

# NIH...

## Turning Discovery Into Health

### OUR HEALTH

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

#### *Americans are Living Longer, Healthier Lives*

- Between 1970 and 2016, the **life expectancy of the average American increased** by eight years, from 70.8 to 78.6.<sup>1</sup>
- Between 1969 and 2015, **the death rate in the U.S. for all causes has decreased by 43%**, from 1279 per 100,000 people to 733.<sup>1</sup>
- In the 1960s, almost 50% of people had lost all their teeth by age 75. By 2012, that rate was **down to 13%**, thanks in large part to NIH-funded dental research.<sup>2</sup>

#### *Babies are Being Born Healthier*

- In 1960, 26 of every 1,000 babies born in the United States died before their first birthday. By 2016 that rate had **fallen to under 6 per 1,000 babies**.<sup>3</sup> This is thanks in part to NIH research on reducing preterm births, neonatal mortality, and other complications.
- Since the mid-1990s, NIH research has informed implementation of HIV testing and preventive interventions that resulted in **a more than 90% decrease in the number of children perinatally infected with HIV in the United States**, according to CDC.<sup>4</sup>
- NIH-funded research has found that **women with lupus can expect a safe pregnancy if their disease is inactive**<sup>5</sup>, and has helped to identify which lupus patients are at risk for the most severe pregnancy complications.<sup>6</sup>

#### *Heart Disease, Stroke, and Diabetes Are Less Deadly*

- Deaths from heart disease **fell 67.6%** from 1969 to 2015, through research advances supported in part by NIH.<sup>7,8,9</sup>
- The Framingham Heart Study and other NIH-supported research have identified **risk factors for heart disease**, such as cholesterol, smoking, and high blood pressure. This work has led to new strategies for preventing heart disease.
- In 1995, an NIH-funded clinical trial established the **first FDA-approved treatment** for the most common type of stroke,<sup>10</sup> the drug tissue plasminogen activator (tPA).
- Since 1969, **the stroke mortality rate has decreased by 71%**,<sup>11</sup> due in part to NIH-funded research on treatments and prevention.
- Despite the increasing prevalence of diabetes in the U.S., from 1969 to 2016 **the death rate for adults with diabetes declined by 17%**.<sup>12,13,14</sup> Between 1990 and 2010, the **rates of major diabetes**

**complications dropped dramatically**, particularly for heart attacks, which declined by 68%, and stroke, which declined by 53%.<sup>15</sup> These improvements are due in part to clinical trials supported by NIH.

- NIH's Diabetes Prevention Program has shown that lifestyle changes, such as diet and physical activity, can **lower the risk of developing type 2 diabetes by 58%** in adults at high risk for the disease.<sup>16</sup>

### *Advances in Preventing and Treating Cancer*

- The death rate for all **cancers combined has been declining since the early 1990s for adults and since the 1970s for children.**<sup>17</sup> **Overall cancer death rates have dropped** by nearly 26% in total from 1991—2015. The American Cancer Society estimates that 2.4 million cancer deaths were averted from 1991—2015 (nearly 1.6 million in men and nearly 740,000 in women) by improvements in cancer treatment, detection, and prevention.<sup>18</sup>
- Between 1989 and 2015, **breast cancer death rates for women declined by about 39%**. Breast cancer is the most common cancer in the United States (excluding non-melanoma skin cancer). NIH-supported research has helped identify major breast cancer subtypes and led to the development of treatments that are tailored to the cancers' specific molecular profiles.<sup>19</sup>
- Lung cancer is the second most common cancer<sup>20</sup> and the leading cause of cancer-related death in both men and women in the United States. NIH-funded research has contributed to **lowering the lung cancer death rate** by 45% in men from 1990 to 2015 and 19% per year in women from 2002 to 2015.<sup>21</sup> New targeted therapies such as erlotinib (Tarceva) and crizotinib (Xalkori) have led to dramatic responses in people whose lung cancers harbor particular genetic mutations.
- Prostate cancer is the second leading cause of cancer-related death among men in the United States. NIH-supported research has improved treatments for prostate cancer. Partly because of these advances, between 1993 and 2015, the **prostate cancer death rate dropped by 52%**.<sup>22</sup>
- Due in part to groundbreaking NIH research, three FDA-approved vaccines, Cervarix, Gardasil, and Gardasil 9, are now available to prevent infection by human papillomaviruses (HPV) that can cause **cervical cancer**.
- Thanks to the development of Gleevec®, supported in part by NIH, patients with a new diagnosis of chronic myelogenous leukemia (CML) can now expect to **live an essentially normal lifespan**.<sup>23</sup>
- Research in **cancer immunotherapy** has led to the development, with NIH support, of several new methods of treating cancer by restoring or enhancing the immune system's ability to fight the disease. Cancer immunotherapies are now a growing class of FDA-approved drugs, from treatments like Keytruda that **help the patient's immune system recognize and attack cancerous cells**, to two recently-approved cancer treatments **that engineer a patient's own immune cells to target and destroy cancerous cells**.<sup>24</sup>

### *Fighting Infections*

- In the early 1980s when the **HIV/AIDS** epidemic began, people infected with the virus were not likely to live longer than a few years. Thanks to an unprecedented effort made by NIH and other private and public funders of biomedical research, today:

- **Treatments can suppress the virus** to undetectable levels.
- A **20-year-old HIV-positive adult** living in the United States who receives these treatments is expected to **live into his or her early 70s**, nearly as long as someone without HIV.<sup>25</sup>
- **Death rates have dropped more than 80%** between 1990 and 2014.<sup>26</sup>
- NIH research has led to evidence-based HIV-intervention strategies, such as the “seek, test, treat, and retain” (STTR) model of care that targets high risk, hard to reach, drug using populations; helps identify those who are HIV-positive; and engages them in ongoing treatment. Research has shown that implementation of STTR has the potential to decrease the rate of HIV transmission by more than half.<sup>27</sup> NIH-supported researchers demonstrated that a combination HIV prevention method can reduce new infections by 42% at a population level.<sup>28</sup> The study showed that combining and scaling up behavioral and pharmaceutical interventions from an individual level to entire rural communities in Uganda can substantially reduce new infections.
- The *haemophilus influenzae* type B (**Hib**) vaccine has reduced the cases of Hib, once the leading cause of bacterial meningitis in children, by more than 99%.<sup>29</sup>
- NIH intramural researchers played a crucial role in developing the first licensed **hepatitis A vaccine, contributing to a 92% decline in hepatitis A rates** since 1995.<sup>30</sup>
- Hepatitis B infection once caused untreatable, fatal illness. Due to intensive vaccination programs based on NIH research, the rate of **acute hepatitis B has fallen by more than 80% since 1980**.<sup>31</sup>
- A diagnosis of hepatitis C once meant months and months of painful drug injections. Thanks in part to NIH research, there are effective **pills for treating hepatitis C**.<sup>32</sup>
- NIH intramural scientists were **the first to identify rotavirus**, the most common cause of childhood diarrhea worldwide, in 1974 and partnered with industry to create **the first rotavirus vaccine** in 1998.<sup>33</sup>
- NIH intramural scientists performed pioneering work to develop the antifungal drugs amphotericin B and flucytosine, which **treat the most common fungal brain infection in patients with weakened immune systems, including AIDS patients**.<sup>34</sup>

### *Understanding Drug Abuse and Addiction*

- In the last three decades, scientists funded by NIH have discovered much about the risks and mechanisms that lead to drug abuse and addiction in adolescents. This has informed **new approaches to prevention**.
- Today, the rate of daily cigarette smoking by teenage students is below 4.2%, **its lowest point since 1975**, when the NIH-funded Monitoring the Future (MTF) survey began tracking drug use and attitudes of teens.<sup>35</sup> The same study found that **alcohol use by teenagers is down to its lowest point since 1975**.<sup>36</sup> Currently, the transition from prison back into the community is associated with a 12-fold increased risk of death from drug overdose in the first 2 weeks after release compared to the general population.<sup>37</sup> NIH-funded researchers have developed strategies for integrating evidence-based addiction treatment into criminal justice settings **that reduce overdoses and deaths during re-entry from prison by more than half**.<sup>38,39,40,41</sup>

- NIH-supported researchers partnered with a pharmaceutical company to develop a naloxone nasal spray, **the first easy-to-use, non-injectable version of a life-saving treatment for opioid or heroin overdoses**, which received FDA approval in December 2015.<sup>42</sup> Since its launch in February 2016, **900,000 life-saving doses** have been distributed around the US<sup>43</sup>, and a recent survey of community organizations reported that **98.8% of overdoses encountered by these organizations had been successfully reversed** in the field.<sup>44</sup>
- An NIH-funded trial reported that among patients who were able to complete an initial detoxification hurdle, **extended-release naltrexone** (an antagonist that can be prescribed by any provider) was **effective in leading to abstinence from illicit opioid use**.<sup>45</sup>
- NIH-supported researchers collaborated with the pharmaceutical industry to develop the drug buprenorphine, the **first drug for opioid addiction that could be prescribed in a doctor's office instead of requiring daily visits to a clinic**. In 2016, NIH research contributed to a newly-FDA-approved formulation of buprenorphine, Probuphine, which can be **implanted in patients over long periods of time** instead of taking daily pills. .<sup>46</sup>

### *Progress in Treating Lost Neural Function*

- As a result of NIH efforts, **nearly all infants born in U.S. hospitals in 2010 were screened for hearing loss**, up from as few as one-tenth of infants born in 1993, allowing them to get hearing aids or cochlear implants during their developmental years when they will be most helpful.<sup>47</sup>
- According to the FDA, approximately **324,000 cochlear implants**, developed in part through NIH funding, have been implanted worldwide, in roughly **58,000 U.S. adults** and **38,000 U.S. children**.<sup>48</sup> Studies have shown that screening and implantation before the age of 18 months allows more than **80% of children** with hearing loss to join mainstream classes with their normal-hearing peers.<sup>49</sup>
- NIH-supported research has **driven the development of hearing aids** from the first electronic hearing devices invented in the 1950s to the sophisticated digital devices available today.
- Building on advances in stimulating the nervous system with electricity, emerging neurostimulation technologies have **the promise of restoring vision**<sup>50</sup> and **movement after paralysis** and traumatic injury.<sup>51</sup>
- **Deep brain stimulation is used to help relieve symptoms of Parkinson's disease and Obsessive-Compulsive Disorder**, thanks in part to NIH-funded research,<sup>52</sup> and is currently being tested in other neuropsychiatric conditions,<sup>53</sup> such as treatment-resistant depression and dementia.
- **NIH funded the clinical trials that demonstrated that three drugs can treat diabetic retinopathy**, the leading cause of blindness in working-age adults. These drugs reversed vision loss and provide the first new therapies in 25 years.<sup>54</sup>
- **NIH-funded research established daily eye-patching or the use of atropine eye drops as a way to improve vision in those suffering from amblyopia**, a common vision disorder in children where the brain does not process images from one eye. When used early, these treatments help prevent further damage to visual development, depth perception, and visual learning.<sup>55</sup>

### *More People Are Surviving Injuries*

- In the mid-1970s, burns that covered even 25% of the body were almost always fatal.<sup>56</sup> Today, **people with burns covering 90% of their bodies can survive.**<sup>57</sup> NIH-funded research on wound cleaning, skin replacement, infection control, and other topics has greatly improved the chances of surviving catastrophic burns and traumatic injuries.
- From 1969 to 2015, the **death rate from unintentional injuries decreased almost 35%**, from 65.1 per 100,000 people to 47.4<sup>58</sup>
- From 1990 to 2010, the death rate per 100,000 people from **motor vehicle traffic injury decreased 42%**, from 18.5 to 10.8. Survivors are healthier, with a higher quality of life. These dramatic advances are due in large part to research.<sup>59</sup>

### *Blazing a Path for Innovations in Treatment*

- **The first human liver transplantation** was performed by an NIH grantee in 1967.<sup>60</sup>
- NIH intramural researchers, in conjunction with several university partners, held the **first large clinical trials of lithium as a mood stabilizer**, supporting its FDA approval in 1970.<sup>61</sup>
- NIH intramural scientists developed the first **cell-targeted enzyme replacement therapy for Gaucher disease** and conducted the first successful clinical trial in 1991, providing a new gold-standard therapy for a rare genetic deficiency.<sup>62</sup>
- NIH intramural researchers spearheaded studies in the 1940s and 1950s that showed the **rate of tooth decay fell more than 60%** in children who drank fluoridated water, laying the foundation for a major component of modern dental health.<sup>63</sup>
- NIH intramural researchers pioneered the **treatment of the rare disease lipodystrophy** using a synthetic form of the fat-derived hormone leptin, which was FDA-approved as a treatment in 2014.<sup>64</sup>
- NIH-funded research helped lead to the development of tofacitinib (approved by the FDA in 2012), **the first new rheumatoid arthritis drug in more than a decade that can be taken as a pill** (rather than an injection) to slow or halt joint damage.<sup>65</sup>
- NIH research led to **breakthrough treatments for a family of rare autoinflammatory diseases**,<sup>66</sup> including familial Mediterranean fever (FMF), neonatal onset multisystem inflammatory disease (NOMID), Tumor Necrosis Factor (TNF) Receptor-Associated Periodic Syndrome (TRAPS), and Deficiency of the Interleukin-1 Receptor Antagonist (DIRA). The NIH Clinical Center conducted much of the genetic research that led to a potential therapy, as well as the clinical trials that proved the therapy could be effective.
- NIH maintains the **Undiagnosed Diseases Program (UDP)**, started in 2008, to help connect patients and researchers to find the right diagnosis for tricky diseases. The UDP has received thousands of applications since opening, with approximately 10% of the program's patients receiving a full diagnosis, and a further 30% gaining partial diagnosis.<sup>67</sup>
- The NIH-funded Recovery After an Initial Schizophrenia Episode (RAISE) project **developed a team approach to treatment that significantly improves symptoms and functioning for patients with a first episode psychosis.**<sup>68</sup> This study demonstrated that delivering coordinated, effective specialty care by mental health professionals from various disciplines can help to avert the more severe symptoms of schizophrenia.

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