CHEMISTRY, ENGINEERING & MEDICINE FOR HUMAN HEALTH
LUCILE PACKARD CHILDREN'S HOSPITAL STANFORD
MATERNAL, FETAL & NEWBORN HEALTH
STEM CELL / REGENERATIVE MEDICINE
WEARABLES & MOBILE MONITORING
MUSCULOSKELETAL / ORTHOPAEDICS
DRUG DISCOVERY & DEVELOPMENT
POPULATION HEALTH SCIENCES
HEALTHCARE VALUE SCIENCE
EPIGENETICS / EPIGENOMICS
BIOMEDICAL DATA SCIENCE
ENVIRONMENTAL SCIENCES
REGIONAL CARE NETWORK
DIAGNOSTICS / IMAGING
STANFORD HOSPITAL
GENOMICS / GENETICS
BRAIN & BEHAVIOR
TRANSPLANTATION
ETHICS & POLICY
CANCER BIOLOGY
NEUROSCIENCES
METABOLONICS
MICROBIOLOGY
GLOBAL REACH
CARDIAC CARE
CANCER CARE
PROTEOMICS

LEADING
THE BIOMEDICAL
REVOLUTION IN
PRECISION
HEALTH

Stanford Medicine
IMAGINE A FUTURE when your health doesn’t depend on the diagnosis and treatment of the diseases that befall you and your loved ones. Imagine instead having the proactive capabilities, with your care provider, to identify which conditions are most likely to strike, and to prevent them altogether—keeping you healthy not just for today, but for your entire life. That’s the bold vision of Precision Health.

The next chapter of precision medicine, Precision Health will harness the power of information to understand how our genetics, our physiology, and our microbiomes (the trillions of microorganisms that reside in our bodies and help direct our biological functions) affect our health and well-being. Precision Health will place at our fingertips the tools to predict and prevent conditions ranging from cancer to heart disease to dementia to diabetes to mental illness. And, if those diseases do strike, Precision Health will search the world of biomedical information to deliver the precise treatment options most likely to work for each individual patient.

Stanford Medicine is uniquely poised to make this vision a reality. As an academic medical center, we pursue an ambitious three-part mission: to promote foundational, clinical, and translational discovery; to train the leaders of tomorrow; and to transform patient care. But we also leverage the depth and breadth of one of the world’s best collections of intellectual capital: Stanford University. Every day, our medical scientists collaborate with engineers, physicists, chemists, design experts, computer scientists, ethicists, educators, business leaders, teachers, economists, and legal scholars resident here on our campus.

These collaborations have delivered new solutions for some of medicine’s most pressing and intractable problems: diagnostics that detect diseases at their earliest, most curable stages. Chemotherapies tailored to attack specific genetic features of individual tumors. New approaches to food allergies using monoclonal antibodies. Gene therapies to treat inborn metabolic and immunological disorders in infants and children. The list is lengthy, and it is just the beginning of the kinds of breakthroughs that will continue at Stanford Medicine, to the benefit of patients everywhere around the globe.

The biomedical revolution is here, and the possibilities of Precision Health are within our grasp. Because of our history of innovation, our relationship with Silicon Valley, our entrepreneurial mindset, and our unparalleled culture of interdisciplinary collaboration, Stanford Medicine is prepared to redefine health and health care delivery.

We invite you to take the journey with us.

Lloyd B. Minor, MD
Carl and Elizabeth Naumann Dean
Stanford University School of Medicine

Amir Dan Rubin
President & CEO
Stanford Health Care

Christopher G. Dawes
President & CEO
Lucile Packard Children’s Hospital Stanford
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We are in the middle of a biomedical revolution more profound and far-reaching than the industrial and digital revolutions that made it possible. Over the past two decades, biomedical knowledge has grown exponentially, giving us utterly new insights into how life works. Breathtaking advances in genomics, bioinformatics, imaging, and stem cell medicine are offering possibilities that were unimaginable just a few years ago. New tools that will allow us to not only heal disease, but to predict it and prevent it, are finally within our reach. This is more than just a revolution in science and healthcare—it’s a revolution in the human condition.

But the innovation that drives all this is at risk. National funding for biomedical research is becoming increasingly constrained and conservative. Proven results are often expected up front, and novel approaches are often rejected out of hand, regardless of potential. Scientists spend so much time and energy chasing dwindling resources, they have little left to explore new ideas. Our best and brightest are growing disillusioned. Without the right investments, right now, America will lose the next generation of biomedical innovators. Without their creativity and vision, the momentum of this revolution will falter, and its brightest promises will slip through our fingers.

Stanford is uniquely poised to lead the biomedical revolution and secure its promise for future generations. Over the last 60 years, our unrivaled atmosphere of interdisciplinary exploration and collaboration has produced many of the innovations that sparked this revolution: MRIs, gene splicing, and stem cell medicine were all born on our campus. Today, that same atmosphere, amplified by the astounding intellectual, technological, and financial capital that surrounds us in Silicon Valley, gives us an unprecedented opportunity. Together, in this place and at this moment, we have the chance to change human health forever.

The Stanford Biomedical Innovation Initiative is a collection of philanthropic investments in disruptive research, visionary faculty, and promising young scientists. With this targeted, flexible funding, we will drive biomedical innovation forward around the world. Through the generosity of our philanthropic partners, we will power a simple idea, proven time and again on our campus: when you set the best minds free to explore to the limits of their talent and imagination, they will deliver a brighter, better future. Read on, and you’ll discover just a few examples of the kinds of innovation your philanthropic vision can fuel.

“We don’t think outside the box because we never see one to begin with.”

— Lucy Shapiro, PhD
Stanford Professor of Developmental Biology and 2012 National Medal of Science recipient
What makes Stanford Medicine so different?

Karl Deisseroth wins the Lurie Prize

TWO REVOLUTIONARY CONTRIBUTIONS to neuroscience—one that uses light to control the activity of the brain and another that renders biological tissues optically transparent—have won Karl Deisseroth, MD, PhD, the prestigious 2015 Lurie Prize in Biomedical Sciences from the Foundation for the National Institutes of Health. The $100,000 prize recognizes outstanding achievements by promising scientists age 52 or younger.

Deisseroth, a practicing psychiatrist and the D. H. Chen Professor and Professor of Bioengineering and of Psychiatry and of Behavioral Sciences at Stanford, pioneered optogenetics, a field that has revolutionized neuroscience by enabling the precise pinpointing of brain circuitry. Optogenetics combines genetic manipulation and optics to activate or deactivate targeted brain cells at the flip of a switch; it is a widely accepted technology to better understand the brain’s complex wiring and to unravel behavior.

Scientists at Stanford and around the world are using optogenetics to probe addiction, depression, anxiety, schizophrenia, autism, pain, stroke, Parkinson’s disease, and many other conditions. By combining neuroscience and chemical engineering, Deisseroth’s team also developed CLARITY, a method for rendering biological tissues both optically transparent and accessible to molecular probes. CLARITY generates a three-dimensional view of the brain’s connections—not sliced or sectioned in any way—with its complexity of fine wiring and molecular structures completely intact and with the ability to be measured and probed with visible light and chemicals. CLARITY vulgarizes an entirely new era of whole-organ imaging that stands to fundamentally change our scientific understanding of the brain, and potentially other organs as well. For his work in optogenetics, Deisseroth also won a 2014 Kao Medical Science Prize, which recognizes outstanding achievements of researchers in medicine and life sciences.

Irv Weissman wins the Brumbacher Prize

STEM CELL PIONEER Irvig Weissman, MD, has been recognized with the 2015 Charles Rodolphe Brumbacher Prize for Cancer Research for isolating cancer stem cells, as well as with the McEwen Award for Innovation for his research on adult stem cells from a variety of human tissues and cancers.

Weissman, who directs the Stanford Institute for Stem Cell Biology and Regenerative Medicine and holds the Virginia and Daniel K. Ludwig Professorship in Clinical Investigation in Cancer Research, was honored for his role in identifying and isolating the first hematopoietic, or blood-forming, stem cell in mice in 1988, and then in humans in 1992. In 2000, he also isolated leukemia cancer stem cells from humans. Recently, he and his colleagues have devoted themselves to understanding how cancer cells escape destruction by the immune system by expressing a “don’t eat me” signal on their cell membranes.

“He discovered how a cell can escape destruction by the immune system,” said Robert E. Shaughnessy, MD, a professor of oncology at Johns Hopkins University School of Medicine. “His work continues to inform my own research on the immune system and cancer stem cells.”

The prize, presented by the Charles Rodolphe Brumbacher Foundation, included 100,000 Swiss francs, or about $108,000, for each recipient. The foundation was created in 1991 by Brumbacher’s wife, Frederique, in honor of her late husband. This is the 12th time Weissman will receive the $100,000 award. Weissman and Clevers will share a $100,000 award.

Lucy Shapiro receives the Greengard Prize

DEVELOPMENTAL BIOLOGIST Lucy Shapiro, PhD, the Virginia and D. K. Ludwig Professor at Stanford University School of Medicine, received the 2014 Pearl Meister Greengard Prize, which celebrates the achievements of outstanding women in biomedical research.

Shapiro’s contributions to the field of systems developmental biology have revolutionized our understanding of bacterial genetic networks. Her insights helped launch the field of systems biology and led to the development of desperately needed antibacterial and antifungal drugs to counter the spread of antibiotic resistance and emerging infectious diseases.

“Hers is a scientific career that has inspired women and men like me to embrace and persevere in the crucial work of systems biology,” said賣tong Zhang, professor of development and stem cell biology at the University of California, San Francisco. “This award is long overdue.”

Shapiro credits the culture at Stanford, which enables interdisciplinary teams to explore the physics and chemistry of life. “This type of collaboration has revolutionized how we understand bacteria, the most abundant organism on our planet,” she said.

“What has changed so dramatically is our understanding of how the bacterial world codes, decodes, and uses information in time and space to create and maintain life on this planet. And almost everything we do comes down to mining information and dealing with not only vast amounts of data but very small molecules and small circuits,” said Shapiro.

The bedrock of what it means to be a living entity is an understanding of how a cell or tissue functions as an integrated system. No longer is it enough to study the biochemistry of specific reactions. Or a specific event. Or an overall function that happens when a tissue turns into something else. We now have to understand all these parts as an integrated, logical process,” she said.

Shapiro has helped influence government policy concerning emerging infectious diseases and the increase in antibiotic resistance by speaking nationally and internationally about the problem and serving as an advisor to the White House.
Alan Yeung and Michael McConnell are accelerating cardiac research with thousands of iPhones

**STANFORD MEDICINE AND APPLE** have partnered for a first-of-its-kind iPhone app to enable users to help advance our understanding of heart health. The MyHeartCounts app, which uses Apple’s free ResearchKit platform, is designed to collect data about physical activity and cardiovascular risk factors for Stanford researchers studying the prevention and treatment of heart disease. Apple also partnered with other medical organizations to study asthma, Parkinson’s disease, and breast cancer.

In less than two months, 36,000 individuals had consented to participate in the MyHeartCounts study. This figure represented more than 60 percent of all individuals who consented to all of the studies offered in Apple’s ResearchKit. Further, what was accomplished in the weeks following the app’s launch would have taken a traditional clinical trial several years to accomplish. As a result of this high volume and early adoption, researchers have already begun examining the data to determine how best to promote heart health.

“We are looking for everyone who is curious about how healthy their heart is to download this app,” said Alan Yeung, MD, the Li Ka Shing Professor in Cardiology at Stanford. Michael McConnell, MD, MSE, professor of cardiovascular medicine and the study’s principal investigator, adds, “We want people to join in this research effort to give them personalized information about their heart health and help provide fundamental new insights into how activity helps your heart, across all ages, genders, cultures, and countries.” Visit myheartcounts.stanford.edu for more information or download the app for free from the App Store.

Tony Wyss-Coray uses young blood to recharge the brains of old mice

**SOMETHING IN THE BLOOD** of young mice has the ability to restore mental capabilities in old mice, a Stanford study has found. If the same goes for humans, it could spell a new paradigm for recharging our aging brains, and it might mean new therapeutic approaches for dementia such as Alzheimer’s disease.

The researchers used sophisticated techniques to pin down numerous important molecular, neuroanatomical, and neuro-physiological changes that occur in the brains of old mice when they received infusions of plasma from young mice. Tony Wyss-Coray, Ph.D., the senior author of the study and a professor of neurology and neurological sciences, compared the performance of old mice on standard lab tests for spatial memory after they received plasma from young mice, from old mice, or no plasma at all. The researchers checked for changes within nerve circuits and individual nerve cells for improvements in learning and memory. They paid special attention to the hippocampus, a brain structure critical for forming certain types of memories and recognizing spatial patterns. “It’s what you use when you try to find your car in a parking lot,” Wyss-Coray said.

The hippocampus is extremely vulnerable to the normal aging process. In dementias such as Alzheimer’s disease, this hippocampal deterioration is accelerated, leading to an inability to form new memories. “There are factors present in blood from young mice that can recharge an old mouse’s brain so that it functions more like a younger one,” Wyss-Coray said. “We’re working intensively to find out what those factors might be and from exactly which tissues they originated.”

The researchers used blood plasma from young mice for two reasons:

1. The plasma is easier to harvest than individual cells.
2. It contains a large number of important bioactive molecules that are released into the circulatory system in small quantities. When released into the system, these molecules can diffuse to sites in the body far from where they were released, making them ideal candidates for promoting health.

The researchers are working to identify the molecules that carry out this rejuvenating effect. They hope this knowledge will enable a new approach to treating age-related cognitive decline, which affects millions of people around the world.

Catherine Blish discovers why the flu is so much worse when you’re pregnant

**WHEN PREGNANT WOMEN CATCH THE FLU,** they tend to get it more severely. In the United States, women who get the flu while pregnant are four times more likely to deliver their babies prematurely. Yet only about half of pregnant women are vaccinated for influenza. In the past, it was thought that pregnancy weakened a woman’s immune response to prevent her body from rejecting the fetus. Now, a first-of-its-kind study suggests the opposite—that pregnant women have an excessively high immune response to the flu. In the study, infectious disease expert Catherine Blish, MD, PhD, and her research team from Stanford University School of Medicine and Lucile Packard Children’s Hospital Stanford examined the immune responses of pregnant and non-pregnant women before and after receiving flu vaccines six weeks after the pregnancy began.

They found that pregnancy causes white blood cells to recruit too many immune cells when exposed to the H1N1 virus. “That’s a bad thing in all situations where you need air space,” said Blish.

Pregnant women who get the flu are usually treated with drugs to slow the replication of the flu virus in their bodies. This treatment is useful, but it isn’t the only good option. The work by Blish and her colleagues show that vaccines are also important for preventing this kind of potentially life-threatening immune response.

“We now understand that severe influenza in pregnancy is a hyper-inflammatory disease rather than a state of immunodeficiency,” said Blish. “So treatment of flu in pregnancy might have more to do with modulating the immune response than worrying about viral replication.” She urged pregnant women to get vaccinated for the flu, especially if they’re pregnant.

Sam Gambhir is collaborating with Google to create a comprehensive picture of human health

**STANFORD MEDICINE IS COLLABORATING** with Google on the Google Baseline Study, the most comprehensive longitudinal cohort study ever designed. With an anticipated enrollment of 100,000 people who will be followed over time, the project seeks to build a baseline understanding of what constitutes health, and what changes occur in the early stages of disease. The study will define the relationships among a variety of physiological and biochemical parameters, discern early indicators of disease, identify predictors of outcomes in patients with cancer or heart disease, and validate the next generation of wearable medical technologies. Sam Gambhir, MD, PhD, the Virginia and D. K. Ludwig Professor for Clinical Investigation in Cancer Research and chair of Stanford’s Department of Radiology, said that what makes the project unique is its focus on understanding the baseline of healthy human beings. “This is an existing study in its early phases still,” he said. “Most studies focus on understanding disease, but as a medical and scientific community we have paid very little attention to what ‘normal’ or ‘healthy’ really means at the biochemical level.”

The project’s scope goes far beyond just looking at genomes. By also looking at each subject’s proteome (all the proteins their bodies make), metabolome (the small molecules circulating in their bodies), and microbiome (the microorganisms that live in them), and aggregating that data across the thousands of other subjects, the study should enable better medical decision-making for decades to come.

Vinod Menon uses math problems and fMRIs to study brain flexibility in kids with autism

**REST AND WORK** may seem as different as night and day, but a recent study shows that children with autism use something similar: brain networks for these activities.

Autism affects about one in every 110 children in the United States. The hallmarks of this developmental disorder are difficulties with social interactions and communication, repetitive behaviors, and sensory problems. The study, led by behavioral expert Vinod Menon, PhD, the Rachel L. and Walter F. Nichols, MD, Professor, used functional magnetic resonance imaging, or fMRI, to examine children’s brain activity at rest and during two tasks: solving math problems and looking at pictures of different faces. The study revealed that, instead of changing when challenged with a task, the connectivity in key brain networks of autistic children remained relatively constant. “We wanted to test the idea that a flexible brain is necessary for flexible behavior,” said Lucina.Uddin, PhD, a lead author of the study. “We found that across a set of brain connections known to be important for switching between different tasks, kids with autism showed reduced ‘brain flexibility’ compared with typically developing peers.”

Menon and his team also found a link between these brain connections and the behaviors associated with autism—kids using highly similar brain networks for rest and play tended to have more severe manifestations of the behaviors that characterize autism.

“The fact that we can tie this neurophysiological brain-state inflexibility to behavioral inflexibility is an important finding because it gives us clues about what kinds of processes go awry in autism,” said Menon.

Eran Bendavid analyzes data from families in developing countries to reduce child mortality

**THE GAP IN HEALTH** between low- and high-income families tends to grow as a nation increases in wealth. Yet, a recent study by Eran Bendavid, MD, MS, shows that the child mortality gap has narrowed between the poorest and wealthiest households in a majority of more than 50 developing countries.

Until recently, many studies of childhood deaths in developing countries focused on the national average. While useful, these studies offered little information on child mortality rates in low-versus-high income families or how these rates might influence the country’s average. So Bendavid and his team analyzed data on more than a million women from 54 developing countries to learn how death rates for children under the age of five might be linked to household income. He found that child mortality rates shrank in more than half of these developing countries because overall mortality rates for low-income families declined.

He also discovered a link between child mortality and the quality of governance in each country. In the developing countries where the child mortality gap increased, poor governance was a common factor. “The findings provide important information for making decisions about prioritizing global health investments to effectively promote equity,” said Bendavid.

“We have the technologies, we have the means, we have the know-how to reduce child mortality dramatically,” said Bendavid. “Even for such low-hanging fruit, however, implementation is not always easy. You need governments that enable basic safety and the ability to reach poor and rural communities that benefit from these kinds of programs.”
When you visit your doctor, you expect to receive the very best health care available. Yet, in truth, most physicians can only rely on their own limited, subjective experience, a research, and memory to provide diagnoses and treatment. Even if a clinician has worked at the top of his or her game for 20 years, he or she will only have about 10,000 patients’ worth of experience to call upon. The result is decisions that are often not as informed as they could be, leading to potential side effects, adverse treatments, multiple drugs tried, and even inadequate care. If we harness the medical data now available, doctors can use it to make better, faster care decisions.

At a time when our understanding of disease and our investigative tools are developing at a breathtaking pace, there is a troubling disconnect between what we know, and what we deliver in the clinic. And the gap is getting wider every day, affecting the quality and cost of care.

The Stanford Biomedical Data Science Initiative is changing this scenario. At the heart of this initiative is a searchable, intelligent system that will quickly analyze vast amounts of information, which is confined to the evidence they can dig out of journals or the anecdotes they hear from colleagues, Patients Like You will deliver the power of millions of records, allowing physicians—for the first time—to deliver evidence-based medicine faster and with precision.

Now is the time to harness the power of biomedical big data. Since 2000, costs of genomic sequencing have fallen by many orders of magnitude. Offsetting the explosion of data are the falling costs of storage—a decline of 30 percent annually during the last two decades. The open-source software ecosystem to process, analyze, and visualize data at a massive scale has flourished. This too, has made software costs manageable.

There is a newfound transparency in government. Sites like healthcare.gov and data.gov, and NIH insistence that data be published as part of study results are all indications of the changing mindset in Washington, D.C. This helps us obtain more data where we had none before. With the addition of President Obama’s investment in data gathering and precision medicine, more data will be available in the future.

The Stanford Biomedical Data Science Initiative complements the president’s vision, adding a global component and a much larger data platform that addresses or fully eradicates current system limitations. With its formidable strengths in computational and medical research, Stanford is an ideal place to capture the potential of biomedical big data to change the face of human health.

While it may seem logical to ask why leading Silicon Valley companies haven’t yet to take on this Herculean task, it is because they lack one important strength that Stanford possesses: the ability to synthesize and translate the clinical applications from the vast amount of data. With Stanford’s exceptional medical knowledge plus our unsurpassed computer science skills, we can design the Patients Like You system better and faster than anyone else. We know how to weight the data to match or discount elements of medical information so that the Patients Like You system delivers search results that affect care decisions most effectively. Few organizations have the strength in medical knowledge and computational expertise, as well as the trust of biobanks, to secure the data. And once we do, we will seek partnerships with industry to build it to scale for the world to use.

A powerful goal is to federate the health data of millions of people worldwide, in perhaps the largest and most diverse “cohort” anywhere, and make it accessible for ever richer research inquiry, reflecting the very nature of the human body. The first step in realizing this vision is the identification and acquisition of the most promising health data in the world. We’ll create the Patients Like You framework, combing providers, biobanks, government sources, and much more to identify and cluster patients with similar profiles, conditions, and medical outcomes. We’ll create an easy-to-use, open-source platform that allows physicians to search the databases and build treatment plans accordingly. We’ll spread this concept beyond patient records to emerging personal monitored streams, and on to even richer patient “omic” profiles.

Over time, this will give us invaluable knowledge of molecular and disease pathways, opening up new frontiers of human health and expanding our ability to not just treat disease, but to predict and prevent. We are already testing systems and have moved some data into design prototypes.

Looking forward, it is believed that data from mobile devices will be the biggest feed into medical records in the near future. Stanford investigators are currently in partnership with major technology companies to benefit human health in two ways: guiding individuals through daily choices for a healthier future, and extracting unprecedented health research based on human activity patterns, adding to the data for sound decision making. Stanford’s team of experts can locate the signal level to get the purest data and physiological measures to make fundamental discoveries. We’ll begin our work with a cardiovascular focus, and eventually apply it across various aspects of human health.

With the advocacy of Stanford University President John Hennessy, PhD, and four deans—Lloyd B. Minor, MD, School of Medicine; Persis Drell, PhD, School of Engineering; Richard Salari, PhD, School of Humanities & Sciences—we have launched the Biomedical Data Sciences Initiative to transform human health. Integrating expertise in bioinformatics, computer science, chemistry, biology, data science, genomics, statistics, information retrieval, and signal processing, we are building on the existing, comprehensive excellence of Stanford.

Our location in Silicon Valley, and on a centralized campus, enables us to take full advantage of superior talent to create a smart and durable architecture for our platform. Surrounded by disruption-minded industries and a change mindset, we have already created an ecosystem of advanced biomedical data science that includes two world-leading hospitals, the School of Medicine, and all data science activities on campus in collaborations that radiate globally. By joining forces with others around the world, we are achieving unprecedented results.
Two new state-of-the-art hospitals are rising quickly on Stanford’s campus and defining what health care can be in the next century.

At the ceremony for the new children’s hospital expansion, Christopher G. Dawes, president and CEO of Lucile Packard Children’s Hospital Stanford and Stanford Children’s Health, said, “More than 30 years ago, Lucile Salter Packard had a vision to create a world-renowned hospital with the sole focus of caring for children and their families. We’re proud to take that vision forward with a hospital that will bring our award-winning and family-focused care to the more than one million children who live in the region, and for the thousands of families who come to us from all over the world.”

Scheduled to open to patients in early 2018, the new Stanford Hospital is an 860,000-square-foot building that will increase patient capacity, add 168 private rooms, and modernize services.

The new adult hospital will feature an enlarged Level-1 trauma center—thr new Mar and Laura Anderson Emergency Department will be more than twice the size of the current one. When completed, the building will be one of the most seismically safe hospitals in the country, able to continue operations after an 8.0, or “great,” earthquake. The existing hospital building, which will continue to be used for patient care, will connect to the new care via above-ground and underground walkways. The 932,000-square-foot Lucile Packard Children’s Hospital Stanford expansion nearly doubles the size of the existing facility, allowing for up to 361 beds onsite. When complete, it will feature state-of-the-art diagnostic and imaging equipment and an adaptable design to accommodate cutting-edge protocols and future technologies. In addition to setting the standard for sustainability in hospital design, the expansion will also have 3.5 acres of green space, private rooms with sleeping space for two parents, engaging playrooms, and public spaces with large windows and patios.

Two new state-of-the-art hospitals are rising quickly on Stanford’s campus and defining what health care can be in the next century.

Building tomorrow today

from two new hospitals to a regional network and health plan, Stanford Medicine is ready for the future.
STANFORD MEDICINE OFFERS EXCEPTIONAL CARE

that’s closer to home. From award-winning hospitals to a world-class network of care, we’re ensuring access to the highest quality care. Now it’s easier than ever for patients throughout the Bay Area to turn to Stanford Medicine and its growing provider network for comprehensive solutions to their health care needs. This network of care means more access for everyone—from infants to teenagers to pregnant women to adults at every stage of life.

Great health starts with outstanding primary care. Through the Stanford Children’s Health network and Stanford Primary Care Centers, families from Monterey to Marin have a convenient option for their primary care needs. Our internal medicine, pediatric, and family practice physicians are committed to becoming true health partners with all of their primary care patients—providing the personal touch of a private practice and access to Stanford Medicine’s innovative research.

The Stanford Health Care and Stanford Children’s Health systems include a premier network of physicians and outpatient centers. This enables community-based physicians and pediatricians to partner with us to provide excellent medical care through exceptional access and service in communities around the Bay Area. This also extends to specialty care.

With several specialty and multi-specialty services locations in addition to partnerships with regional hospitals, patients have even more access to the unmatched medical resources and advanced care that Stanford Medicine provides. And, thanks to Stanford’s integrated advanced electronic medical records system, we can quickly review medical histories, order tests and prescriptions, and view test results.

STANFORD HEALTH CARE ALLIANCE (SHCA) is a new health care plan that brings the entire Stanford Medicine-affiliated team and resources—Stanford Health Care, Lucile Packard Children’s Hospital Stanford, and our affiliated physician network—to provide patients with leading-edge and coordinated care. Initially offered only to Stanford University and Stanford Medicine employees and their dependents, SHCA is now available to area employers.

Based on the emerging “accountable care” model, SHCA’s more than 400 primary care physicians and 2,300 specialists work together to improve the quality, coordination, and efficiency of the care they deliver to a specific set of patients, typically a company’s employees.

Patients receive personal support through Member Care Specialists: a dedicated advisor to help with a wide range of needs, including selecting a primary care physician, scheduling appointments, and identifying SHCA resources to help them stay healthy. SHCA offers access to services and resources that best meet a patient’s needs, from walk-in express care to hospitalization; convenient medical visits by video or phone; and connection with Stanford’s world-renowned specialists and innovative programs.
DETECTING SOLID MASSES OF CANCER with a blood test is like finding a needle in a haystack. Unlike leukemias and other liquid cancers that circulate many cancer cells in the bloodstream, solid tumors shed only a few cancer cells into the blood. So a blood test to detect solid tumors must be highly sensitive.

An additional complication is that cancer DNA has slightly different mutations in each patient. This means that for just one type of cancer, the test has to recognize several slightly different DNA patterns to identify most of the patients with the disease.

Previous blood tests for solid cancers had mixed success. They were either not sensitive enough or took too much time to customize the test to each patient.

Now, researchers at Stanford University School of Medicine have devised a highly sensitive and specific blood test that should be broadly applicable to many types of cancers.

With this new test, Maximilian Diehn, MD, PhD, Ash Alizadeh, MD, PhD, and their team accurately identified 100 percent of patients in their study with advanced stages of lung cancer. They were also able to identify patients with the earliest stage of lung cancer—when cancer cells are extremely scarce—in about half of the cancer patients.

The test can detect just one molecule of tumor DNA in a sea of 10,000 healthy DNA molecules.

“For most cancers it’s very difficult to identify any one particular genetic aberration or mutation that is found in every patient,” Alizadeh said.

So, to create a search image for the many faces of lung cancer, the team carefully scrutinized scores of DNA samples from hundreds of patients with lung cancer. They looked for mutations that appeared in many samples, reasoning that although no one patient will have every mutation that causes lung cancer, nearly all patients will have at least some.

Diehn explained that they chose to focus on lung cancer because there are currently no reliable biomarkers available for this disease. The result is a technique that’s sensitive enough to detect just one molecule of tumor DNA in a sea of 10,000 healthy DNA molecules in the blood.

“We are very excited about our findings because a personalized, clinically useful biomarker could revolutionize how we detect and manage this devastating disease,” Diehn said. The team is now working to design clinical trials to see whether the test can improve patient outcomes and decrease costs. They’re also aiming to extend the technique to other types of tumors.

Screening healthy but at-risk populations is another goal. “It may be possible to develop assays that could simultaneously screen for multiple cancers,” Diehn said. “This would include diseases such as breast, prostate, colorectal, and lung cancer.” Alizadeh said. “This approach could, theoretically, work for any tumor. We expect it to be broadly applicable across cancers.”

So it’s possible that one day, a single, easy blood test could be used not just to track the progress of previously diagnosed patients, but to screen anyone for several different kinds of cancer.
Stanford’s Clinical Excellence Research Center (CERC) has designed new stroke treatment guidelines that could lower U.S. health-care costs by as much as $1.6 billion per year.

About Every Two Seconds, someone on the planet suffers a stroke. This serious condition restricts blood flow to the brain, so every second counts. A stroke patient’s life—and if they survive—quality of life hinges on the timing of care delivered by doctors and health professionals.

Strokes are the leading cause of disability in the U.S. and cost our nation roughly $20.6 billion in direct health-care spending. For people who experience a stroke, its cost is beyond measure.

New researchers at the Stanford Clinical Excellence Research Center (CERC) have developed a concise set of guidelines to help clinics and hospitals treat and prevent strokes more efficiently.

“About every two seconds, someone on the planet suffers a stroke. This serious condition restricts blood flow to the brain, so every second counts. A stroke patient’s life—and if they survive—quality of life hinges on the timing of care delivered by doctors and health professionals. Strokes are the leading cause of disability in the U.S. and cost our nation roughly $20.6 billion in direct health-care spending. For people who experience a stroke, its cost is beyond measure.”

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“Our nation needs to find ways to safely treat more patients for less money,” said CERC’s Director Arnold Milstein, MD. Milstein helps shape national health policies. “Our center’s innovative care models provide clinicians and administrators with a roadmap to improving patient outcomes while simultaneously responding to the national imperative,” he explained.

The model’s new strategies reduce unnecessary time spent in the hospital and fast track emergency care for patients so they get the critical processing of treatment, called tPA, faster. Moreover, these guidelines could lower U.S. health-care costs by as much as $1.6 billion per year.

CERC takes a multidisciplinary approach to redesigning health-care models. “CERC is an innovation accelerator,” said Milstein. “We recruit creative young scholars into our center, introduce them to some of the most progressive thinkers both inside and outside of health care, then challenge them to find better ways to address our biggest and most costly health-care challenges.”

For this project, CERC recruited three research fellows: Lucy Kalanithi, MD; Waimei Tai, MD; and Jared Conley, PhD, MPH.

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Kalanithi, Tai, and Conley analyzed existing guidelines for stroke treatment and care and studied its cost-effectiveness. Then, they contacted top-performing stroke care and prevention centers around the world to see what they could learn from their protocols.

The team learned an important lesson from stroke experts in Finland: the key to rapid stroke treatment is to do as much as possible before the patient arrives. “For every 15 minutes we cut from the initiation of treatment, an average patient will gain a month of disability-free life,” said Atte Meretoja, MD, one of the architects of the successful Helsinki stroke care model.

The Helsinki team goes into action as soon as an ambulance calls in a probable stroke. Paperwork, test setups, and drug orders are initiated before the patient arrives. To achieve this, it is crucial that the ambulance relay patient details to the stroke team. From the initiation of treatment, patients are wheeled directly to an emergency bay, patients are wheeled directly to an adjacent imaging room, bypassing the emergency department. This year, four institutions are testing the new stroke care model: Stanford Health Care, Allina Health in Minnesota, Geisinger Health in Pennsylvania, and Virginia Mason Health System in Washington.

On September 1, 2013, Stanford Health Care launched the first phase of its transition to CERC’s recommended stroke emergency care redesign. The challenge to making sweeping changes to a traditional hospital’s stroke procedures is this: the very thing that makes a hospital a safe place— reliance on well-established protocols—is the same thing that makes it hard for these institutions to embrace change. Incorporating CERC’s recommended changes, which involve disrupting the established routines of dozens of emergency medical personnel working in life-or-death situations, has to be done in a careful, methodical way.

Tai, a neurologist, is managing Stanford Health Care’s transition to the new model. An essential tool in this process is the mock stroke code drill, which Tai and her team calls “dynamic problem solving.” During drills, they look for areas where things get bogged down. Problem areas are noted and workarounds are tested.

For example, the Stanford stroke team shaved a few minutes off the hospital admissions process by having admissions paperwork done in the ambulance bay. Another small, but time-saving, change was the addition of a sample-collection station in the imaging room.

The team is pleased with its progress thus far. After the new CERC care design was implemented, 94 percent of suspected stroke patients arriving via ambulance receive brain imaging well within national targets, and the median door-to-needle time for tPA administration has already dropped by 30 percent.

“The Joint Commission [an organization that accredits and certifies U.S. health-care organizations] just re-accredited our Comprehensive Stroke Center, and they were very impressed with our continuous improvement processes, including the impact that applying the Helsinki model to Stanford has had on our performance,” Tai said.

Today, each of the fellows feels that their CERC experience has been transformative—not just for them personally, but for the health-care industry as a whole. “I like many working physicians, every day I’d see needed health-care improvements, both large and small, that weren’t happening,” explained Tai. “CERC gave me a way to fix these problems at a national level.”
Solving the big problem of tiny babies

PREMATURE BIRTH IS THE LEADING CAUSE OF DEATH in children under the age of five. Worldwide, about 15 million babies are born prematurely each year and roughly one million will die within 28 days of birth. In the United States, the magnitude of this problem is staggering. According to the Centers for Disease Control, the infant mortality rate (the number of infants that die before their first birthday out of 1,000 births) is higher in the United States than in any of the other 25 developed countries they surveyed. Of the more than four million babies born in the U.S. each year, one in eight arrives too early.

To address this problem, more than 200 experts in fields ranging from public health to statistics are taking part in the March of Dimes Prematurity Research Center at Stanford, a bold new initiative to identify the causes and reduce the occurrence of premature births. Thanks to $20 million in funding from the March of Dimes, this first-of-its-kind program launched at Stanford in 2011.

“The problem will not be solved by taking a traditional silo approach, with researchers focused on one discipline, one problem, or one perspective at a time,” said lead investigator David Stevenson, MD, director of the Johnson Center for Pregnancy and Newborn Services at Lucile Packard Children’s Hospital Stanford. Instead, Stevenson and the leadership team—a Professor of Obstetrics and Gynecology Maurice Druzin, MD, Research Professor of Neonatology Gary Shaw, PhD; and Professor of Health Research and Policy Paul Wise, MD, MPH—adopted a transdisciplinary approach that unites experts from a diverse array of fields.

From environmental risk factors to the genetic interactions between the mother and fetus, the Center’s diverse teams will look at prematurity from all angles. This broad range of expertise will help the research team examine why premature birth in the U.S. are so common. This fresh perspective could yield new solutions to the problem of prematurity birth. “We are willing to try new things and solve problems creatively,” Stevenson said. “Team science is about making new connections, which Stanford is known for, and the issue of prematurity has introduced a sort of inspirational glue.”

The research team is compiling data on social, biological, and clinical factors to gain a better understanding of the things that contribute to prematurity. Once they have this information, the team will collaborate with clinicians and other experts to identify the most effective ways to translate their research findings into strategies to prevent premature births. Epidemiologist Jeffrey Gould, MD, the director of the California Perinatal Quality Care Collaborative, oversees a network of more than 130 California hospitals that provide intensive care to newborns. He uses the statewide data to identify which mothers and babies are at high risk for poor outcomes and to bridge the gap between research and clinical care.

The Center is working to identify the things that appear to be harbingers of premature births, such as inflammation and infections. For example, a project headed by infectious disease expert David Relman, MD, found that infection is a common cause of preterm labor and delivery. Next, Relman and his team will determine whether infections can be detected before the onset of preterm labor. If so, this knowledge could lead to new prevention or treatment strategies.

Another project, headed by Shaw, found that women who are obese before they become pregnant have a greater risk of delivering an extremely preterm baby (less than 28 weeks). Yet, the mother’s weight had no effect on preterm or late preterm births (between 28 and 37 weeks). His findings clarify the connection between obesity and the risk of preterm delivery, and suggest that premature birth may have different causes at different stages of pregnancy.

The Center and the March of Dimes have already made an impact on late preterm births. Due dates are only estimates; so a delivery scheduled for 37 or 38 weeks may actually result in a preterm birth. Meanwhile, fertility treatments—which can result in multiple births—are also adding to the high rate of preterm births in the U.S.

So, the Center and the March of Dimes created a tool kit that established specific, measurable criteria for inducing labor. Their guidelines also provided recommendations for the timing and strategy of fertility treatments. These changes are already helping to reduce late preterm births. “Nearly every hospital in the U.S. has adopted the tool kit, and the result is that late preterm rates have dropped,” said Druzin. “The situation was fixed by a change in practice. But for extreme preterm births, there has been little improvement. Early preterm is harder to fix. It’s about delivery, it’s about development.”

Center investigators are optimistic that within the next five to 10 years, they will have a well-developed picture of the causal mechanisms behind extreme preterm delivery and practical prevention techniques to offer expectant mothers.

“In the past, I thought we might never solve the problem of prematurity,” said Gould. “But now, after three years with the Center, we have already made important inroads. I think we are on our way to making significant changes for mothers and babies both locally and around the world.”

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PUTTING PRECISION HEALTH INTO PRACTICE

STANFORD MEDICINE’S CLINICAL GENOMICS SERVICE IS LEADING HEALTH CARE INTO A NEW ERA

TO ACHIEVE THE LIFE-CHANGING POSSIBILITIES of Precision Health, we first have to deliver the fundamentals of precision medicine—including genomic sequencing that’s accurate, fast, and affordable. A pilot program in clinical genomics is allowing a small group of patients at Stanford Health Care and Lucile Packard Children’s Hospital Stanford to have their DNA deciphered to help doctors with diagnosis and treatment. The goal of the Clinical Genomics Service is to help doctors better diagnose and treat genetic disorders. In the pilot phase, genomic testing will be limited to patients with “mystery” diseases (typically children), patients with unexplained hereditary cancer risk, patients with inherited cardiovascular or neurological disease, and those with severe, unexplained drug reactions. Potential participants must first be referred by a physician and the Clinical Genomics team will then determine if cases are suitable for sequencing.

“I’m very excited to bring the pioneering work of Stanford genomic scientists to the bedside of our patients.”

“...we have a remarkable opportunity to bring world-leading Stanford science to Stanford patients fast and first.”

Christopher G. Dawes, president and CEO of Lucile Packard Children’s Hospital Stanford and Stanford Children’s Health, sees the service as a bridge to better connect the groundbreaking genetic science of our laboratories with the patient care of our hospitals and clinics. The efforts of Drs. Ashley and Merker and their team are helping to shape a medical future in which disease risk can be more accurately predicted and treatments better tailored to individual patients.

Michael Snyder, PhD, the director of the Stanford Center for Genomics and Personalized Medicine (SCGPM), the Stanford W. Ascherman, MD, FACS, Professor in Genetics, and chair of the Department of Genetics, as well as members of the SCGPM, played a pivotal role in the foundation of the Clinical Genomics Service. Also included in those discussions were Carlos Bustamante, PhD, a Stanford professor of genetics who was named a 2010 MacArthur Fellow for his work in genetic sequencing, and Michael Cherry, PhD, Stanford professor of genetics and principal investigator in several genome database projects.

“This service can represent the best definition of the term personalized medicine,” said Amir Dan Rubin, president and CEO of Stanford Health Care. “The collaboration of our world-class experts in patient care and scientific research will advance the leading edge of knowledge in genome sequencing, bringing greater value, in the most responsible way, to what we offer our patients. Our goal is to use this new technology for early and accurate diagnosis and treatment for patients now—and to learn and share that knowledge with medicine’s future.”

Lloyd B. Minor, MD, the dean of the School of Medicine, said the Clinical Genomics Service exemplifies the bench-to-bedside philosophy at the heart of Stanford Medicine. “It serves as a bridge to better connect the groundbreaking genetic science of our laboratories with the patient care of our hospitals and clinics. The efforts of Drs. Ashley and Merker and their team are helping to shape a medical future in which disease risk can be more accurately predicted and treatments better tailored to individual patients.”

“...we have a remarkable opportunity to bring world-leading Stanford science to Stanford patients fast and first.”

Euan Ashley, MRCPath, DPhil, co-director of the Clinical Genomics Service.
Thanks to utterly new ways of understanding life’s processes, we have vastly expanded our knowledge of health and medicine in the past two decades—and the pace of discovery is accelerating at a breathtaking rate. The Campaign for Stanford Medicine is a collection of philanthropic investments to empower this biomedical revolution and shape the future of medicine:

- **The new Stanford Hospital** A state-of-the-art hospital to serve our patients and act as a global example of health care in the future
- **Clinical Excellence Research Center** A national model for delivering better health care at lower cost
- **Transforming Cancer Care** An effort to completely re-imagine the delivery of cancer care and shape the future of cancer science
- **Biomedical Data Science Initiative** An endeavor to harness big data and improve health around the globe
- **Biomedical Innovation Initiative** Investments in disruptive research, visionary faculty, and promising young scientists
- **Biomedical Innovation Building** A technically advanced facility that fully supports the talent and vision of Stanford’s leading researchers

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