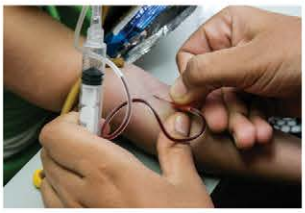
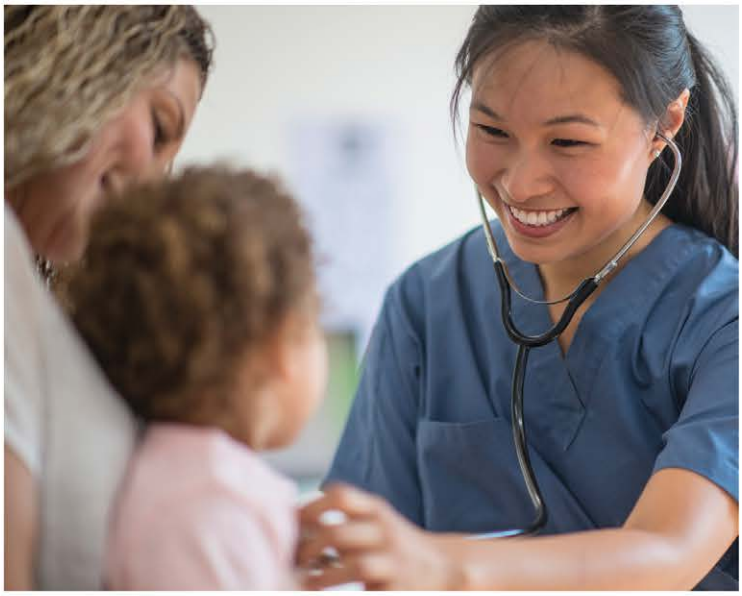


CALIFORNIA LIFE SCIENCES SECTOR REPORT **2020**



CLSA
California Life Sciences Association

pwc

Letter from the Governor

For decades, California's life sciences sector has had profound impacts on patients and their families in the Golden State and around the world. As we grapple with a global pandemic, the world increasingly looks to California for life-saving solutions. We are prouder than ever of this sector's relentless pursuit of medical breakthroughs—not to mention the ongoing development of tools to improve agriculture, increase clean energy production, mitigate climate change, and more.

Gavin Newsom
Governor of California

California is the global leader in life sciences innovation because of our world-class university system that produces incredible discoveries, a well-educated workforce dedicated to putting in the hard work to seek out and solve problems, and an entrepreneurial spirit that does not shy away from the decades it often takes to move these discoveries forward.

President Kennedy famously said, "We choose to do these things not because they are easy, but because they are hard." That spirit embodies life sciences innovation in our state today.

The 2020 California Life Sciences Sector Report provides an opportunity to celebrate the tremendous contributions California's life sciences ecosystem brings to patients and their families and to highlight the diverse and complex sector that allows California to rise to any challenge and lead the world in innovation.

We are proud of these accomplishments and look forward to continued success.

Sincerely,

Letter to Stakeholders

At the dawn of a new decade, we would be remiss to not reflect for a moment on the tremendous advances that the life sciences have contributed in the past ten years.

Since 2010, scientists have created the first ever organism with a synthetic genome, created a preventative treatment for HIV, utilized CRISPR to edit genetic code, developed the ability to generate organs using bionic technology and 3D printing, and dramatically integrated technology into the delivery of medicine, just to name a few.

The application of biology, medical technology, and the fundamental advances in our understanding of the world around us will continue to drive innovation in the 21st Century. It will also drive job growth and shape an economy that is progressively more bio-based and dependent on the innovation originating in our golden state.

The world economic forum projects that by 2030, it is realistic to say that the life sciences will likely play an even greater role in daily life, from advanced diagnostics, devices, and drugs to environmentally friendly chemicals, fuels and materials.

With the rapid pace of technological advancements in the healthcare sector, the future of medical devices looks promising. The new-age medical technology has transformed the way doctors and patients participate and interact with each other. Obtaining real-time information, tracking health records, identifying potential health issues, and devising a treatment plan are all signs of the efforts that will improve quality of life for people around the world, but most importantly, the patients that need care.

California's 3,700+ life sciences companies, world-class universities and biological research institutes are leading the way, and we could not be prouder of the work they do.

The COVID-19 pandemic that has gripped most of the world is a testament to the value of the life sciences in treating, preventing, and innovating solutions to global challenges.

As a trade association representing such a diverse ecosystem, it is imperative that we advocate for federal, state, and local policies, and a regulatory environment, that fosters bold ideas. We must also cultivate the relationship building and collaboration that is critical to life sciences growth.

Our 2020 edition of this economic impact report serves as a reminder of that growth; in just ten years, there are 1700 more life sciences companies than in 2010, we employ almost 250,000 more Californians at direct and indirect jobs related to the sector, we have doubled the total number of wages and salaries, and pay $34 billion more per year in federal, state and local taxes.

Together, we have built something wonderful in California – a sector that we must preserve and improve. We have continued to work with industry, academia, and lawmakers to streamline regulations, increase education and research funding, improve the tax climate and deliver other policy changes that protect health innovation and patient access to care. All this while incubating the next generation of innovation through business leadership and a passion for the ecosystem that sustains our sector.

We cannot forget the sound ideas that got us here. With your support, we can continue to grow California's life sciences impact and improve outcomes for people around the world, and we cannot wait to see the impact that will have by the year 2030.

Mike Guerra, President & CEO
California Life Sciences Association (CLSA)

Peter Claude, Partner
Pharmaceutical & Life Sciences Advisory PwC

A Growing Worldwide Footprint

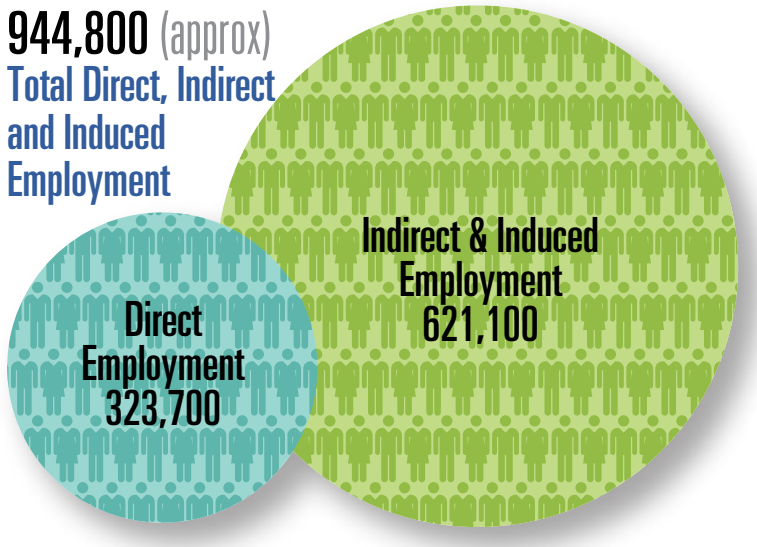
California's life sciences ecosystem continued to innovate in 2019, despite an uncertain political climate, with 3,766 life sciences companies in the state—348 more than the previous year. This includes 1,805 pharmaceutical and biotechnology companies (up 235 from 2018) and 1,961 medical device and equipment companies (113 more than last year). Increasingly, these companies are applying the basic process of biotechnology to the world around them, as with the growing field of synthetic biology, or using life sciences research tools to tackle global challenges such as climate change, data storage and analysis, food, and industrial security. Additionally, the amount of funding through FY2019 from National Institutes of Health (NIH) grants to California scientists increased to $4.5 billion. Biomedical exports also increased slightly from $23.2 billion to $24.3 billion through the end of 2018.

Despite this success, the industry saw mixed investment indicators, with venture capital investment decreasing to $6.5 billion from $8.9 billion.

Separately, the sector produced an estimated $191.6 billion in revenue—an over $10 billion increase from the previous year. Life sciences companies employed more than 323,000 Californians, second only to information technology, and paid over $40 billion in wages, and more than $17.5 billion in federal, state and local taxes. Perhaps the most important measure of success—California's pipeline for new medicines, devices, and diagnostics—continued to be strong, improving health for people in the United States and around the world.

California Life Sciences Industry 2018 (estimated)

Total Estimate Revenue	$191.6B
Total Estimated Employment	323,723
Total Estimated Wages	$40.0B
Average Annual Biomedical Industry Salary	$123,577
Total NIH Grants Awarded, 2019	$4.5B
Totally Estimated Venture Capital Investments, 2019	$6.5B
Total Biomedical Exports	$24.3B
Direct Federal Taxes	$11.1B
Direct State and Local Taxes	$6.4B
Number of Life Sciences Companies	3,766

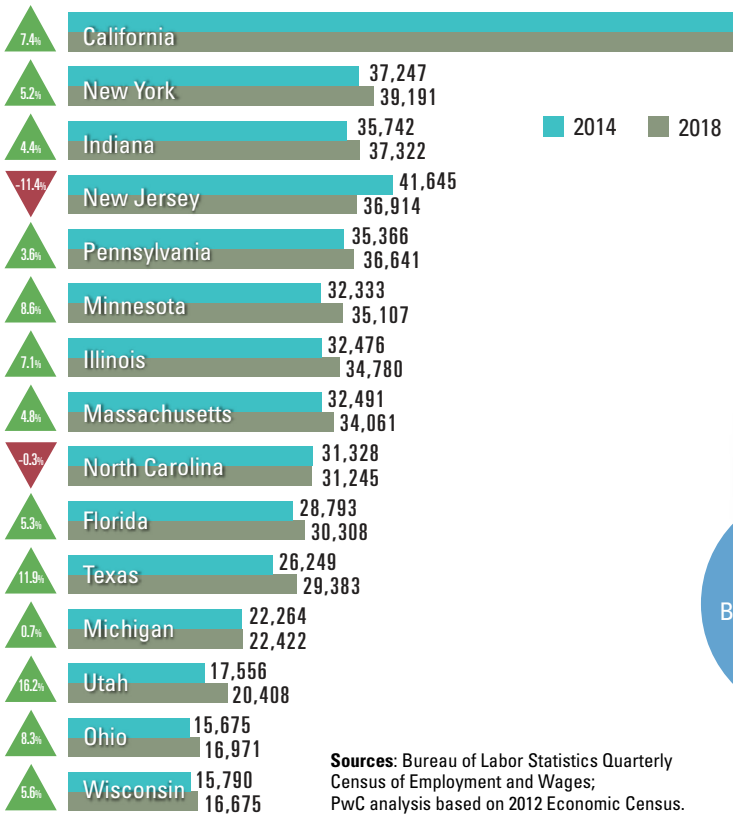


Sources: Estimates based on the Impact Analysis for Planning modeling system

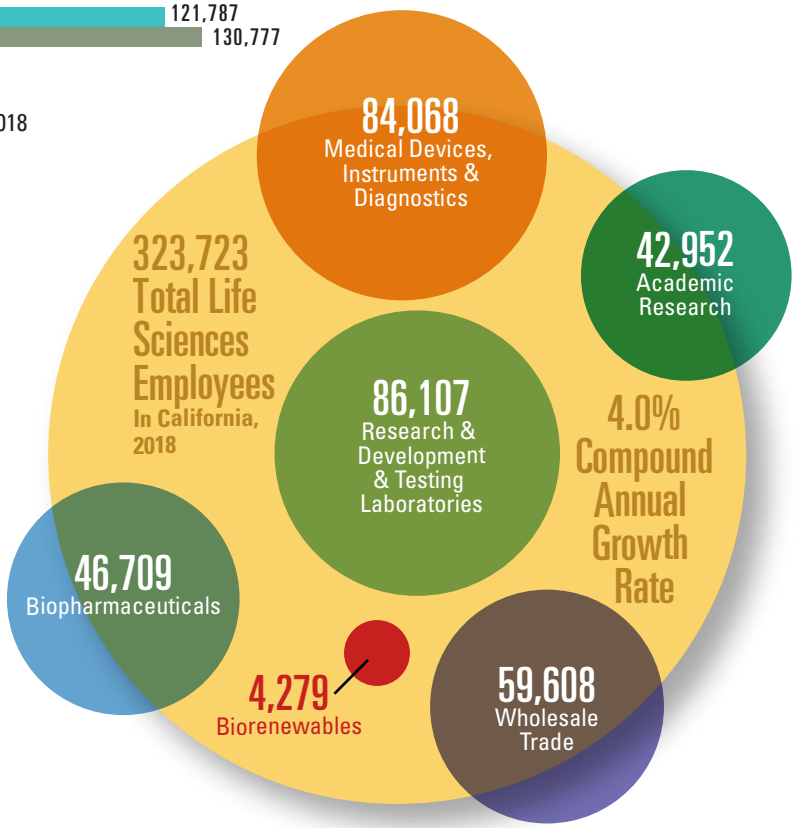
Total Life Sciences Companies in California

Source: Bloomberg Government, Dec. 24, 2019

Growth in Biopharmaceutical & Medical Device Employees by State 2014-2018



Sources: Bureau of Labor Statistics Quarterly Census of Employment and Wages; PwC analysis based on 2012 Economic Census.



Life-Saving Therapeutics

Millions of people around the world look to California life sciences companies for hope in the fight against their diseases and illnesses affecting a loved one. However, before a drug or device can help patients, it must undergo a rigorous testing process.

Most often, new medicines must go through at least three clinical trial phases to test its safety and effectiveness. The drug can only be approved by the U.S. Food and Drug Administration (FDA) after it has passed these regulatory hurdles. Medical devices have equivalent review and approval standards based on their class or category.

In 2019, California companies had 1,380 new medicines in the pipeline. These included 455 medicines for cancer, 136 for central nervous system (CNS) disorders and 105 for infectious diseases.

In addition, in 2019, California companies received 18 expedited approvals from the FDA, accelerating the industry's ability to get new treatments to patients in critical need.

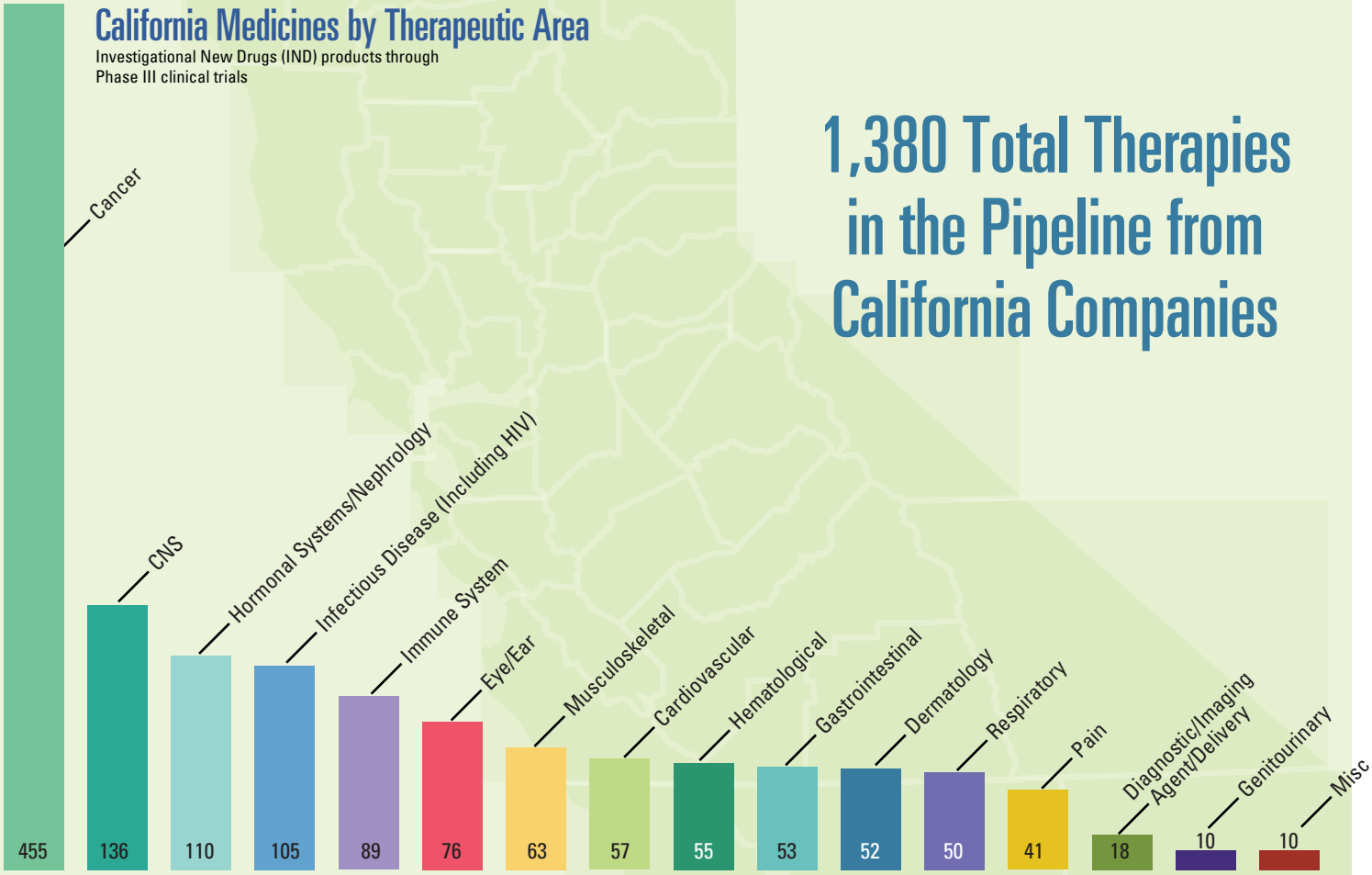
In medical devices, California companies received 424 product approvals in 2019. These included 12 PMA first approvals, five de novo approvals, and 407 510(k) clearances.

Source: EvaluatePharma® February 2020, Evaluate Ltd.; EvaluatePharma USA, Inc.

California Medicines by Therapeutic Area

Investigational New Drugs (IND) products through Phase III clinical trials

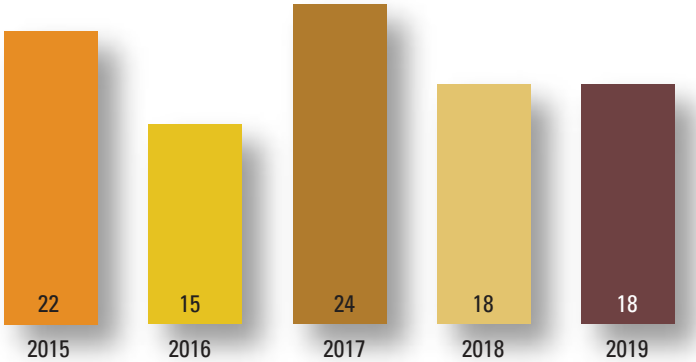
1,380 Total Therapies in the Pipeline from California Companies



Source: BioPharm Insight, IND's filed through Phase III, Jan. 3, 2020

Expedited Drug Approvals from California Companies

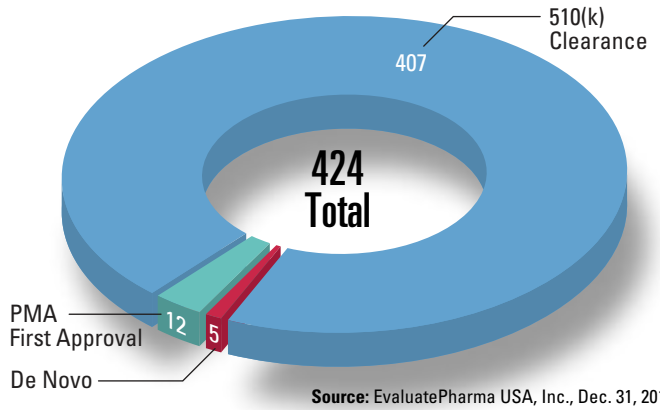
By companies headquartered in California



Source: EvaluatePharma, October 2018

Medical Devices Approved

By companies headquartered in California, 2019



Source: EvaluatePharma USA, Inc., Dec. 31, 2019

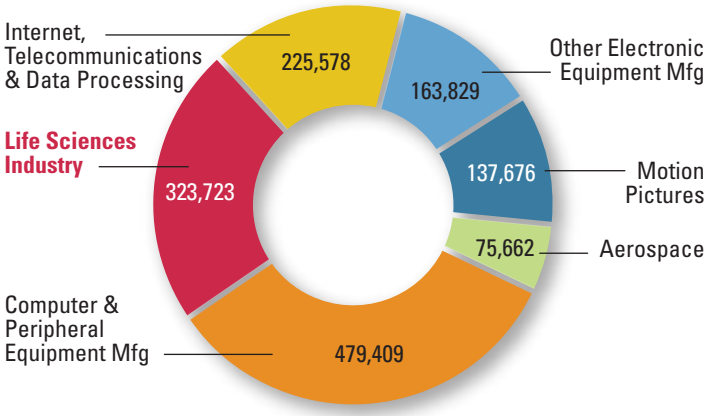
An Economic Driver

The life sciences have a major economic impact on California. In 2018, the sector directly employed more than 323,700 Californians, a 4.0% increase over the previous year. These were split up over several subsectors: academic research, biopharmaceuticals, biorenewables, medical devices, research and development, and wholesale trade. The greatest gains were seen in research and medical devices.

Indirect employment, which includes industries that contribute to the life sciences supply chain, topped 275,600. Induced employment, generated by associated household spending in the economy, created around 345,500 more jobs, bringing the approximate total of indirect and induced employment to 621,100. The largest share of these jobs was in the Bay Area, followed by Los Angeles, San Diego, and Orange Counties. The average life sciences salary in 2018 was around $123,000, increasing from $119,000 the previous year.

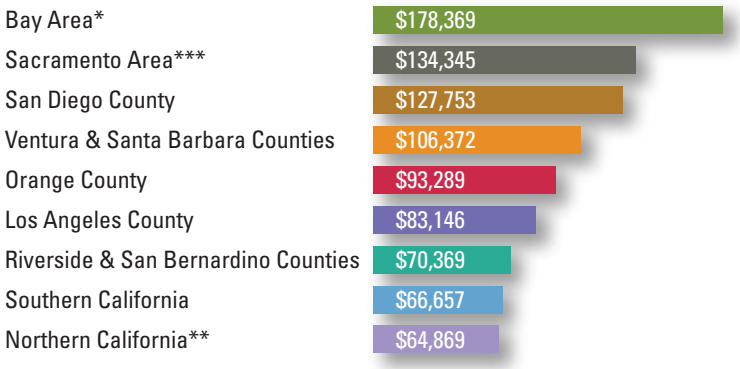
Life Sciences Employment vs. Other Tech Sectors

in California, 2018



Average Annual Life Sciences Salary by Cluster

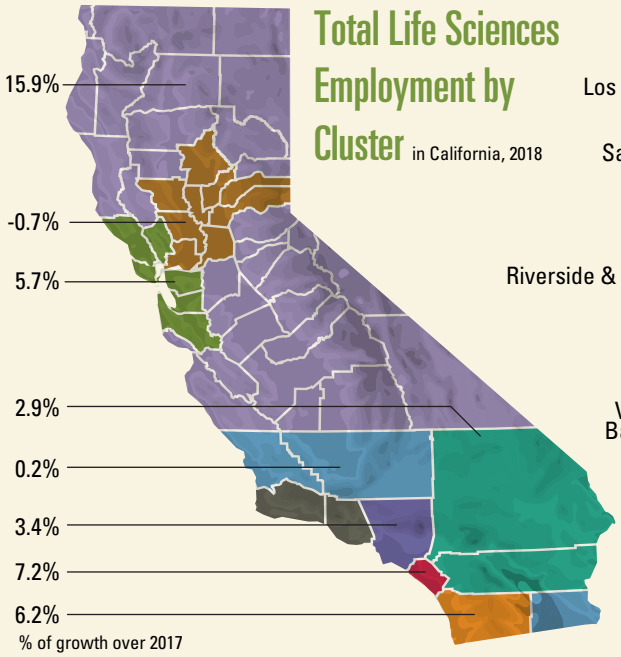
in California, 2018

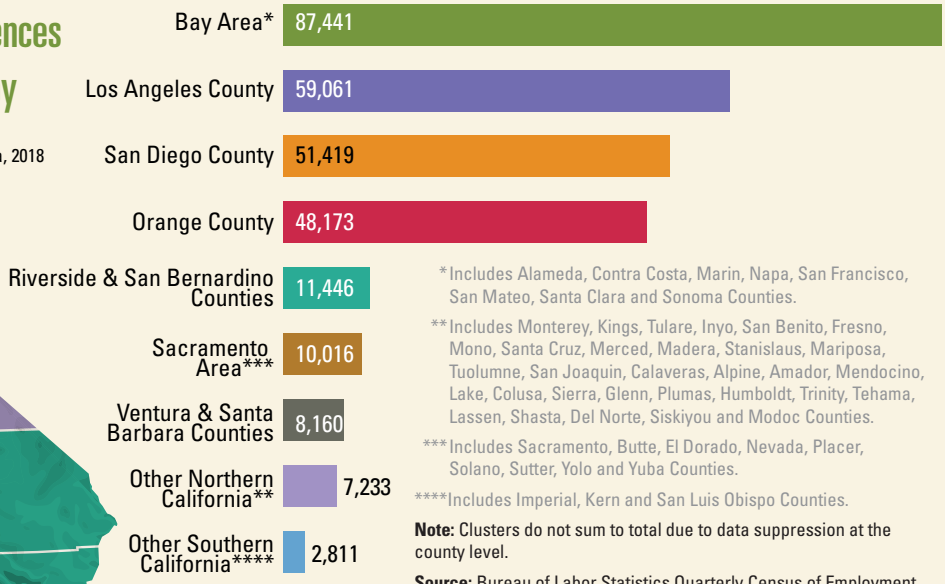


Source: Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages; PwC analysis based on 2012 Economic Census.

Total Life Sciences Employment by Cluster

in California, 2018





*Includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara and Sonoma Counties.

**Includes Monterey, Kings, Tulare, Inyo, San Benito, Fresno, Mono, Santa Cruz, Merced, Madera, Stanislaus, Mariposa, Tuolumne, San Joaquin, Calaveras, Alpine, Amador, Mendocino, Lake, Colusa, Sierra, Glenn, Plumas, Humboldt, Trinity, Tehama, Lassen, Shasta, Del Norte, Siskiyou and Modoc Counties.

***Includes Sacramento, Butte, El Dorado, Nevada, Placer, Solano, Sutter, Yolo and Yuba Counties.

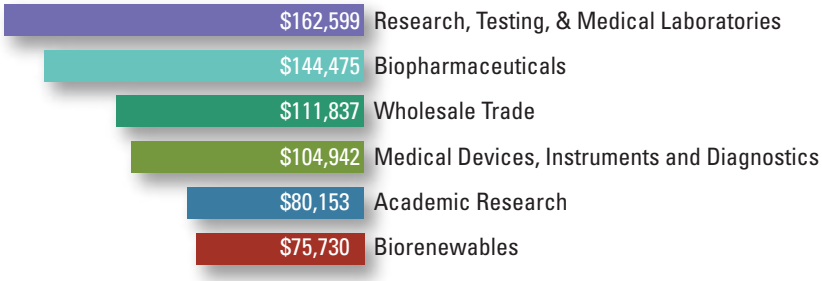
****Includes Imperial, Kern and San Luis Obispo Counties.

Note: Clusters do not sum to total due to data suppression at the county level.

Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages; 2012 Economic Census.

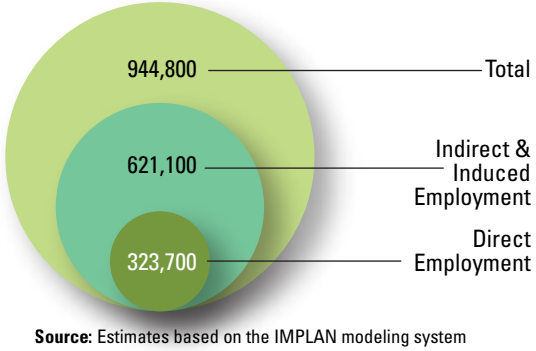
Life Sciences Average Salary by Sector

in California, 2018



Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages; PwC analysis based on 2012 Economic Census.

Total Direct, Indirect and Induced Jobs



Source: Estimates based on the IMPLAN modeling system

Attracting Venture Capital Investment

California has long been a magnet for investment due to our companies' strong record of translating science into products that help patients, farmers, consumers, and many others. However, in 2019, the financial and investment picture for the sector changed slightly, perhaps due to the increasing policy pressure of national and state initiatives that have a chilling effect on investment.

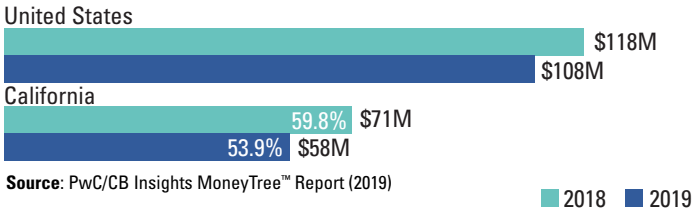
In positive news, initial public offerings (IPOs) remained steady. There were 23 in 2019* and 24 in 2018. Additionally, the dollar value for these deals increased from $2.5 billion to $3.4 billion.

Conversely, mergers and acquisitions went down. There were 79 deals (for which terms were announced) in 2019* valued at $18.7 billion. By contrast, in 2018, there were 136 transactions valued at $35.5 billion.

While most indicators show the sector is healthy, there are early concerns that investment may be wavering. Venture companies invested more than $6.5 billion in California life sciences companies in 2019, down from $8.9 billion in 2018, and $7.6 billion in 2017. This is particularly important for innovative startups that rely on these funds for survival.

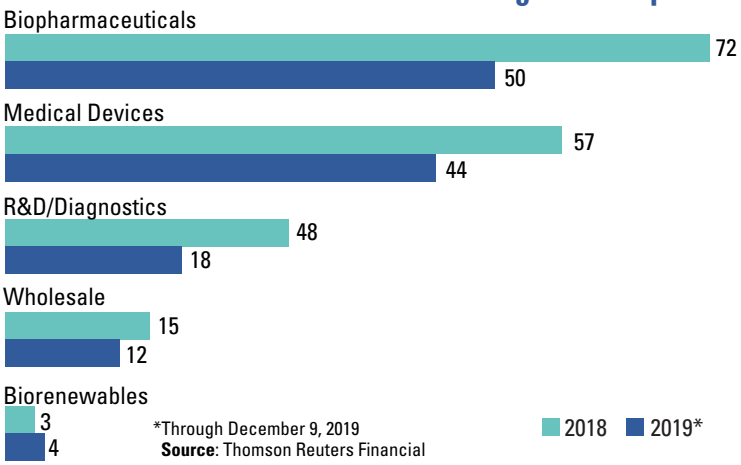
**Through December 9, 2019.*

Total US Venture Capital Investment in California



Source: PwC/CB Insights MoneyTree™ Report (2019)

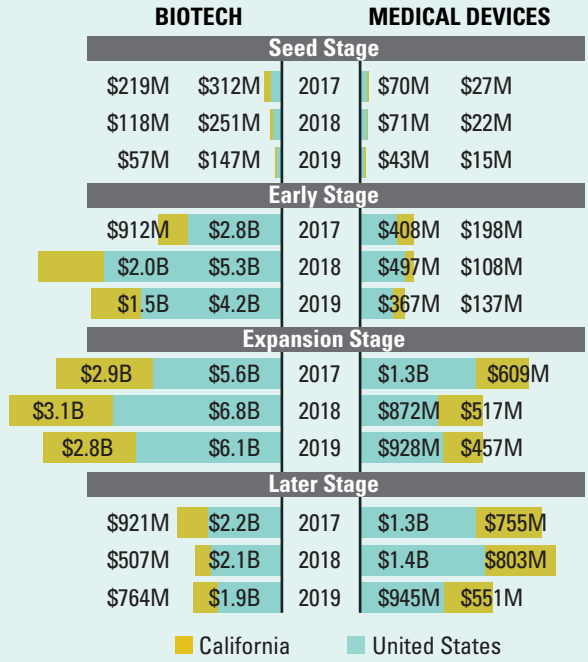
Number of California Life Sciences Mergers & Acquisitions



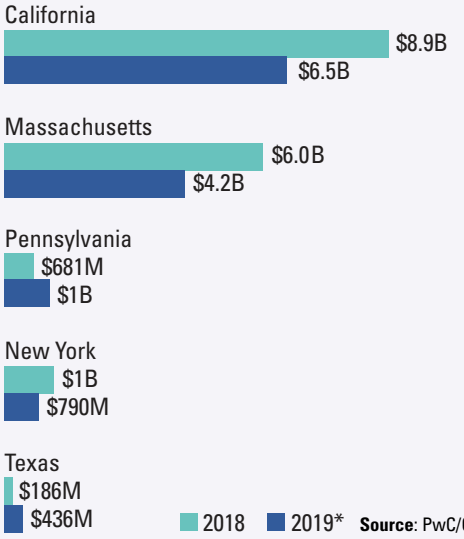
*Through December 9, 2019
Source: Thomson Reuters Financial

VC Investment, Biotech & Medical Devices

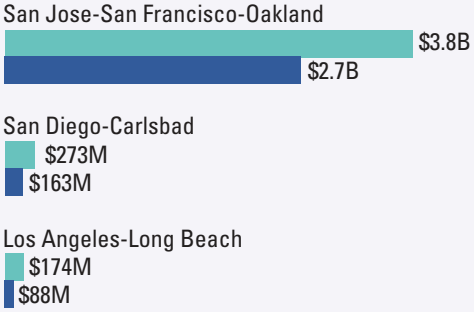
by stage, U.S. and California 2017–2019



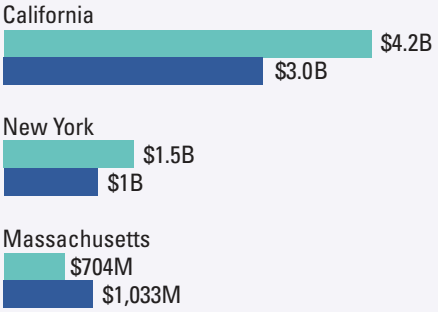
Top 5 States for Life Sciences VC Investments



California Digital Health VC Investment by Metro Region



Top 5 States for Digital Health VC Funding



Source: PwC/CB Insights MoneyTree™ Report (2019)

Academic Support & Science Funding

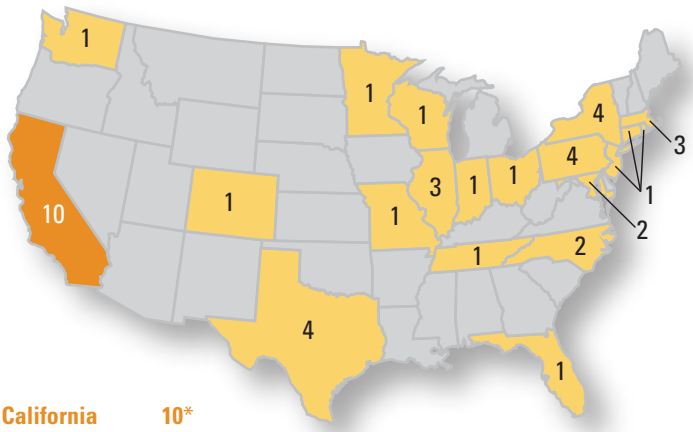
California's world-class university system has helped make the state a global nexus for life sciences innovation. The state's universities and research institutes generate new ideas that could become next generation therapies. In turn, entrepreneurs and scientists develop these ideas into therapeutic targets and move them through the regulatory approval process –with financing from the venture community and partnerships with larger companies.

In 2019, California had 10 universities in the World Top 100 (Shanghai Index). Three other states rank second in the U.S. with four. Additionally, in 2019,* California universities and research institutions brought in nearly $4.5 billion from the National Institutes of Health (NIH), 15.4% of all NIH biomedical research grants. This compares to $3.9 billion in 2018.

Start-up companies in the state also received over $218 million in Smart Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding.

Number of Universities in the World Top 100

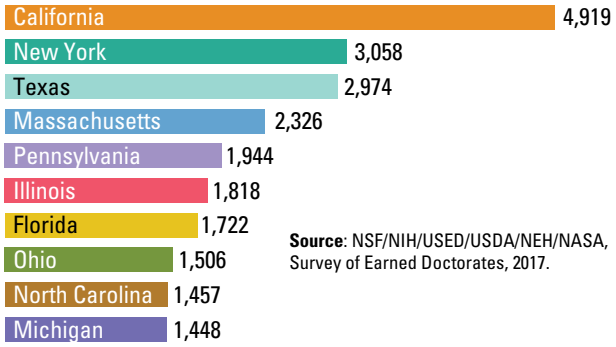
Shanghai Index, 2019 Rankings



California	**10***						
New York	4	Maryland	2	Indiana	1	Rhode Island	1
Pennsylvania	4	North Carolina	2	Minnesota	1	Tennessee	1
Texas	4	Colorado	1	Missouri	1	Washington	1
Illinois	3	Connecticut	1	New Jersey	1	Wisconsin	1
Massachusetts	3	Florida	1	Ohio	1		

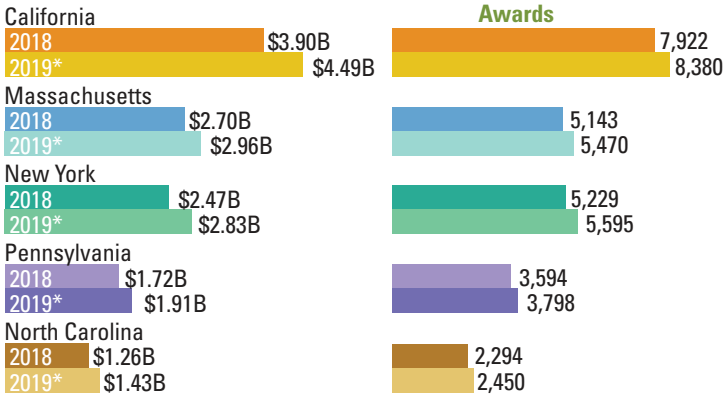
*Stanford University, UC Berkeley, California Institute of Technology, UCLA, UC San Diego, UC San Francisco, UC Santa Barbara, USC, UC Irvine and UC Davis.
Source: Academic Ranking of World Universities (ARWU) 2019, Shanghai Ranking Consultancy.

Top 10 States with Doctoral Recipients in Sciences & Engineering

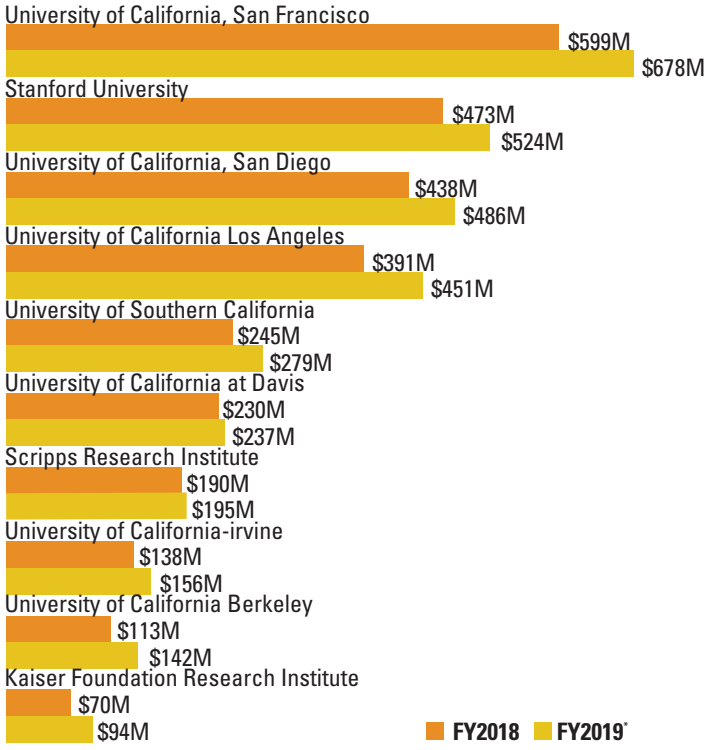


Source: NSF/NIH/USED/USDA/NEH/NASA, Survey of Earned Doctorates, 2017.

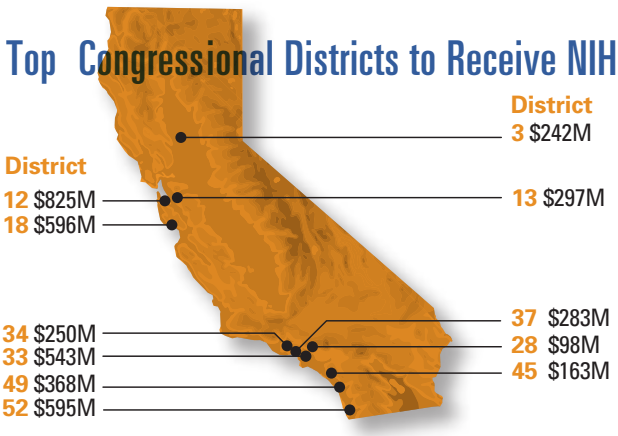
Top Five States Receiving NIH Grants

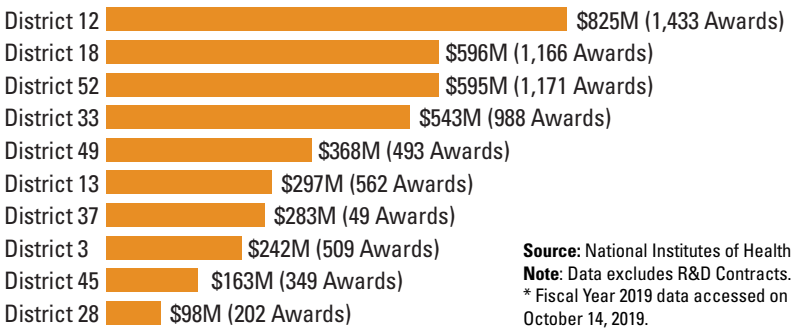


Top 10 California Organizations Receiving NIH Funding



Top Congressional Districts to Receive NIH Funding





Source: National Institutes of Health
Note: Data excludes R&D Contracts.
* Fiscal Year 2019 data accessed on October 14, 2019.

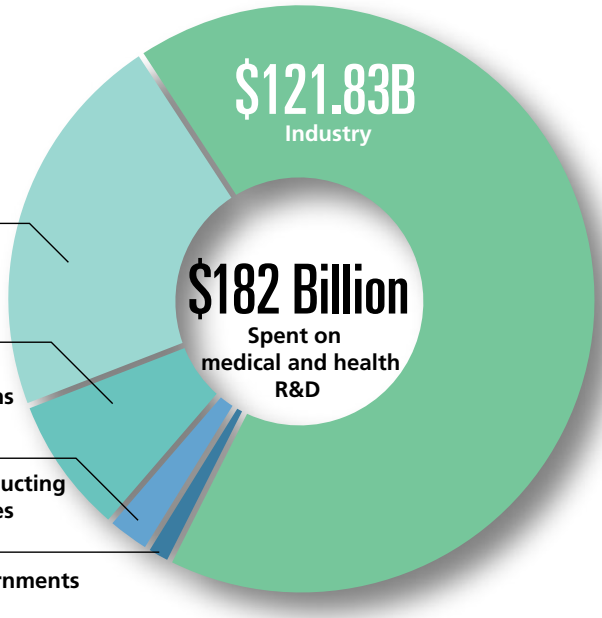
Who Funds Medical and Health R&D?

Investment in R&D is a good way to enable our nation to prepare a response to health threats. New therapies do not come cheap. To go from concept to reality takes years of basic, clinical and translational science and research, all of which requires major financial investment, particularly from the private sector. Investments from private industry, VC, and the government are vital sources of funding to develop innovative therapies for patients in need of hope. This infographic outlines the various sources of funding for medical and health R&D, which collectively make California the world leader in life sciences innovation.

Total investment in medical and health R&D in the U.S. has been on the rise in recent years, reaching $182.3B in 2017. Private funding from the biomedical sector remains the largest contributor to that investment, accounting for two-thirds (67%) of total R&D spending in 2017. The federal government's share is 22%, representing nearly a quarter of all funding.

Total US R&D Investment

by Source 2017 (est.)



Did You Know?

While funding from federal research agencies like the NIH is critical to the process of developing new therapies, the life sciences industry contributes the overwhelming majority of financial contributions.

R&D Investment by Sector (2017)

Industry Investment Breakdown

- **$97.00B** Biopharmaceutical
- **$16.16B** Medical Technology
- **$7.83B** Other Sectors' Biomedical R&D
- **$0.837B** Healthcare Service

Federal Investment Breakdown

- **$32.42B** NIH (82.1% of total federal investment)
  - **$3.85B CA NIH Grants** (12% of total 2017 NIH investment)
- **$7.09B** Non-NIH Federal Agencies

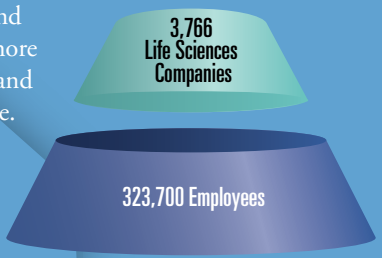
Total US VC Investment by Sector (2018)

- **$17.1B** Biotechnology
- **$3.4B** Medical Technology
- **$9.1B** Digital Health (Total US VC Life Sciences Investment)

California Spotlight

Patients around the world benefit from innovative research coming out of California. The Golden State is a hotbed of biomedical innovation, with more than 3,700 life sciences companies working to advance human health, agriculture, biofuels and other areas. These companies currently have more than 1,380 medicines (and many diagnostics and devices) in the pipeline to improve patient care.

California's life sciences sector continues showing tremendous growth, and leads the nation in biomedical jobs and established companies.



California VC Investment by Sector (2018)

- **$7.1B** Biotechnology
- **$1.8B** Medical Technology
- **$4.2B** Digital Health
- **$13.1B** Total California Life Sciences VC Investment

Developing new treatments takes decades of research, billions of dollars and many attempts that ultimately fail along the way. Investors and innovators take those risks because they recognize the critical need for and value of new life-saving therapies and technologies and hope their efforts will likely ultimately pay off. Let's protect entrepreneurship and bold biomedical innovation in California.

Sources: Research!America, California Life Sciences Association (CLSA), NIH and CLSA Research. Data as of July 2019.

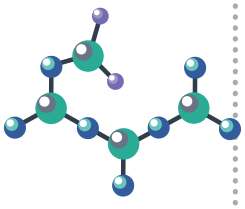
California: Clinical Trials Spotlight

Participation in clinical trials has demonstrable effects on improved outcomes - they show us what works (and what doesn't) in medicine. While fewer than 1 in 20 adult cancer patients in the U.S. have participated in a clinical trial, 60% of childhood cancer patients have participated. This is one key reason that survival rates for childhood cancer have increased so dramatically in the last few decades. Advances in medicine are made possible due in large part to the people who volunteer as participants in clinical trials, and the researchers and clinicians who run them! With around 25% of all active clinical trials in the U.S. having a site in California, people in the Golden State are making an extraordinary contribution to advancing human health.

Facts About Clinical Trials

About 50% of clinical trials in California are funded solely by life sciences companies.

Clinical trials in California are generating a large amount of data critical for advancing research in the most challenging diseases.



- **Over 25%** of cancer clinical trials in the U.S. have a trial site in California
- **1/3 of rare disease** clinical trials in the U.S. have a trial site in California
- **1/3 of HIV** clinical trials in the U.S. have a trial site in California

8,500+ clinical trials being conducted in California

Clinical research conducted in California is investigating therapies on important gender-and age-specific populations, helping to increase diversity and inclusion in medical discovery.

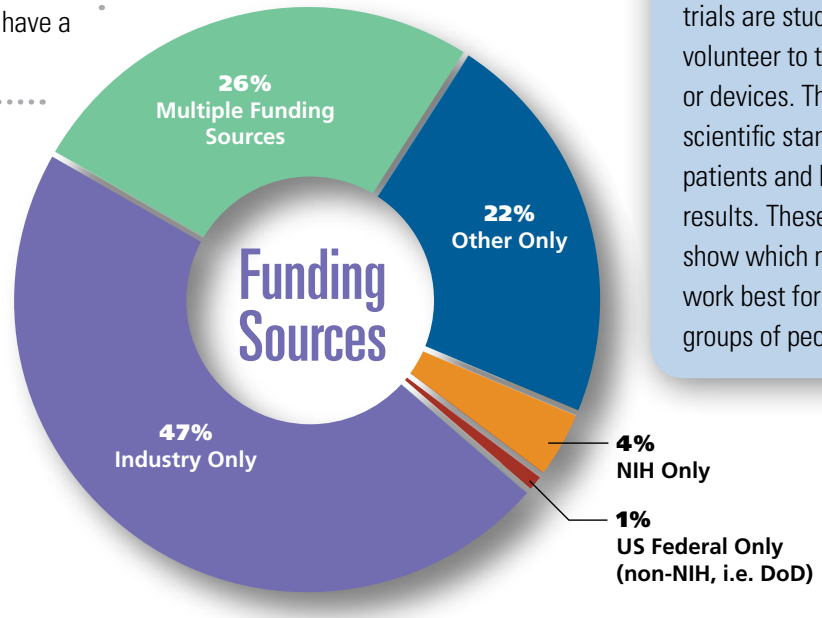
- **6.28%** of clinical trials in California are focused on pediatric populations, a rate higher than the national average
- **8.08%** of trials in California involve women only, and 4.64% of all trials in California involve men only

What are Clinical Trials?

Life sciences companies spend many years, and billions of dollars, developing a single new medicine. But before being used to help patients around the world, new therapies must be tested for safety and efficacy. Clinical trials are studies in which people volunteer to test new drugs or devices. They follow strict, scientific standards which protect patients and help produce reliable results. These studies may also show which medical approaches work best for certain illnesses or groups of people.

Clinical Trials Funding Sources

Almost half of all clinical trials in California are funded solely by life sciences companies. Over 25% of trials in California receive funding from some combination of industry, NIH, non-NIH U.S. Federal agencies and some combinations of multiple other sources. More than 68% of clinical trials in California receiving funding from the NIH also receive funding from additional non-industry sources.



Multiples Funding Sources denotes some combination of Industry, NIH, non-NIH U.S. Federal agencies, and some combinations of multiple other sources.

Patients in California are fortunate to live in a state that's home to nearly one quarter of all North American clinical trials. Public and private financial support for clinical research are all critical to supporting and expanding the number and reach of clinical trials in California, however, private industry is still the single largest funder of clinical trials in the Golden State and across the U.S. Let's protect this ecosystem of bold biomedical innovation, so that patients can continue to benefit from the clinical trials and R&D coming out of California.

Sources: ClinicalTrials.gov, NIH and CLSA Staff Research. Data as of July 2019.

Looking Forward

The California life sciences ecosystem continued to thrive in 2019. However, reduced venture capital investment raises a clear warning sign. This may only be a brief blip, a down year in an otherwise strong trend. However, we will continue to watch closely, particularly in light of the COVID-19 pandemic and the corresponding economic downturn.

Overall, the industry's fundamentals remain strong. NIH grant revenue continued to rise, as did the number of PhDs produced by California universities. Life sciences employment was also strong. Factoring indirect and induced employment, the figure is now approaching 1 million Californians.

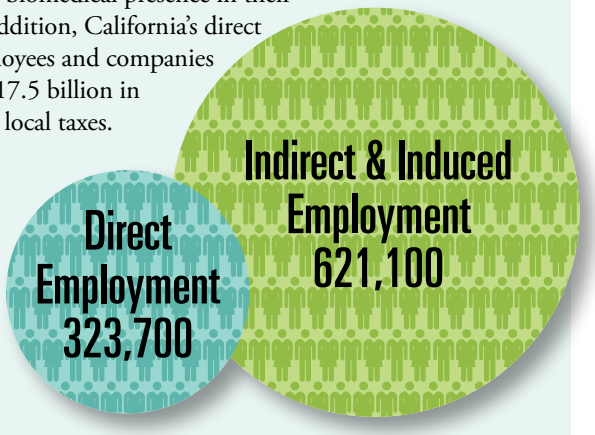
For decades, the industry has been an engine for innovation, producing medicines, devices and diagnostics that help people around the world. This footprint has expanded to support agriculture, renewable energy and other areas, with the fundamentals of biotechnology being applied to a broader segment of the economy and increased application of technology to the fields of medicine and diagnostics.

Ultimately, California continues this success by continuing the sound practices that got us here: strong investment in education; thoughtful public policy; and an environment that supports taking risks to produce tremendous benefits. These are the ideals that power the life sciences ecosystem, and we look forward to continuing them for decades to come.

Ripple Effect

The life sciences industry footprint extends well beyond the institutions conducting innovative research and the businesses commercializing new products. Dozens of related industries generate jobs and expansive economic activity throughout California. While the sector directly employs more than 323,700, there are an additional 621,100+ Californians whose jobs are connected to the life sciences enterprise. These are computer programmers, construction workers, consultants, distribution trades, attorneys and many others who are supported by the biomedical presence in their community. In addition, California's direct life sciences employees and companies pay more than $17.5 billion in federal, state and local taxes.

944,800
Total Direct, Indirect & Induced Employment



About California Life Sciences Association (CLSA)

California Life Sciences Association (CLSA) is the state's largest and most influential life sciences advocacy and business leadership organization. With offices in Sacramento, San Diego, South San Francisco, Los Angeles and Washington DC, CLSA works closely with industry, government, academia and others to shape public policy, improve access to innovative technologies and grow California's life sciences economy. CLSA serves biotechnology, pharmaceutical, medical device and diagnostics companies, research universities and institutes, investors and service providers throughout the Golden State. Visit CLSA at www.califesciences.org, and follow us on Twitter @CALifeSciences, Facebook, Instagram, LinkedIn and YouTube.

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