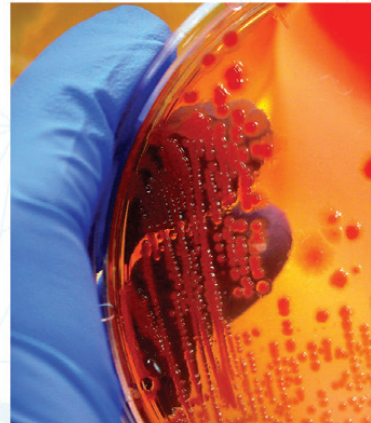
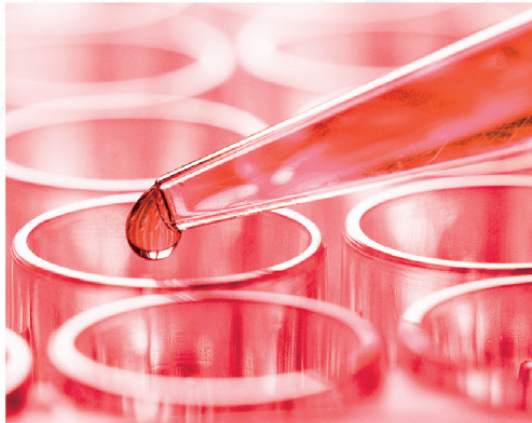


California Life Sciences Industry Report 2018





Jerry Brown
Governor of
California

Letter from the Governor

The life sciences industry is a shining example of how California is a driver in innovation. The industry, which began just 50 years ago, has made great strides to put California at the forefront of the biotech revolution—inventing new cures; dominating the nascent field of genomics; and blazing new trails in biofuels, agriculture and the microbiome.

Each year, California universities and colleges award more advanced degrees in the science, technology, engineering, arts and mathematics fields than any other state. This is the pipeline that supports the nearly 300,000 Californians working in the life sciences, and their efforts are making enormous inroads against cancer, cardiovascular disease, neurological disorders and numerous other debilitating conditions. We take enormous pride in these contributions, which help provide new medicines for billions of patients around the world.

This year, California extended until 2030 a state sales tax exemption for equipment used in manufacturing and research and development to encourage more investment in California. I also established the Governor's Advisory Committee on Precision Medicine to continue the state's efforts to promote the use of advanced computing and technology to better understand, treat, and prevent disease.

California is committed to supporting this great industry of creativity and innovation. The California Life Sciences Association is a key partner in cultivating this sector and increasing the state's efforts to foster a stronger life sciences industry and boost job growth in California. I look forward to continuing to work with leaders from the life sciences sector to find solutions that advance new medical technologies and therapies that boost our economy and contribute to a healthier society.

Sincerely,



Sara Radcliffe
President & CEO
California Life
Sciences
Association (CLSA)

Letter to Stakeholders

California's life sciences ecosystem plays many roles. First, it's a hotbed of innovation. There are more than 3,200 life sciences companies in the state trying to move the needle in human health, agriculture, biofuels and other areas. These companies have more than 1,200 medicines—and even more diagnostics and devices—in the pipeline to improve patient care.

The industry is also an economic engine. Direct, indirect and induced employment exceeds 900,000. The average life sciences salary is \$113,000 a year. In 2016, the sector's revenue exceeded \$169 billion and exports topped \$22 billion. Life sciences companies paid more than \$17 billion in federal, California state and local taxes.

In addition, the state attracted more than \$6.6 billion in life sciences venture capital investment in 2017. The next closest state, Massachusetts, drew less than half that amount.

California succeeds because it offers a well-educated workforce, committed investors and entrepreneurs and sound public policy that supports industry growth. And while the life sciences ecosystem continues to flourish in the Golden State, we should always be cautious. We worked hard to get here and must continue that focus to remain.

Sincerely,



Peter Claude
Partner
Pharmaceutical
& Life Sciences
Advisory
PwC

Life Sciences Success

California hosts a complex infrastructure that produces life-changing medicines, devices and diagnostics, improves crops and may soon help provide sustainable energy. The 3,249 life sciences companies throughout the state are leading these efforts, 209 more than last year. This number includes 1,453 biotechnology and pharmaceutical companies, as well as 1,796 device and medical equipment manufacturers.

These enterprises have an enormous impact on human health. As of September 21, 2017, California companies had 1,274 medicines in

the pipeline to treat cancer, infectious diseases, immune issues, central nervous system disorders and many other conditions. In addition, California companies received approval for 440 medical devices in 2016.

In recent years, the life sciences have helped reshape the state's economic landscape. The industry earned revenue of \$169 billion in 2016 and directly employed more than 298,000 Californians. The life sciences are second only to computer technologies in employment among high-tech industries.

California Life Sciences Industry

2016 (estimated)

Total Estimated Revenue	\$169.0 billion
Total Estimated Life Sciences Employment.....	298,709
Total Estimated Wages	\$34.0 billion
Average Annual Life Sciences Industry Wage	\$113,674
Total NIH Grants Awarded, FY2017	\$3.8 billion
Total Estimated Venture Capital Investments, 2017	\$6.7 billion
Total Biomedical Exports	\$22.7 billion
Direct Federal Taxes.....	\$11.5 billion
Direct State and Local Taxes	\$5.8 billion
Number of Life Sciences Companies	3,249

298,709

Direct
Employment

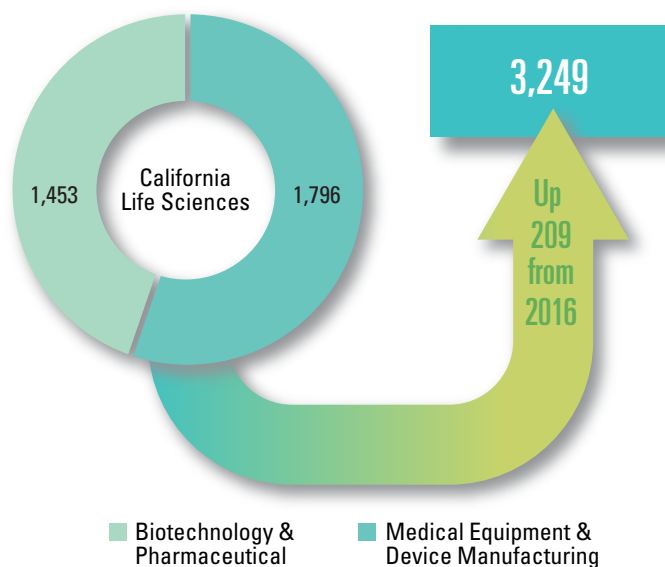
621,000

Indirect & Induced
Employment

919,700

Total Direct, Indirect and Induced Jobs

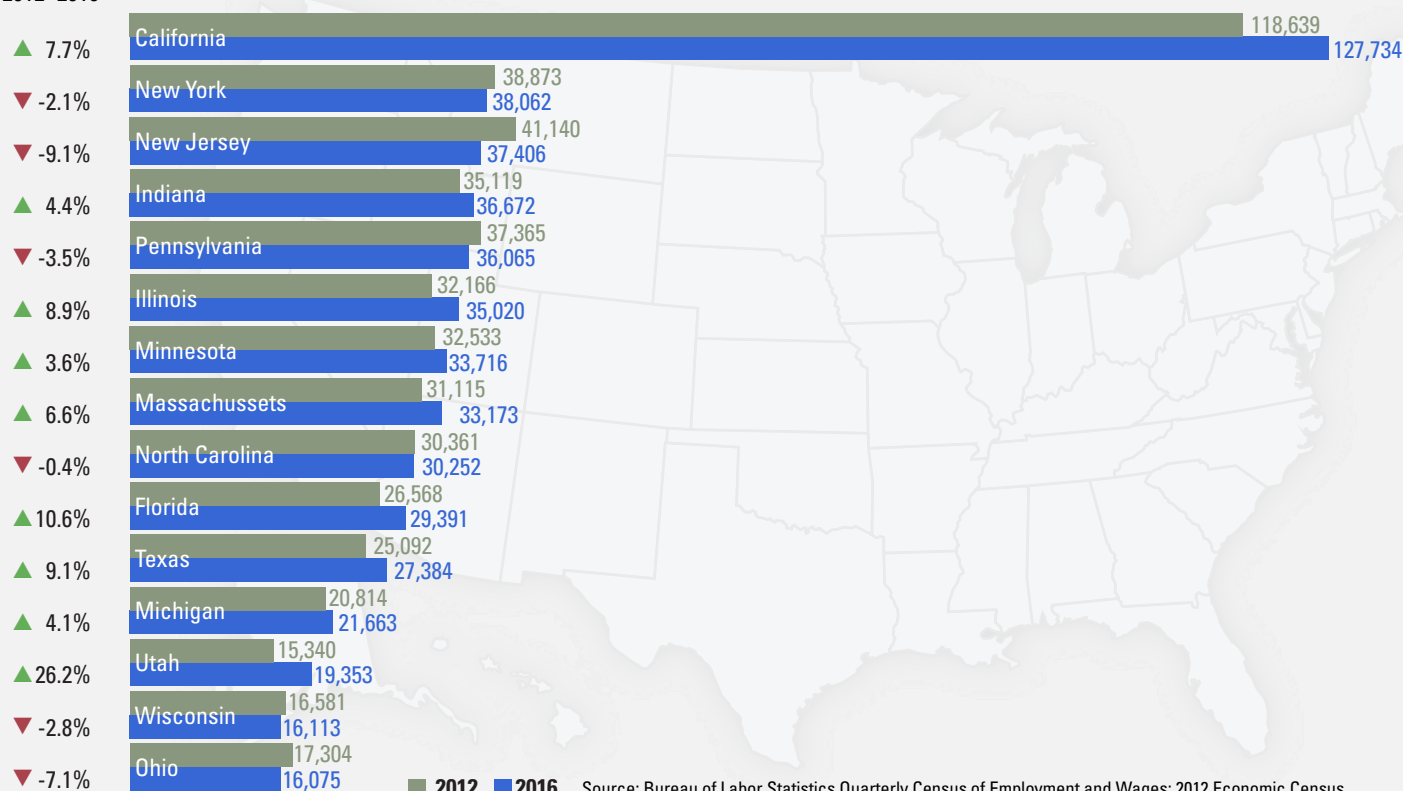
Number of Life Sciences Companies in California



Source: Bloomberg

Growth
2012–2016

Growth in Biopharmaceutical and Medical Device Employees by State, 2012–2016



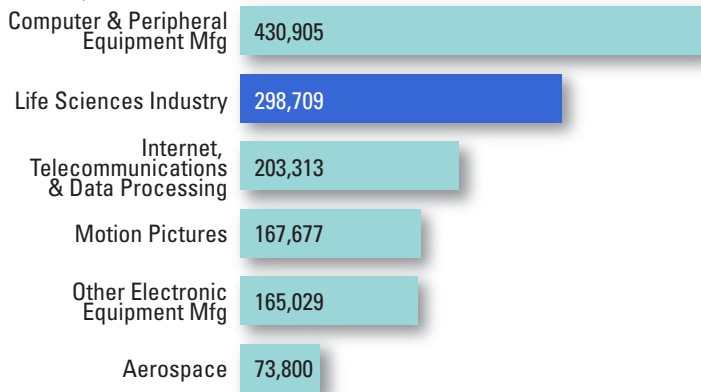
Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages; 2012 Economic Census.

An Economic Strength

The life sciences industry provides major contributions to the state's economy. With revenues approaching \$170 billion, California life sciences companies were responsible for \$22.7 billion in exports and paid \$17.3 billion in federal, California state and local taxes. In 2016, California companies directly employed 289,709 people, second only to computer technologies among high-tech industries. In addition, indirect and induced employment increased that total to 919,700.

Life Sciences Employment vs. Other High-Tech Sectors

in California, 2016



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

Direct employment increased by 3.6 percent across the state, anchored by San Diego, a region that saw 12.5 percent growth in biopharmaceutical employment, 21.9 percent growth in medical devices, and 10 percent growth in R&D employment (*see San Diego insert*). Statewide, there was also significant growth in biorenewables, R&D and biopharma. Average wages are strong, over \$113,000 per year, but declined slightly from the previous year.

California Life Sciences Wages by Sector

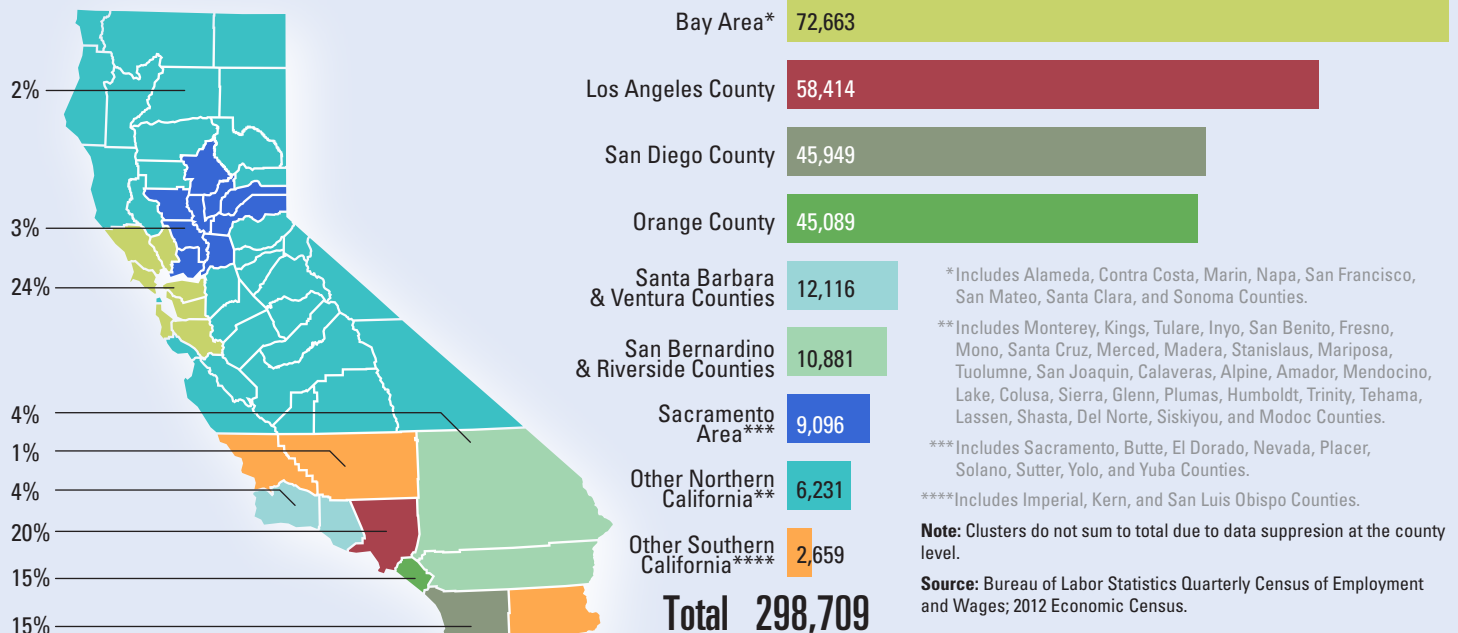
in California, 2016

	Average Wage	Total Wages
Academic Research	\$73,007	\$3.1B
Biopharmaceuticals	\$152,703	\$7.7B
Biorenewables	\$72,696	\$278M
Medical Devices, Instruments and Diagnostics	\$94,528	\$7.3B
Research & Development and Testing Laboratories	\$140,574	\$10.5B
Wholesale Trade	\$101,261	\$5.1B
Total	\$113,674	\$34.0B

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

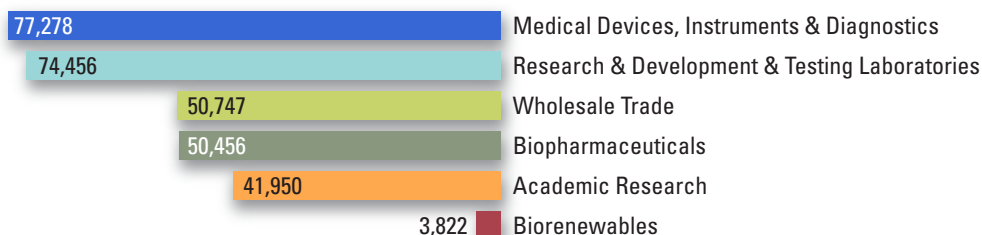
Total Life Sciences Employment by Cluster

in California, 2016

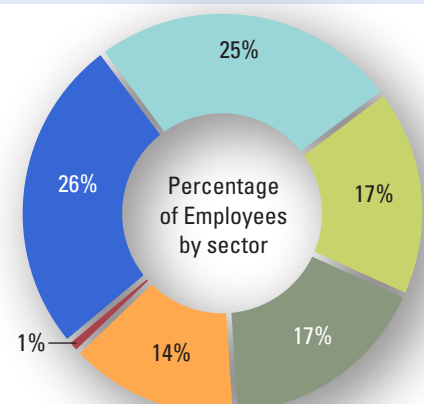


Total Life Sciences Employees by Sector

in California, 2016



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

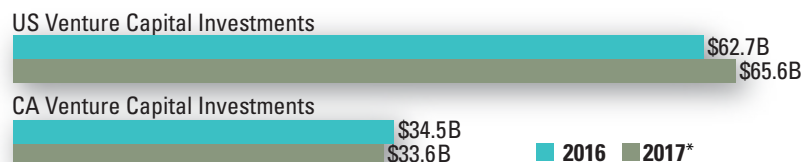


Investing in California

In 2017, California biotechnology and medical device companies are expected to attract more than \$6.6 billion in venture capital (VC) investment, a dramatic increase over 2016. These figures make up 53.2 percent of the nation's entire VC life sciences investment.

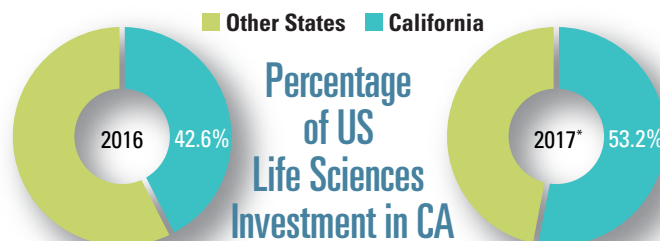
In addition, California led the nation in digital health VC funding for 2017* with \$2.3 billion. Top sectors were diagnostics, devices and therapies, consumer health and wellness and care management.

Total US VC Investment to CA**



M&A activity was strong in biopharmaceuticals and medical devices. As of September 7, 2017, there were 23 biopharma deals and 21 medical device deals for which terms were announced. Overall M&A activity in all sectors was slightly lower. IPOs were also down, with three as of September 7, compared to six for all of 2016.

*2017 data based on projection from the first two quarters



2017 California Digital Health VC Investment by Category



¹Includes the Consumer health information, Enterprise wellness, Healthcare consumer engagement, and Personal health tools and tracking categories.

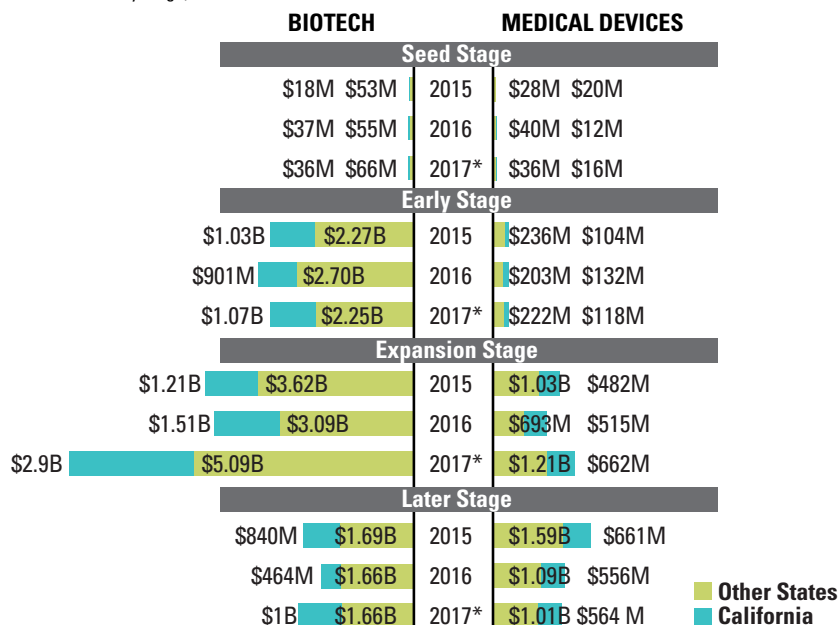
²Includes the Care coordination, General care management, Hospital administration, Physician practice management, Population health management, Hospital CRM and marketing, and EHR/Clinical workflow categories.

³Includes the Life sciences commercialization tools and the Life sciences R&D tools categories.

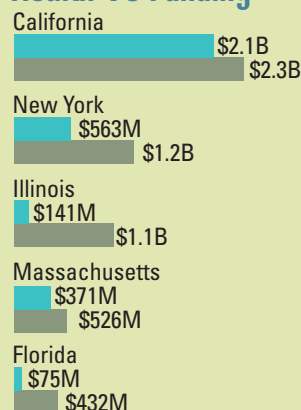
Source: Rock Health Digital Health Funding Database.

Venture Capital Investment, Biotech & Medical Devices

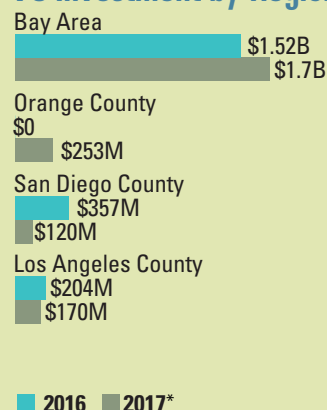
by stage, U.S. and California 2015 - 2017*



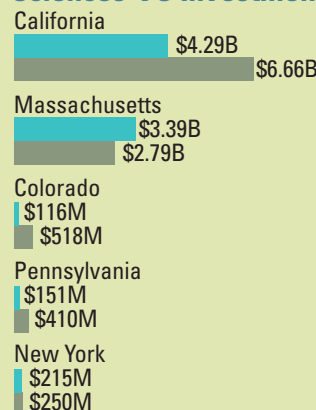
Top 5 States for Digital Health VC Funding



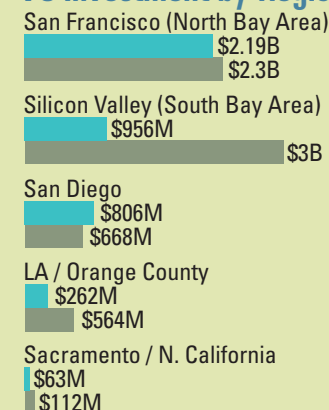
California Digital Health VC Investment by Region



Top 5 States for Life Sciences VC Investments



California Life Sciences VC Investment by Region**



*2017 data based on projection from the first two quarters.

**Source: PwC/CB Insights MoneyTree™ Report. Note: The LA and Orange County region is comprised of Southern California (excluding the San Diego region); the Sacramento/Northern California region is comprised of Sacramento and north of Marin County (excluding San Francisco and Silicon Valley regions); the San Diego Region is comprised of the San Diego area; the Silicon Valley (South Bay) Area is comprised of Bay Area cities south of Highway 92, extending east to the Nevada border and south to include Fresno County; and the San Francisco (North Bay) Area is comprised of Bay Area cities north of Highway 92, extending up the northern coast to the Oregon border along the Hwy 101 corridor, including some counties not adjacent to the coast.

Basic Research Excellence

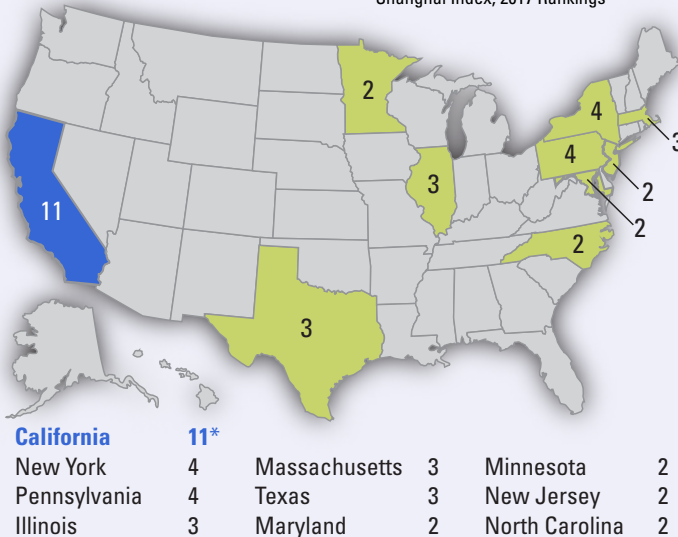
Academic excellence drives California's life sciences ecosystem. The state's universities and independent institutions produce world-class research that generates new companies, commercialized technologies and improved care.

In 2015, California graduated more than 4,800 science and engineering PhDs. The state boasts 11 institutions in the Shanghai Index of the world's 100 top universities.

In addition, in federal fiscal year 2017, California's research infrastructure attracted \$3.8 billion in research grants from the National Institutes of Health (NIH), \$203 million in Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding and \$330 million from the California Institute for Regenerative Medicine. These funders, particularly the NIH, play an enormous role in supporting innovation.

Number of Universities in the World Top 100

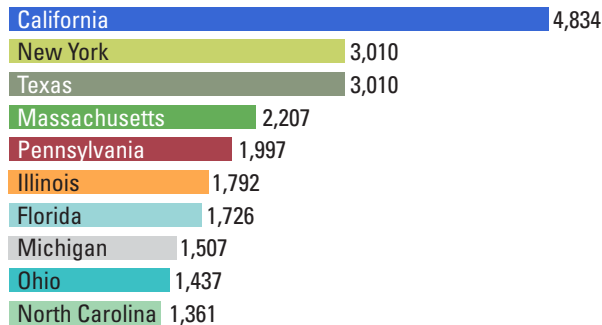
Shanghai Index, 2017 Rankings



*Stanford University, UC Berkeley, California Institute of Technology, UCLA, UC San Diego, UC San Francisco, UC Santa Barbara, USC, UC Irvine, UC Davis and UC Santa Cruz

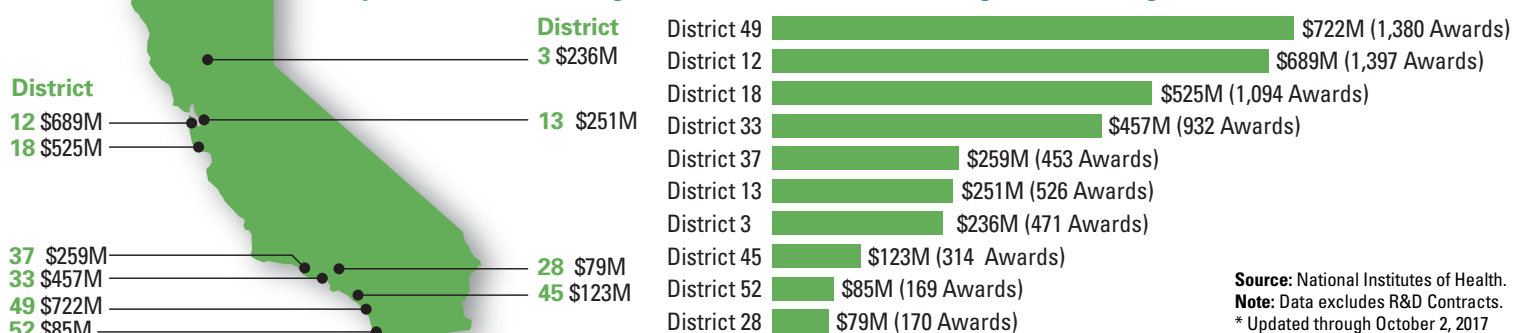
Source: Academic Ranking of World Universities

Top 10 States with Doctoral Recipients in Sciences and Engineering, 2015



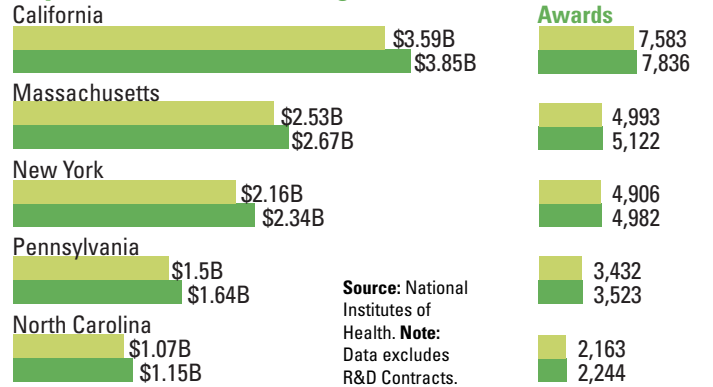
Source: NSF/NIH/USED/USDA/NEH/NASA, Survey of Earned Doctorates, 2015.

Top 10 California Congressional Districts Receiving NIH Funding



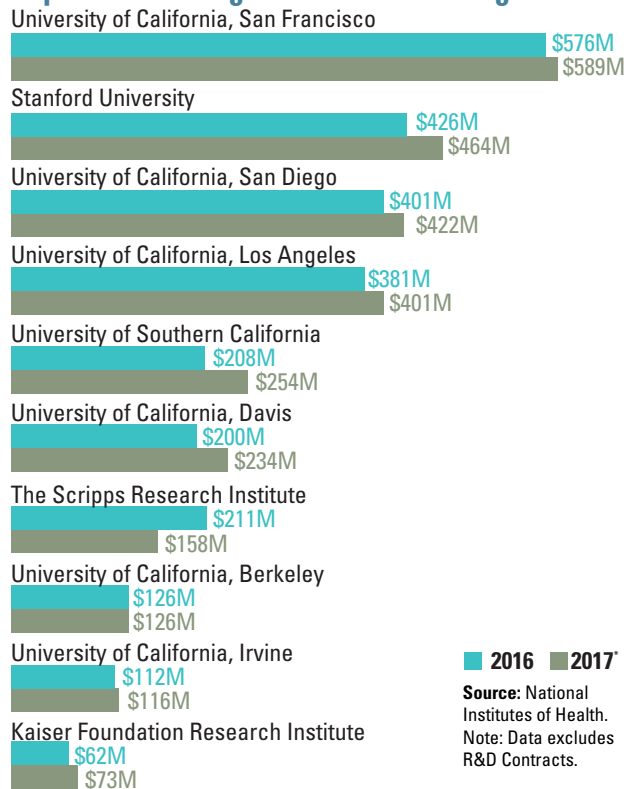
Source: National Institutes of Health.
Note: Data excludes R&D Contracts.
* Updated through October 2, 2017

Top Five States Receiving NIH Grants



Source: National Institutes of Health. Note: Data excludes R&D Contracts.

Top California Organizations Receiving NIH Funding



Source: National Institutes of Health.
Note: Data excludes R&D Contracts.

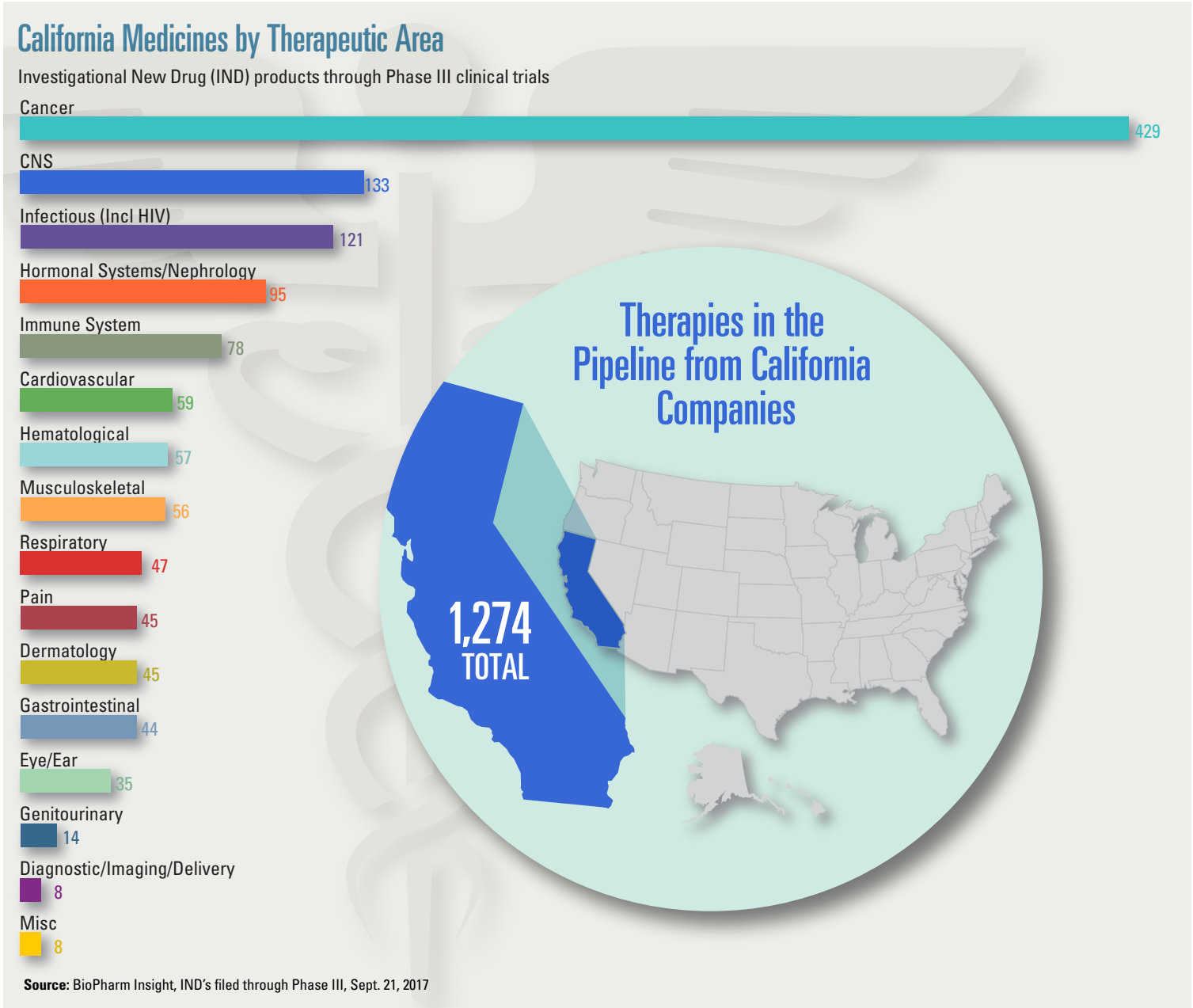
A Strong Therapeutic Pipeline

California's life sciences community is laser-focused on finding new therapies and technologies for patients everywhere. The state's robust academic infrastructure and investment community continue to drive a strong therapeutic pipeline.

As of September 21, California companies had filed applications for 1,274 new therapies. The most active area was cancer, which had 429 applications, up 25 from 2016. There were also major entries to combat infectious diseases, central nervous system disorders and immune conditions.

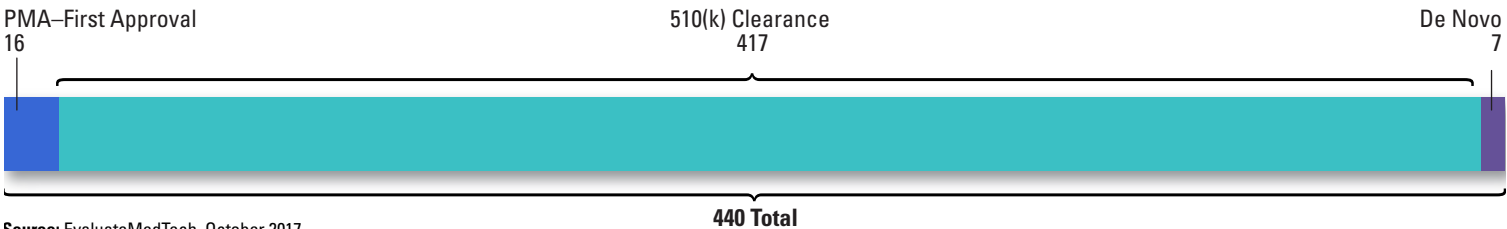
In addition, California device companies moved 440 products through regulatory approval, a significant increase of 176 over the previous year. Of these, 16 received FDA pre-market approval, the most rigorous standard for medical devices.

Collectively, these contributions have great potential to provide new hope for patients and provide solutions for some of the world's most profound unmet medical needs.



Medical Device Approvals

By companies headquartered in California, 2016



Collaborative San Diego

Life sciences people in San Diego still speak fondly of Hybritech, the city's first biotech. The company went public in 1981 and was purchased by Eli Lilly in 1986. By some estimates, more than 50 companies grew out of Hybritech, including Idec, Ligand and Amylin.

The company epitomized the San Diego biomedical community's approach: take a sound idea from academic research and advance it to the clinic. Sell and repeat.

"We have a long history of biotech, starting with Hybritech," says Lesley Stolz, Ph.D., who heads JLABS, Johnson & Johnson Innovation's incubator division, in California. "Which means we have experienced entrepreneurs and founders that all come together to form a vibrant ecosystem."

The results have been impressive. In 2016, nearly 46,000 San Diegans worked in the life sciences. The county had a 21.9 percent growth in medical device employment and 12.5 percent growth in biopharmaceutical employment from the previous year.

In addition, San Diego research institutions received more than \$800 million in NIH grants, while the region's companies received \$668 in venture capital investment.

San Diego offers many ingredients that contribute to life sciences success, such as top basic research institutions which have produced a critical mass of experienced entrepreneurs and researchers, committed investors and seasoned leaders.

These are the elements that brought Keith Murphy to San Diego to build 3-D tissue printing company, Organovo.

"We started in San Diego because it was a known biotech hub, and because we'd have access to the talent we needed," says Murphy. "What makes San Diego hum is the close-knit nature of the biosciences community. Coming to San Diego from LA, I had free access to mentorship from all kinds of folks in the community, successful entrepreneurs always willing to help."

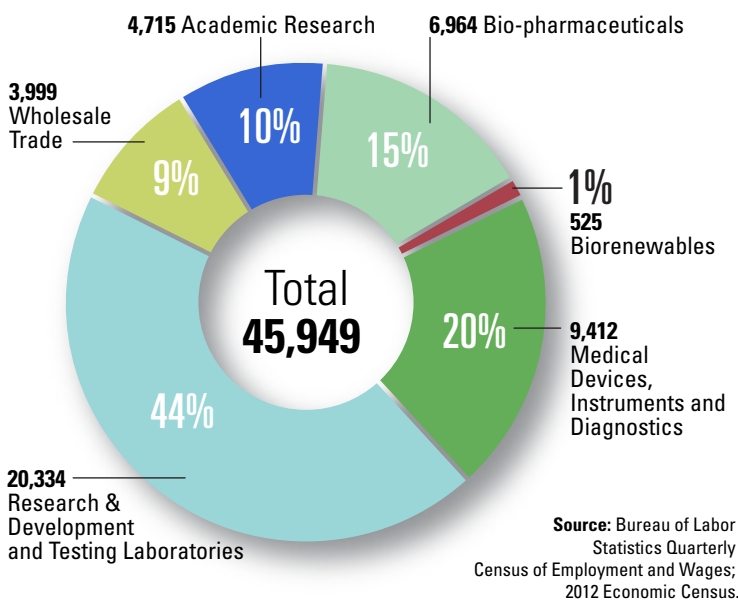
San Diego's rich startup culture is another factor, attracting scientists, investors and ideas. One of many incubators, JLABS San Diego has nurtured companies that have attracted more than \$1 billion in funding.

The community thrives on serial entrepreneurship. Murphy stepped down as CEO of Organovo last year and started a new company, Viscient Biosciences, which is focused on liver disease. His R&D leadership formerly worked for Ardea Biosciences.

It's this recycling of talent, along with new players from academic research and incubators, that constantly refreshes the San Diego ecosystem.

"San Diego is the capital of two guys/gals with a molecule companies," says Stoltz. "And since it's such a desirable place to live, company founders tend not to leave when they are acquired or scaled. They stay in the area to form their next innovative company."

Total San Diego Life Sciences Employment



\$115,555 San Diego Average Life Sciences Wages

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

Top 5 San Diego Organizations Receiving NIH Funding

University of California, San Diego	\$422.5M	Awards 881
The Scripps Research Institute	\$158.3M	252
Sanford Burnham Prebys Medical Discovery Institute	\$62.2M	110
Salk Institute For Biological Studies	\$49.6M	85
La Jolla Institute for Allergy and Immunology	\$27.6M	44

Total: \$720.2M

Total: 1,372

Source: National Institutes of Health. Note: Data excludes R&D Contracts. Updated through October 2, 2017

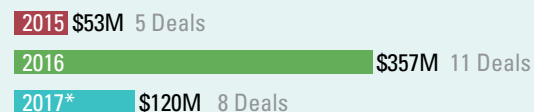
Venture Capital Investment in San Diego, 2015-2017

Life Sciences



Source: PwC/CB Insights MoneyTree™ Report

Digital health



Source: Rock Health Digital Health Funding Database. *2017 data based on projection from the first two quarters.

A Strong Ecosystem

In some ways, California's life sciences industry mimics the biological processes its scientists are trying to understand. The system is incredibly complex, with multiple converging pathways determining its success.

These pathways are not on autopilot. California succeeds because we are constantly examining each piece of the system: education, infrastructure, corporate governance, investment, government regulation and other factors.

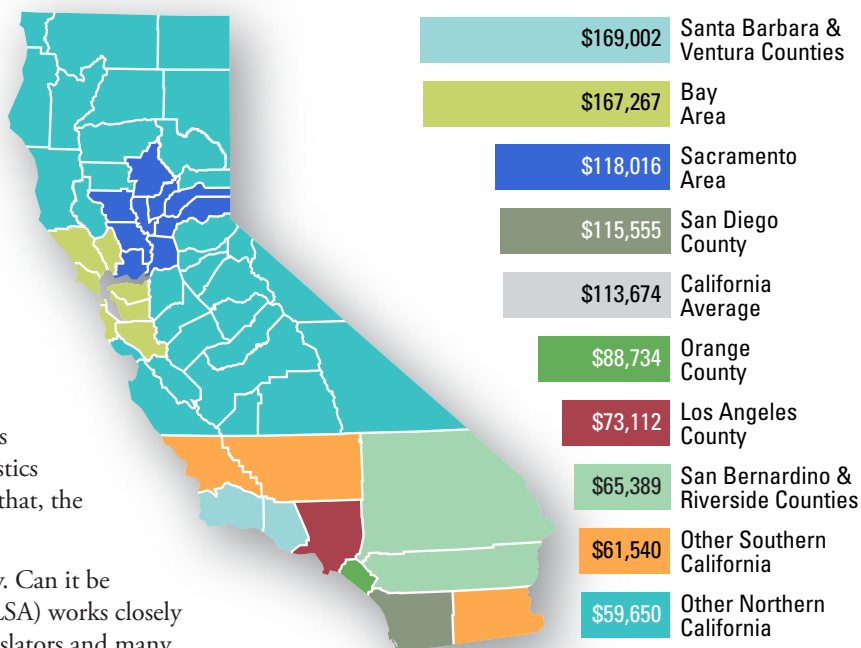
Thoughtful public policy plays a critical role, supporting a healthy business climate, improved access to diagnostic and therapeutic technologies and affordable care for all Californians.

When each aspect is working, the state's life sciences companies produce a steady stream of new medicines, devices and diagnostics to help solve a wide range of unmet medical needs. On top of that, the industry provides excellent jobs throughout the state.

Today, we can proudly say the life sciences ecosystem is healthy. Can it be improved? Absolutely. California Life Sciences Association (CLSA) works closely with industry, advocacy organizations, regulatory agencies, legislators and many others to make the system better. This spirit of collaboration is a major contributor to California's success.

Average Life Sciences Wages by Cluster

in California, 2016



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

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. CLSA was founded in 2015 when the Bay Area Bioscience Association (BayBio) and the California Healthcare Institute (CHI) merged. Visit CLSA at www.califesciences.org, and follow us on Twitter @CALifeSciences, Facebook, Instagram, LinkedIn and YouTube.

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