting.
- As of August 2022, FDA had issued Emergency Use Authorization for three COVID-19 treatments: monoclonal antibodies, Paxlovid, and molnupiravir.

## Hepatitis C

*Image credit: CDC*

NIH research played a major role in the discovery of the hepatitis C virus, resulting in the development of drugs that can cure almost all infected individuals and blood donor screening programs that have decreased the incidence of transfusion-transmitted hepatitis to near zero.

- Hepatitis C affects millions of people in the U.S. and around the world.
- It is a viral infection that spreads through contact with an infected person's blood and causes liver inflammation and damage. It is one of the most common causes of liver cancer.
- In 2020, an NIH researcher received a Nobel Prize for his contribution to the discovery of the virus.
- This work was instrumental in leading to the development of new diagnostic and therapeutic agents for hepatitis C and for providing the scientific basis for instituting blood donor screening programs.

## Hepatitis A Vaccine

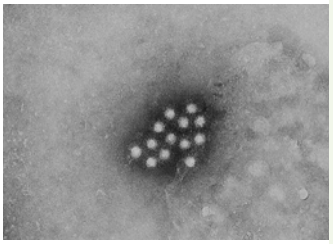

*Image credit: CDC/ Betty Partin*

NIH researchers played a crucial role in developing the first licensed hepatitis A vaccine in 1995, contributing to a 92% decline in hepatitis A rates since then.

- The hepatitis A virus causes acute inflammation of the liver.
- Prior to the discovery of a vaccine, an estimated 100 people died from hepatitis A every year in the U.S.
- NIH intramural researchers played a crucial role in developing the first licensed hepatitis A vaccine, from initial identification and characterization of the virus to the clinical trials that demonstrated the effectiveness of the vaccine.

## HIV Treatment

*Image credit: Office of AIDS Research, NIH*

NIH research led to the development of medications such as antiretroviral therapy (ART) to prevent people with HIV from developing AIDS, resulting in nearly normal life expectancy.

- Over 40 million people with HIV have died worldwide since 1981.
- NIH research led to the development of ART. By taking ART as prescribed, most people with HIV will not develop AIDS and will have improved life expectancy.
- NIH research demonstrated that people living with HIV who achieve and maintain undetectable levels of virus in their blood—by taking and adhering to ART as prescribed—cannot sexually transmit the virus to others, known as U=U (Undetectable = Untransmittable).

## Rotavirus Vaccine

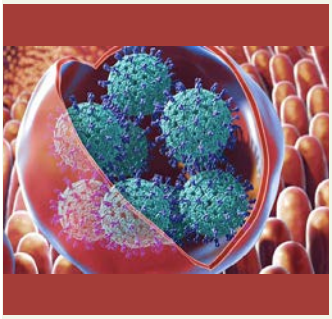

*Image credit: Ethan Tyler and Nihal Altan-Bonnet*

Because of NIH research, the introduction of a vaccine for rotavirus—the most common cause of childhood diarrhea worldwide—has resulted in the prevention of up to 50,000 child hospitalizations each year.

- NIH intramural scientists were the first to identify rotavirus in 1974, and they partnered with the pharmaceutical industry to create the first rotavirus vaccine in 1998. This paved the way for the creation of second-generation rotavirus vaccines in 2006 and 2008.
- Prior to vaccine introduction in the U.S., rotavirus caused up to 70,000 children to be hospitalized and 60 deaths annually.
- After the introduction of rotavirus vaccine in 2006, rotavirus activity in the U.S. decreased up to 90%, with up to 50,000 child hospitalizations prevented annually.

## Hepatitis B Vaccine

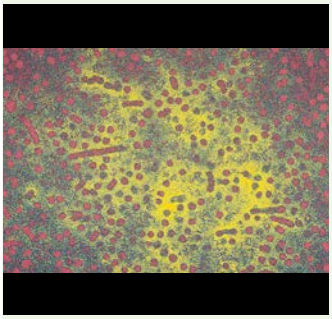

*Image credit: Photographer: Alain Grillet Copyright Sanofi Pasteur*

Hepatitis B infection causes inflammation of the liver that can lead to life-threatening health issues. Due to intensive vaccination programs based on NIH research, the rate of acute hepatitis B has fallen by more than 80% since the late 1980s.

- Hepatitis B infection causes inflammation of the liver.
- It occurs through contact with infected blood, semen, or other bodily fluid through sex, sharing needles or other drug-injection equipment, or from mother to baby at birth.
- For many people, hepatitis B is a short-term illness. For others, it can become a long-term, chronic infection that can lead to serious, even life-threatening health issues like cirrhosis or liver cancer.
- The best way to prevent hepatitis B is to get vaccinated.

## Autoimmune Disorders

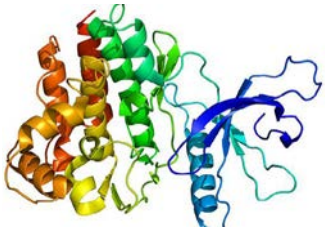

*Image credit: Illustration by Emw - Own work, based on PyMOL rendering of PDB 1yvj. CC BY-SA 3.0, sh.wikipedia.org/wiki/Janus_kinaza_3#/media/Datoteka:Protein_JAK3_PDB_1yvj.png*

NIH-supported basic research on the immune system in the 1990s led to the development of Janus kinase (JAK) inhibitors—a class of drugs routinely used to treat a wide range of autoimmune disorders. To date, eight JAK inhibitors have been FDA-approved for treatment of a range of disorders.

- NIH researchers discovered the importance of the JAK family of proteins as regulators of the human immune system, leading to the development of a class of drugs that block JAK activity to suppress the immune system and protect against damaging inflammation.
- To date, JAK inhibitors have been FDA-approved for treatment of rheumatoid arthritis, psoriatic arthritis, polyarticular juvenile arthritis, ulcerative colitis, atopic dermatitis, graft-versus-host disease, myeloproliferative neoplasms, alopecia areata, vitiligo, COVID-19 pneumonia, and counting.

## Rubella Vaccine

*Image credit: National Library of Medicine, NIH*

Thanks to NIH-supported research that led to a vaccine in 1969, rubella—a virus that causes birth defects—was eliminated in the U.S. by 2004. Prior to the vaccine, rubella caused an epidemic that struck every six to nine years, causing many miscarriages and stillbirths.

- Rubella virus is a leading cause of vaccine-preventable birth defects. In 1964 and 1965 in the U.S., rubella caused about 11,000 miscarriages, 2,100 newborns to die, and 20,000 infants to be born with birth defects.
- In 1971, the combined measles, mumps, and rubella (MMR) vaccination program began in the U.S. to prevent these three common deadly infections.
- In 2021, the CDC reported that 90.8% of children in the U.S. received at least one MMR vaccine dose by 24 months of age.

## RSV VACCINE

1. RSV in Older Adults: https://www.cdc.gov/rsv/older-adults/.
2. NIAID Research Journeys: Safe and Effective RSV Protein Vaccines: https://www.niaid.nih.gov/sites/default/files/safe-effective-rsv-protein-vaccines.pdf.
3. Article: FDA Approves First Respiratory Syncytial (RSV) Vaccine: https://www.fda.gov/news-events/press-announcements/fda-approves-first-respiratory-syncytial-virus-rsv-vaccine.
4. Article: FDA Approves First Vaccine for Pregnant Individuals to Prevent RSV in Infants: https://www.fda.gov/news-events/press-announcements/fda-approves-first-vaccine-pregnant-individuals-prevent-rsv-infants.

## VACCINES

1. Article: A Long Tradition of Vaccine Breakthroughs: IRP Vaccine Research Stretches Back to the NIH's Birth: https://irp.nih.gov/blog/post/2020/05/a-long-tradition-of-vaccine-breakthroughs.
2. Producing Novel Vaccines: https://irp.nih.gov/our-research/accelerating-science/producing-novel-vaccines.

## COVID-19 VACCINE

1. COVID-19 Vaccines: https://covid19.nih.gov/covid-19-topics/covid-19-vaccines.
2. COVID-19 mRNA Vaccine Development: https://www.niaid.nih.gov/sites/default/files/mRNA%20Vaccine%20Development.pdf.
3. CDC COVID Data Tracker: https://covid.cdc.gov/covid-data-tracker/#datatracker-home.
4. Article: Impact of U.S. COVID-19 Vaccination Efforts: An Update on Averted Deaths, Hospitalizations, and Health Care Costs Through March 2022: https://www.commonwealthfund.org/blog/2022/impact-us-covid-19-vaccination-efforts-march-update.
5. Benefits of Getting Vaccinated: https://www.cdc.gov/covid/vaccines/benefits.html.
6. COVID-19 after Vaccination: Possible Breakthrough Infection: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/effectiveness/why-measure-effectiveness/breakthrough-cases.html.

## HPV VACCINE

1. Article: NIH Technology Licensed to Merck for HPV Vaccine: https://www.techtransfer.nih.gov/news/nih-technology-licensed-to-merck-for-hpv-vaccine.
2. Human Papillomavirus (HPV) Vaccines: https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-vaccine-fact-sheet.
3. Article: The HPV vaccine: Two decades of research pays off: https://irp.nih.gov/accomplishments/the-hpv-vaccine-two-decades-of-research-pays-off.
4. Article: Protecting Against HPV: Common Viruses Can Lead to Cancer: https://newsinhealth.nih.gov/2020/04/protecting-against-hpv.

## COVID-19 DIAGNOSTICS

1. Rapid Acceleration of Diagnostics (RADx®): https://www.nih.gov/research-training/medical-research-initiatives/radx.

2. RADx® Tech and ATP Programs: https://www.nibib.nih.gov/covid-19/radx-tech-program.
3. RADx® Tech/ATP/ITAP Dashboard: https://www.nibib.nih.gov/covid-19/radx-tech-program/radx-tech-dashboard.
4. RADx® Tech and ATP Programs: Phase 2 Awards: https://www.nibib.nih.gov/covid-19/radx-tech-program/radx-tech-phase2-awards.
5. Article: RADx One Year Later – A Sea Change for Diagnostics: https://www.nibib.nih.gov/about-nibib/directors-corner/corner-posts/radx-one-year-later-%E2%80%93-sea-change-diagnostics.
6. Radical solutions. *Nat Biotechnol*. 2021;39(4):391. PMID: 33824513.
7. Roback JD, et al. *Nat Biotechnol*. 2021;39(9):1060-1062. PMID: 34404954.
8. Barat B, et al. *J Clin Microbiol*. 2021;59(3):e02486-20. PMID: 33262219.
9. Article: One Year of Rapid Acceleration of Diagnostics, and Anticipating New Challenges: https://nlmdirector.nlm.nih.gov/2021/03/31/one-year-of-rapid-acceleration-of-diagnostics-and-anticipating-new-challenges/.

## HIV PREVENTION

1. Pre-exposure Prophylaxis (PrEP) to Reduce HIV Risk: https://www.niaid.nih.gov/diseases-conditions/pre-exposure-prophylaxis-prep.
2. HIV Prevention Trials Network: HPTN 083 Summary: https://www.hptn.org/research/studies/hptn083.
3. HIV Prevention Trials Network: HPTN 084 Summary: https://www.hptn.org/research/studies/hptn084.
4. Article: Global data shows increasing PrEP use and widespread adoption of WHO PrEP recommendations: https://www.who.int/news-room/feature-stories/detail/global-data-shows-increasing-prep-use-and-widespread-adoption-of-who-prep-recommendations.
5. Preventing HIV with PrEP: https://www.cdc.gov/hiv/prevention/prep.html.
6. National HIV Prevention Program Monitoring and Evaluation Data: https://www.cdc.gov/hiv-data/program/index.html.
7. Fauci AS, et al. *JAMA*. 2012;308(4):343-4. PMID: 22820783.
8. Harden, Victoria A. *AIDS at 30: A History*. Potomac Books. 2012.
9. In Their Own Words... NIH Researchers Recall the Early Years of AIDS: https://history.nih.gov/display/history/In+Their+Own+Words.
10. HIV Undetectable=Untransmittable (U=U), or Treatment as Prevention: https://www.niaid.nih.gov/diseases-conditions/treatment-prevention.
11. Article: Final HIV Prevention & Treatment Research Highlights from CROI 2021: https://www.hiv.gov/blog/hiv-covid-19-potential-new-hiv-prevention-tools-and-more-research-highlights-croi-2021-video.
12. HIV/AIDS: https://www.niaid.nih.gov/diseases-conditions/hivaids.
13. Article: FDA Approves First Injectable Treatment for HIV Pre-Exposure Prevention: https://www.fda.gov/news-events/press-announcements/fda-approves-first-injectable-treatment-hiv-pre-exposure-prevention.
14. Landovitz RJ, et al. *N Engl J Med*. 2021;385(7):595-608. PMID: 34379922.
15. Delany-Moretlwe S, et al. *Lancet*. 2022;399(10337):1779-1789. PMID: 35378077.

## COVID-19 TREATMENTS


1. Hammond J, et al. *N Engl J Med*. 2022;386(15):1397-1408. PMID: 35172054.
2. Coronavirus Treatment: https://www.niaid.nih.gov/diseases-conditions/coronavirus-treatment.
3. Article: Expert U.S. panel develops NIH treatment guidelines for COVID-19: https://www.nih.gov/news-events/news-releases/expert-us-panel-develops-nih-treatment-guidelines-covid-19.
4. COVID-19 Treatments and Therapeutics: https://www.hhs.gov/coronavirus/covid-19-treatments-therapeutics/index.html.
5. Types of COVID-19 Treatment. https://www.cdc.gov/covid/treatment/.


## HEPATITIS C


1. Article: Harvey Alter, M.D., Wins the 2020 Nobel Prize in Physiology or Medicine: https://www.nih.gov/harvey-alter-md-wins-2020-nobel-prize-physiology-or-medicine.
2. Hepatitis C NIH Page: https://www.niddk.nih.gov/health-information/liver-disease/viral-hepatitis/hepatitis-c.
3. Liang TJ, et al. *N Engl J Med*. 2014;370(21):2043-7. PMID: 24795199.
4. Marinho RT, et al. *World J Gastroenterol*. 2013;19(40):6703-9. PMID: 24187444.
5. Video: CC Grand Rounds: 1) Hepatitis C Virus Infection: A Disease Cured but Not Conquered and 2) Update on Management and the Road to a Cure for Chronic Hepatitis B: https://videocast.nih.gov/watch=35941.
6. Hepatitis C CDC Page: https://www.cdc.gov/hepatitis/hcv/index.htm.
7. Alter HJ, et al. *Clin Liver Dis (Hoboken)*. 2020;15(Suppl 1):S64-S71. PMID: 32140215.
8. Nobel Prize 2020 Press Release: https://www.nobelprize.org/prizes/medicine/2020/press-release.


## HEPATITIS A VACCINE


1. Article: In the fight against viral hepatitis A, vaccines save lives: https://irp.nih.gov/accomplishments/in-the-fight-against-viral-hepatitis-a-vaccines-save-lives.
2. Hepatitis A Vaccine: https://www.cdc.gov/hepatitis-a/vaccination/index.html.
3. CDC Pink Book: Hepatitis A Vaccine (Chapter 9). 2021: https://www.cdc.gov/pinkbook/hcp/table-of-contents/chapter-9-hepatitis-a.html.


## HIV TREATMENT


1. Global HIV & AIDS statistics — Fact sheet: https://www.unaids.org/en/resources/fact-sheet.
2. HIV/AIDS Treatment: https://www.niaid.nih.gov/diseases-conditions/hiv-treatment.
3. Antiretroviral Drug Discovery and Development: https://www.niaid.nih.gov/diseases-conditions/antiretroviral-drug-development.
4. HIV Undetectable=Untransmittable (U=U), or Treatment as Prevention: https://www.niaid.nih.gov/diseases-conditions/treatment-prevention.
5. Guidelines for the Use of Antiretroviral Agents in Pediatric HIV Infection: https://clinicalinfo.hiv.gov/en/guidelines/pediatric-arv/whats-new-guidelines.
6. Orkin C, et al. *N Engl J Med*. 2020;382(12):1124-1135. PMID: 32130806.
7. Wandeler G, et al. *Curr Opin HIV AIDS*. 2016;11(5):492-500. PMID: 27254748.
8. Teeraananchai S, et al. *HIV Med*. 2017;18(4):256-266. PMID: 27578404.
9. Eisinger RW, et al. *JAMA*. 2019;321(5):451-452. PMID: 30629090.

10. Cohen MS, et al. *N Engl J Med*. 2016;375(9):830-9. PMID: 27424812.
11. Rodger AJ, et al. *Lancet*. 2019;393(10189):2428-2438. PMID: 31056293.
12. Article: The science is clear: with HIV, undetectable equals untransmittable: https://www.nih.gov/news-events/news-releases/science-clear-hiv-undetectable-equals-untransmittable.

## ROTAVIRUS VACCINE

1. Article: Developing the first rotavirus vaccine: https://irp.nih.gov/accomplishments/developing-the-first-rotavirus-vaccine.
2. Clinical Overview of Rotavirus: https://www.cdc.gov/rotavirus/hcp/clinical-overview/.
3. The National Respiratory and Enteric Virus Surveillance System (NREVSS) Interactive Dashboard: https://www.cdc.gov/nrevss/php/dashboard/index.html.

## HEPATITIS B VACCINE

1. Hepatitis: https://www.niaid.nih.gov/diseases-conditions/hepatitis.
2. Hepatitis B: https://www.cdc.gov/hepatitis/hbv/index.htm.
3. Kim WR. *Hepatology*. 2009;49(5 Suppl):S28-34. PMID: 19399791.
4. Surveillance for Acute Viral Hepatitis—United States, 2007: https://www.cdc.gov/mmwr/PDF/ss/ss5803.pdf.

## AUTOIMMUNE DISORDERS

1. Liu C, et al. *Arthritis Rheumatol*. 2021;73(12):2166-2178. PMID: 34180156.
2. Shawky AM, et al. *Pharmaceutics*. 2022;14(5):1001. PMID: 35631587.
3. Philips RL, et al. *Cell*. 2022;185(21):3857-3876. PMID: 36240739.

## RUBELLA VACCINE

1. Impact of U.S. MMR Vaccination Program: https://www.cdc.gov/rubella/vaccine-impact/index.html.
2. Rubella Vaccination: https://www.cdc.gov/rubella/vaccines/index.html.
3. Immunization: https://www.cdc.gov/nchs/fastats/immunize.htm.
4. Progress Toward Rubella and Congenital Rubella Syndrome Control and Elimination—Worldwide, 2012–2020: https://www.cdc.gov/mmwr/volumes/71/wr/mm7106a2.htm.

# Education and Prevention

## Medline Plus


The NIH MedlinePlus website is a free and trusted source of easy-to-understand health information in English and Spanish, which is accessed by over 1 million members of the public each day to help them make informed decisions about their health.

- In 2021, 418 million users viewed MedlinePlus almost 900 million times.
- MedlinePlus covers a broad range of topics from medical conditions such as high blood pressure, cancer, and diabetes, to important public health issues including COVID-19, bullying, opioid misuse and addiction, mental health, and HIV/AIDS.
- MedlinePlus Connect is a free service that allows health organizations and IT providers to link their patient portals and electronic health record systems automatically to patient education materials from MedlinePlus and other NIH resources.

## Sudden Infant Death Syndrome

*Image credit: National Institute of Child Health and Human Development, NIH*

NIH research on sudden infant death syndrome (SIDS) has informed recommendations for safe infant sleep, including the initiation of the NIH-led *Back to Sleep*® campaign in 1994 (now *Safe to Sleep*®). Following its launch, deaths due to SIDS declined considerably from 130.3 to 35.4 deaths per 100,000 live births between 1990 and 2017.

- SIDS—the sudden, unexplained death of an infant under 1 year old—is the leading cause of death in children between 1 month and 1 year of age.
- Although there is no sure way to prevent SIDS, NIH-funded research has informed recommendations for safe infant sleep, including the American Academy of Pediatrics (AAP) guidelines initially published in 1992 and subsequently updated every 4-5 years.
- The AAP guidelines form the basis of messages from the NIH-led *Safe to Sleep*® campaign, which launched as *Back to Sleep*® in 1994.

## Asbestos Ban

*Image credit: Shutterstock*

Results of NIH-supported research showing the cancer-causing properties of asbestos led to the Consumer Product Safety Commission (CPSC) and EPA banning asbestos in many products in the U.S. since the 1970s. As a result, asbestos-linked cancers are down in the U.S.—with the incidence of mesothelioma dropping 3.3% between 2009 and 2018.

- NIH-funded research linked asbestos exposure to lung tumors and mesothelioma and supported the CPSC and EPA banning the use of asbestos in some products during the late 1970s.
- In the U.S., use of asbestos dropped from around 803,000 metric tons per year in 1973, to 360 metric tons per year by 2015.
- Replacement over time of old, asbestos-containing products, such as insulation in homes, will further reduce the potential for asbestos exposure.

## Disease Prevention

*Image credit: Rhoda Baer/NCI*

Because of NIH-supported research, the U.S. Preventive Services Task Force (USPSTF) has the scientific evidence base needed to make the recommendations used by primary care clinicians, patients, and families to guide decisions on preventive services such as screenings, behavioral counseling, and preventive medications.

- Clinical preventive services can identify diseases at earlier stages when they are more treatable or may reduce a person's risk for developing a disease.
- Between 2010 and 2019, USPSTF used new scientific evidence to update the status of several preventive services that had previously had insufficient evidence supporting them, leading to these recommendations being upgraded to definitive clinical recommendations.
- NIH-supported research contributed new evidence for 11 of these upgraded USPSTF recommendations, including those focused on prevention of diabetes, hepatitis C, preeclampsia, skin cancer, obesity, and tobacco use in children and adolescents.
- Infographic: NIH Stories of Success in Disease Prevention

## Air Pollution and Health

*Image credit: Shutterstock*

NIH-supported research found an association between air pollution and mortality, which ultimately led to new Clean Air Act regulations in 1997 that are estimated to have prevented more than 230,000 early deaths by 2020.

- The NIH-funded Harvard Six Cities Study found a strong association between exposure to fine particle air pollution and mortality in communities where air quality was within the EPA standards.
- These findings led to other studies on the effects of air pollution on health, culminating in 1997 with new Clean Air Act regulations on fine particle pollution.

## Lead Exposure


*Image credit: Shutterstock*

NIH-supported research demonstrated that children exposed to lead suffer irreversible brain damage, leading to significant regulatory action to reduce lead exposures. From 1988-2014, the percentage of children aged 1-5 years with lead exposure declined from 25.6% to 1.9%.

- Research shows that lead exposure early in life irreversibly disrupts brain development and blood lead levels are associated with adverse neurological effects in children.
- This knowledge led to significant action to reduce lead exposures, primarily through removal of lead from gasoline, paint, toys, and other consumer products, and water systems.
- These actions have led to blood lead levels falling dramatically for all racial and ethnic groups, and CDC recently updated their guidance so that children exposed to lead can get interventions sooner.

## MEDLINEPLUS


1. MedlinePlus: https://medlineplus.gov/.
2. MedlinePlus Connect: https://medlineplus.gov/connect/overview.html.
3. Health Education Materials Assessment Tool: https://medlineplus.gov/pdf/HealthEducationMaterialsAssessmentTool.pdf.
4. Easy-to-Read Health Information: https://medlineplus.gov/all_easytoread.html.


## SUDDEN INFANT DEATH SYNDROME


1. The Science Of SIDS And Safe Infant Sleep: https://safetosleep.nichd.nih.gov/research/science.
2. Key Moments in *Safe to Sleep*® History: 1994–2003: https://safetosleep.nichd.nih.gov/safesleepbasics/moments/1994-2003.
3. Sudden Unexpected Infant Death and Sudden Infant Death Syndrome: https://www.cdc.gov/sudden-infant-death/.
4. Timely Advice on Safe Infant Sleep: Research on Sudden Infant Death Syndrome (SIDS). 2010: https://www.nichd.nih.gov/newsroom/resources/spotlight/100610-timely-advice-SIDS.


## ASBESTOS BAN


1. Selikoff IJ, et al. *JAMA*. 1968;204(2):106-12. PMID: 5694532.
2. Asbestos Exposure and Cancer Risk: https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/asbestos/asbestos-fact-sheet.
3. Mesothelioma: Recent Trends in SEER Age-Adjusted Incidence Rates, 2000-2019: https://seer.cancer.gov/statistics-network/explorer/application.html?site=111&data_type=1&graph_type=2&compareBy=sex&chk_sex_1=1&chk_sex_3=3&chk_sex_2=2&rate_type=2&race=1&age_range=1&stage=101&advopt_precision=1&advopt_show_ci=on&hdn_view=0&advopt_show_apc=on&advopt_display=2#resultsRegion0.
4. Mesothelioma: Long-Term Trends in SEER Age-Adjusted Incidence Rates, 1975-2019: https://seer.cancer.gov/statistics-network/explorer/application.html?site=111&data_type=1&graph_type=1&compareBy=sex&chk_sex_1=1&chk_sex_3=3&chk_sex_2=2&rate_type=2&race=1&age_range=1&advopt_precision=1&advopt_show_ci=on&hdn_view=0&advopt_show_apc=on&advopt_display=2#resultsRegion0.
5. EPA Regulatory History: https://www.epa.gov/asbestos/epa-actions-protect-public-exposure-asbestos#history.
6. EPA Asbestos Laws and Regulations: https://www.epa.gov/asbestos/asbestos-laws-and-regulations.


## DISEASE PREVENTION


1. Klabunde CN, et al. *Am J Prev Med*. 2022;62(2):e77-e86. PMID: 34657771.
2. Villani J, et al. *JAMA*. 2018;319(20):2132-2133. PMID: 29800165.
3. 2021 USPSTF Annual Report to Congress - II. Background: https://www.uspreventiveservicestaskforce.org/uspstf/sites/default/files/inline-files/2021-uspstf-annual-report-to-congress.pdf#page=6.
4. Maciosek MV, et al. *Ann Fam Med*. 2017;15(1):14-22. PMID: 28376457.
5. Office of Disease Prevention. Spotlight on 2019 Annual Report: Closing Evidence Gaps and Informing Clinical Practice with NIH Prevention Research: https://prevention.nih.gov/sites/default/files/2020-01/ODP_Spotlighton2019_508_FINAL.pdf#page=5.

## AIR POLLUTION AND HEALTH


1. Environmental Protection Agency. Benefits and Costs of the Clean Air Act 1990-2020, the Second Prospective Study. 2022. https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1990-2020-second-prospective-study.
2. Dockery DW, et al. *N Engl J Med*. 1993;329(24):1753-9. PMID: 8179653.


## LEAD EXPOSURE


1. Needleman HL, et al. *Nature*. 1972;235(5333):111-2. PMID: 4550400.
2. National Toxicology Program. NTP Monograph Health Effects of Low-Level Lead. 2012. https://ntp.niehs.nih.gov/ntp/ohat/lead/final/monographhealtheffectslowlevellead_newissn_508.pdf.
3. Toxicological Profile for Lead: https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf.
4. Lead Exposure Symptoms and Complications: https://www.cdc.gov/lead-prevention/symptoms-complications/.
5. Gasoline and the environment: Leaded Gasoline: https://www.eia.gov/energyexplained/gasoline/gasoline-and-the-environment-leaded-gasoline.php.
6. EPA Lead Laws and Regulations: https://www.epa.gov/lead/lead-laws-and-regulations.
7. Blood Lead Reference Value: https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm.

# Infant and Maternal Health

## Phenylketonuria (PKU)

*Image credit: Clinical Center, NIH*

Thanks to NIH-supported research, all infants born in the U.S. are tested for Phenylketonuria (PKU)—a genetic disease that can cause seizures, deafness, and intellectual disabilities. This testing enables infants with the disorder to be put on a special low-protein diet, virtually eliminating PKU as a cause of intellectual disability in the U.S.

- PKU is a rare disease caused by the body's inability to break down a common part of most proteins, resulting in intellectual disability, seizures, and deafness.
- In the 1950s, NIH researchers developed a low-protein diet for people with PKU that promoted normal development if started right after birth.
- In the 1960s, NIH-supported researchers developed an inexpensive blood test to detect PKU in newborns, enabling mass screening and much earlier diet-based interventions.
- NIH-supported research demonstrated that if adults with PKU follow the low-protein diet before and during pregnancy it ensures healthy infant development.

## Newborn Screening

*Image credit: National Institute of Child Health and Human Development, NIH*

Thanks in part to NIH research, 4 million infants are screened in the U.S. each year for over 20 disorders that are treatable with early medical intervention. Newborn screening programs detect a treatable condition in 1 in 300 newborns, facilitating early interventions and preventing long-term health problems.

- Newborn screening can include several tests such as taking a few drops of blood from an infant's heel, using an external monitor to measure blood oxygen levels, and hearing exams, among others.
- These tests are used to detect serious, life-threatening diseases like critical congenital heart disease (CCHD), phenylketonuria (PKU), and severe combined immunodeficiency disorder (SCID).
- For example, screening for CCHD reduces early infant deaths by 33%, or about 120 per year.

## Declining Newborn Mortality

*Image credit: National Library of Medicine, NIH*

The first month of life is the most vulnerable period for child survival. Long-term NIH investments in newborn health have contributed to a global decline in newborn mortality, from 5.0 million newborn deaths in 1990 to 2.3 million in 2022.

- The global decline in newborn deaths is a result of improved newborn screening, treatments for premature infants, better guidelines for newborn care, and more—all of which have been advanced by NIH-supported research.
- For example, the introduction of prenatal steroids given to women at risk for pre-term birth helped to improve the survival rates in infants born as early as 23 weeks gestation.
- Screening for critical congenital heart disease reduces early infant deaths by 33%, or about 120 per year.

## Infant Lung Health

*Image credit: National Institute of Child Health and Human Development, NIH*

NIH-supported research led to the development of treatments for respiratory distress syndrome (RDS), which has increased survival rates for premature infants born before 28 weeks gestation from 5% in the 1960s to over 90% today.

- RDS occurs when there is not enough surfactant in the lungs. Surfactant is a foamy substance made by the lungs that keeps the airways open, making it possible for babies to breathe in air after delivery.
- RDS occurs in nearly all infants born before 28 weeks gestation and, while uncommon, can also occur in full-term infants.
- In the early 1990s, FDA approved two synthetic lung surfactants—developed by NIH-supported research—for use as replacement surfactants in infants who suffer from RDS.

## Postpartum Depression

*Image credit: National Institute of Child Health and Human Development, NIH*

Thanks in part to decades of research by NIH researchers, FDA approved the first medications specifically for postpartum depression (PPD). About 1 in 8 people who give birth experience PPD, and the rate of depression diagnoses at delivery is increasing, with rates seven times higher in 2015 than in 2000.

- In the 1980s, NIH researchers discovered that levels of metabolites—products that are formed when hormones break down—fluctuate throughout the menstrual cycle and during times of stress (like pregnancy).
- During pregnancy, certain metabolites increase significantly and then drop quickly after birth, which triggers PPD in some people.
- Based on this research, a biopharmaceutical company developed brexanolone, an injectable treatment for PPD. In 2019, FDA approved brexanolone as the first treatment specifically for PPD, and in 2023, FDA approved zuranolone, the first oral treatment for PPD.

## HIV and Pregnancy

*Image credit: National Institute of Child Health and Human Development, NIH*

Since the mid-1990s, NIH research has informed implementation of HIV testing and preventive interventions. HIV testing and interventions have resulted in a more than 90% decrease in the number of children with perinatally acquired HIV in the U.S.

- HIV can be transmitted during pregnancy, birth, or infant feeding. Perinatal transmission, also known as mother-to-child transmission, is the most common way that children get HIV.
- NIH-supported research showed that a three-drug regimen—called HAART, or highly active antiretroviral therapy—was shown to be better than the drug azidothymidine (AZT) at preventing mother-to-child transmission of HIV.
- HAART was shown to reduce the risk of perinatal transmission to 1.2%, and because of this and related interventions, an estimated 21,956 perinatally-acquired HIV cases have been prevented in the U.S. since 1994.

## Lupus and Pregnancy

*Image credit: istock*

Findings from NIH-supported research showing that people with lupus can have safe and healthy pregnancies resulted in a change in CDC guidance for people with lupus who are planning to become pregnant. Previously, patients with lupus were counseled to avoid becoming pregnant.

- NIH-supported researchers identified key factors that may put patients with lupus at risk for complications during pregnancy, so physicians are able to better counsel and monitor high-risk patients.
- Now patients with lupus who are planning pregnancies have NIH-informed resources from CDC to help guide conversations with their physicians.
- These findings are expected to significantly impact prenatal care and allocation of health care resources for the 1.5 million people in the U.S. with lupus, of which 90% are women.

## PHENYLKETONURIA (PKU)


1. Phenylketonuria (PKU) and Newborn Screening: https://www.nichd.nih.gov/about/accomplishments/contributions/pku.
2. Phenylketonuria (PKU): https://www.nichd.nih.gov/health/topics/pku.
3. What are common treatments for phenylketonuria (PKU)?: https://www.nichd.nih.gov/health/topics/pku/conditioninfo/treatments.


## NEWBORN SCREENING


1. Article: Major Accomplishment in Public Health Marks Its 50th Anniversary: https://www.nichd.nih.gov/newsroom/resources/spotlight/092413-sept-newborn-screening.
2. Brief History of Newborn Screening: https://www.nichd.nih.gov/health/topics/newborn/conditioninfo/history.
3. Newborn Screening: https://www.nichd.nih.gov/health/topics/newborn.
4. Article: NIH-funded data resource advances understanding of diseases identified by newborn screening: https://www.nichd.nih.gov/newsroom/news/071321-newborn-screening.
5. Article: NIH-funded project leads to FDA-approved newborn screening device: https://www.nichd.nih.gov/newsroom/news/sbir_ma_020617.
6. Article: Test reliably detects inherited immune deficiency in newborns: https://www.nichd.nih.gov/newsroom/releases/082014-test-newborns.


## DECLINING NEWBORN MORTALITY


1. Newborn Mortality: https://www.who.int/news-room/fact-sheets/detail/newborn-mortality.
2. Rouse DJ, et al. *N Engl J Med*. 2008;359(9):895-905. PMID: 18753646.
3. Venkatesan T, et al. *JAMA Pediatr*. 2023;177(10):1085-1095. PMID: 37669025.
4. Article: Survival of the Tiniest: https://www.nichd.nih.gov/about/org/od/directors_corner/prev_updates/preterm-births-Feb2022.
5. Article: Prenatal steroid treatment may improve survival, reduce complications for extremely preterm infants: https://www.nih.gov/news-events/news-releases/prenatal-steroid-treatment-may-improve-survival-reduce-complications-extremely-preterm-infants.


## INFANT LUNG HEALTH


1. Venkatesan T, et al. *JAMA pediatrics*. 2023;177,10: 1085-1095. PMID: 37669025.
2. Article: Survival of the Tiniest: https://www.nichd.nih.gov/about/org/od/directors_corner/prev_updates/preterm-births-Feb2022.


## POSTPARTUM DEPRESSION


1. Article: Bench-to-Bedside: NIMH Research Leading to Brexanolone, First-Ever Drug Specifically for Postpartum Depression: https://www.nimh.nih.gov/news/science-news/2019/bench-to-bedside-nimh-research-leading-to-brexanolone-first-ever-drug-specifically-for-postpartum-depression.
2. Article: FDA approves first treatment for post-partum depression: https://www.fda.gov/news-events/press-announcements/fda-approves-first-treatment-post-partum-depression.

3. Bauman BL, et al. *Morbid and Mort Weekly Report*. 2020;69(19)575-581. PMID 32407302.
4. Haight SC, et al. *Ob and Gyn*. 2019;133(6)1216-1223. PMID 31135737.
5. Article: FDA Approves First Oral Treatment for Postpartum Depression: https://www.fda.gov/news-events/press-announcements/fda-approves-first-oral-treatment-postpartum-depression.

## HIV AND PREGNANCY

1. NICHD Contributions to Society: Nearly Eliminating Perinatal Transmission of HIV: https://www.nichd.nih.gov/about/accomplishments/contributions.
2. Tuomala RE, et al. *N Engl J Med*. 2002;346(24):1863-70. PMID: 12063370.
3. Cooper ER, et al. *J Acquir Immune Defic Syndr*. 2002;29(5):484-94. PMID: 11981365.
4. How is HIV Transmitted? https://www.hiv.gov/hiv-basics/overview/about-hiv-and-aids/how-is-hiv-transmitted.
5. Little KM, et al. *Pediatr Infect Dis J*. 2017;36(1):66-71. PMID: 27749662.
6. Connor EM, et al. *N Engl J Med*. 1994 Nov 3;331(18):1173-80. PMID: 7935654.

## LUPUS AND PREGNANCY

1. Pregnancy and lupus: https://womenshealth.gov/lupus/pregnancy-and-lupus.
2. Breacher G, et al. *Am J Clin Path*. 1956;26: 1439-49. PMID: 13394550.
3. Lupus facts and stats: https://www.lupus.org/resources/lupus-facts-and-statistics.