a venture to transform human health

From curing individual patients to healing entire populations,
The Stanford Biomedical Data Science Initiative will lead the way to a better world. A world where your data transforms not just your health, but the health of people everywhere. Where doctors instantly search millions of medical records to find what worked for patients just like you. Where new drugs, and new uses for old ones, are delivered at astonishing speeds. Where we can finally predict disease in both people and populations to stop it before it starts. By harnessing the power of large-scale computing and data analysis, we’ll make this world a reality. We’ll untangle the awesome complexity of human health and disease—and create longer, better lives for everyone on the planet.
Why is medicine stuck in the last century? For decades, the technology industry has been crunching billions of data points to sell everything from diapers to diamonds. But until just a few years ago, most hospitals still kept medical records on paper. Worse still, none of what we know about environment, behavior, and social factors is linked to this data at all. Even though we’re gathering more data from more sources than ever before, only a tiny fraction is being used to benefit patients.

Harnessing the world’s data to improve human health is a huge challenge. The messiness and compartmentalization of health data, the cultural resistance to sharing it, the lack of a common programming ecosystem, the scarcity of people with expertise in both biomedicine and computation, and of course, the safety and privacy of patients, all make data science far more difficult in biomedicine than it is in other fields. Lives are literally on the line, so the stakes—and the hurdles—are much higher.
This initiative is changing all that. With Stanford’s powerful engines of basic, translational, and population research, our computational expertise, our ties to Silicon Valley, our entrepreneurial spirit, and our history of tackling society’s big, intractable problems, we’re changing how biomedical research is done to put data science to work for patients everywhere. We’re smashing silos to connect the health data of millions. We’re leveraging that data at every scale to personalize treatment and improve outcomes. We’re training the next generation and creating a new breed of scientists. And we’re wrestling with the legal and ethical issues that are holding medicine back.

No other place on earth has the technological and intellectual capital to accomplish this as quickly and efficiently. In 2014, Stanford was ranked #1 in computer science, biological sciences, genetics/genomics/bioinformatics, artificial intelligence, statistics, entrepreneurship, and business by U.S. News & World Report. Stanford was also the academic incubator of the digital revolution. Nurtured by our unrivaled atmosphere of collaborative exploration, optimism, and entrepreneurial spirit, companies born on and around our campus have not only spread across the globe, they have transformed it. Now, these same innovators are helping us drive a new revolution forward. This time it’s a revolution in biomedicine, and with their help and yours, we’re bringing to bear the full power of data science to benefit not just individual patients, but entire populations.
Little Jazline was in serious trouble. On her first day of life, her tiny heart kept stopping. By day two, her doctors at Lucile Packard Children’s Hospital Stanford had implanted a defibrillator to keep it going. They knew she had an inherited cardiac condition, but to treat her they needed to pinpoint which genetic mutations were driving it. So they had her entire genome sequenced over the weekend, and 12 hours after receiving the raw data, they had an exact diagnosis. They developed a precisely tailored treatment plan, and by day ten, she was out of the woods. Just a few years ago, that process would’ve taken months—and Jazline probably wouldn’t be alive today.

We’re integrating genomics into everyday care so patients everywhere can benefit from the kind of precision treatment Jazline received. Starting with patients at Stanford we’re adding genomic and other “omic” data to medical records to deepen our understanding of each patient’s biology and how it responds to everything from drugs to the environment. To that, we’re adding millions of records from biobanks and health data repositories around the world to create the largest and most ethnically diverse health data set in history.
We're incorporating data from mobile devices to give physicians and researchers not just an accurate picture that evolves in real time, but a way to instantly communicate with and get input from patients and study participants. We're developing intelligent systems that can quickly analyze vast amounts of unstructured data like images and physicians’ notes. And we’re integrating everything to give us the most detailed and comprehensive picture of human health ever seen.

We’re making it all searchable in real time, so physicians and researchers anywhere in the world can have accurate outcomes information on huge numbers of patients just like the ones they’re treating or studying, right at their fingertips. No longer will doctors have to make treatment decisions based only on their direct experience of treating a few dozen similar patients. Nor will they have to rely only on the evidence they can dig out of journals or the anecdotes they hear from colleagues. They’ll have instant access to detailed information on thousands—or even millions—of patients like theirs, so they’ll finally have the power to practice medicine that’s truly evidence-based.
We're accelerating drug discovery by using large-scale data analysis to not just model molecular interactions, but to find new uses for existing drugs that are already approved by the FDA. Stanford Medicine has already earned a global reputation for this work, including our discovery that Lipitor, a well-known drug that has lowered cholesterol in millions by blocking a liver enzyme, can also jam signals that cause a patient’s immune system to reject a transplanted organ. Other examples include our findings that an antidepressant that’s been in use for years kills lung cancer cells and an off-patent antiepileptic therapy holds promise for treating inflammatory bowel disease.

The FDA has approved around 5,000 drugs, but there are many more compounds that are known to be safe but haven’t proven to be effective for their intended conditions. With this initiative, we’re digging into this huge trove to find new uses for these already-approved drugs. And the introduction of these new treatments will take a fraction of the time and cost it took to approve them the first time around.
We’re creating a new breed of scientist to capture the astonishing potential of biomedical data—experts with the talent and training to work at the intersection of the life and quantitative sciences. Stanford is uniquely capable of creating this hybrid profession. In virtually every discipline that touches biomedical data science, including computer science, biomedical research, imaging, genomics, engineering, law, business, design, education, epidemiology, demography, economics, and ethics, we have the intellectual capital to fuel the advancement of this burgeoning field.

Stanford is the ideal training ground for these new physicians and researchers. In addition to our unparalleled atmosphere of interdisciplinary collaboration and unfettered exploration, our campus is steeped in the ethos of Silicon Valley. Our close partnerships with some of the world’s greatest innovators are instilling a disruptive vigor in the professionals who train here. This initiative, with its seed grants and its annual Big Data in Biomedicine Conference, is already attracting a rich convergence of talent from both academia and industry.

These students will change everything. Today, their energy and ideas infuse all parts of this initiative with enthusiasm and vitality. Tomorrow, as they take their skills and experience out into the world as practitioners and professors, their knowledge and expertise will flow to every corner of the globe and down through the generations. They will forever change not just the science and practice of medicine, but the human condition itself.

Veena Goel, MD is one of two inaugural fellows in Clinical Informatics at Stanford, the first clinical informatics fellowship in the nation to receive accreditation by the Accreditation Council for Graduate Medical Education. She’s also the first fellow in Pediatric Hospital Medicine at Stanford, and is working with a unique data set at Lucile Packard Children’s Hospital Stanford to improve bedside monitor alarm fatigue.
What’s legal? What’s responsible? What’s right? The tantalizing question of what’s possible in biomedical data science must be balanced with questions like these. To protect the interests of both society and individuals, we must reconstruct the existing legal and ethical frameworks that guide biomedical research. A vital part of this initiative will incorporate public policy and research programs to address these issues, not just in the U.S., but across the many countries and cultures participating in this scientific movement.

How can we use all this data to make research better? How can we best serve the needs of patients while respecting their autonomy, dignity, and diversity? How do we protect patient privacy? How do we create standards that work across wildly diverse nations, who vary so widely in their practices of collection, communication, and disclosure? Empirical research is needed to ask and answer critical questions like these.

With every patient and project, we must prove ourselves to be trusted guardians of all this valuable and sensitive information. This initiative will support research and health policy programs to assure wise stewardship of this new power.
We finally have the power to transform human health. From the molecular mechanics of individual cells to the behavioral dynamics of entire populations, the Stanford Biomedical Data Science Initiative is delving into every aspect of health and disease. We’re assembling a medical data set of unprecedented breadth, depth, scale, and dynamism. We’re building tools and writing algorithms to mine it for fresh insights. We’re accelerating the development of new treatments and interventions to improve health outcomes for each patient and every community. We’re producing an entirely new species of scientist that will spread our discoveries and our methods around the world and into the future. And we’re doing it all while fiercely protecting the privacy, safety, and dignity of each and every patient. Please join us.
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