The good thing about science is it's True whether or not you believe it.

Neil deGrasse Tyson
Last Spring, hundreds of members of the Harvard Medical School community rallied on the Quad in support of science. What I saw on that cold, bleak, rainy morning was nothing short of inspirational. The sheer energy and passion of the crowd said it all, and I was humbled.

The stories I heard from students, scientists, physicians, and patients reminded me, yet again, that this is a truly extraordinary place. They reminded me of the discoveries, the life-altering research, and the transformative care that take place here on the Quad and at our affiliated hospitals every day. They reminded me why I became a doctor and researcher in the first place.

The questions we are seeking to answer here remain as daunting as ever. We are on a quest to unravel the mechanisms underpinning some of the world’s most intractable diseases. We are committed to training the next generation of physician-scientists. And we do all of this while setting the highest standards for patient care, locally and globally.

HMS researchers are working to solve some of the most confounding mysteries in physiology and medicine, seeking answers to questions that have baffled humans for ages. In the field of neurobiology alone, we ask: How do brains detect motion and light? How are orientation and direction perceived? How do the brain’s electrical and chemical signals move and change when one is thinking?»
HMS neurobiology research fellow Yvette Fisher is pursuing answers to some of these questions. What she discovers should yield basic insights into neural function and behavior and, in the long term, what she learns may help us understand some of the mysteries of the human brain, as well as its diseases and dysfunction.

In the Department of Biomedical Informatics, pulmonary physician and computational biologist Maha Farhat has teamed with Michael Baym, a mathematician and evolutionary biologist, to uncover the secrets of microbial drug resistance using whole-genome sequencing. Their findings may one day enable clinicians to choose just the right antibiotic for a particular patient, and do it more quickly than ever before. Rapid treatment of microbial infections is necessary for preventing and curbing microbial drug resistance rates over time.

And these are just two examples of the work taking place here.

Both, however, are emblematic of the creativity, drive and innovation that have made HMS the nucleus of the most dynamic biomedical research and training ecosystem on the planet.

Our more than 11,000 faculty across the Quad and in the School’s affiliated teaching hospitals and research institutions are setting the pace for progress in biomedical research and clinical medicine. They are inspiring a bold new vision for the health care of tomorrow. Our faculty’s work promises to advance science, glean unprecedented insights, and transform human health in unimaginable ways. And many of these discoveries are occurring at a dizzying pace, one of the reasons I remain confident that discoveries made in the next few decades will dwarf those of the past millennium.

HARNESSING OUR RESOURCES

As the twenty-second dean of this school, I am proud to be leading an institution dedicated to educating and training the biomedical and health care leaders of tomorrow. I am inspired by the determination of those who are pursuing new therapies that will save or improve human lives. On a broader scale, we are working to be part of the solution to the primary care crisis, and we are informing the national conversation on health care on multiple fronts. We are also partnering with resource-strapped nations to help them build or strengthen their health care systems, making the world a healthier, safer place.

Our ability to achieve major scientific breakthroughs is exceptional. Thanks to our researchers we can now envision treating sickle cell anemia by taking a patient’s diseased blood cells, repairing the defective globin genes, and restoring the patient’s ability to make healthy, robust red blood cells. As incredible as this sounds, we’ve only begun to scratch the surface of the advances in medicine yet to come.

But it is more important than ever before that we translate our discoveries in the lab into meaningful treatments in the clinic. I have formed a therapeutics task force charged with exploring how HMS can play an even greater role in the development of therapeutics. Moreover, we are making strides in the creation of new tools, technologies and facilities for faculty and students. The Harvard Cryo-Electron Microscopy Center for Structural Biology in the Longwood Medical Area is one such venture. Cryo-EM will allow us to see single molecules at the atomic level. The center, which grew from a collaboration between HMS, the University and several of our affiliates, will greatly enhance our understanding of cellular mechanisms and accelerate biomedical discovery.

We continue to cultivate our greatest resource—our students—and evolve our transformative curriculum by creating new ways to train tomorrow’s doctors. This year, we are taking steps to more effectively integrate science and medicine in the classroom, reuniting basic science with clinical applications. By fortifying ties with our affiliates, we are capitalizing on the matchless mentorship environment at HMS. One of my foremost goals is to increase opportunities for the next generation of physician-scientists who will make the fundamental breakthroughs that will change the very nature of medical diagnosis, treatment and prevention.
that encourage a free exchange of ideas, group gatherings and study sessions. Such changes help ensure that our campus provides an environment that fosters community and collaboration.

Our students and faculty share their expertise with the world, providing education, training and collaborative research opportunities from Africa to Asia, and from the Middle East to South America. We are creating programs that offer knowledge to new types of learners, both in this country and worldwide. A new free online course addresses the current opioid crisis in America, while the pioneering HMX program provides courses on fundamental scientific disciplines for learners anywhere in the world who are interested in or beginning careers in health care. This year, we partnered with Harvard Business School to convene leaders from universities and health systems in 17 countries in an effort to find ways to improve global health care delivery.

SERVING WITH DEDICATION

In my role as dean, I also hope to spark a greater sense of connection at HMS—by nurturing closer bonds, both on the Quad and between our campus and the wider community. This year our entering class of medical students began orientation week by immersing themselves in the communities in which they will serve. They visited clinics across Greater Boston, meeting people in 20 different neighborhoods to get a better sense of how patients’ environments and histories directly affect their health.

Diversity is fundamental to fostering a greater sense of connection, collaboration and excellence across our HMS community. It forms the foundation for our ideals and goals as an institution and as a nation, and it is a critical driver of new ideas, partnerships and breakthroughs. Diversity underpins our values as a school, values that embrace respect for all individuals in an environment where every person can thrive. Although half of our entering class this year is female and 20 percent are from minorities under-represented in medicine, we must do more to increase the diversity of our faculty and in other areas across our entire campus. I have created the Task Force on Diversity and Inclusion, which is assessing how HMS can become more supportive and looking at how we can measure progress so that we hold ourselves accountable to our goals.

We also continue to renovate our physical environment to create spaces

awards for pioneering or transformative research and innovation. Stephen Elledge, the HMS Gregor Mendel Professor of Genetics and of Medicine at Brigham and Women’s Hospital, received the 2017 Breakthrough Prize for work that elucidated critical mechanisms by which cells detect and respond to damage to their DNA. Elizabeth Armstrong, director of educational programs at HMS, received the Abraham Flexner Award for Distinguished Service to Medical Education from the Association of American Medical Colleges, one of the most prestigious awards in medical education.

Against this backdrop of remarkable advancement and inspiring possibility, there is a real concern—both in the scientific community and more broadly—that funding for basic research could be still be compromised.

One of our responsibilities in the coming years will be to demonstrate and communicate the importance of the work we do, so that we may secure—and grow—the support that is so vital to our mission. We remain committed to ensuring that HMS will continue to be at the forefront of new discovery, dedicated to producing knowledge that can help safeguard the health and welfare of the world, and devoted to the education and training of the next generation of leaders in science and medicine.

I am grateful, humbled and inspired by the work that takes place at HMS every day, and I recognize how fortunate I am to be a part of this exceptional community.
Biomedicine is propelled by the quest to understand the great mysteries of life and by our collective mission to keep each other and the planet healthy.”

Alex Garruss
PHD 2018
BIOINFORMATICS AND INTEGRATIVE GENOMICS

“I look forward to a future where conditions as complex as cancer and autoimmunity can be addressed with a treatment as simple as a vaccine.”

Eric Grewal
MMSC 2018
IMMUNOLOGY

“Regardless of the advancements made in medicine, it is the compassion and kindness that will be constant. The promise of medicine, for me, is the promise of humanity.”

Dayang Nyandak
MD 2018
CANNON SOCIETY

“Medicine promises people hope. Hope rooted in the discoveries of the past and felt in the therapies of the present. Hope that is inspiring the future.”

Wilfredo Garcia Beltran
PHD 2016
MD 2018
LONDON SOCIETY

“The promise of medicine rests within its unique capacity to serve as a bridge to peace.”

Andrew Kim
MD 2018
HOLMES SOCIETY

“I hope to always think about the person in front of me, their families and environment. This will motivate me to fight the structures ... that stand in the way of a person’s health.”

Adeola Oni-Orisan
MD 2018
PEABODY SOCIETY

“I have seen and continue to see the consequences of global and historic political, social and economic events manifested in the bodies of my patients.”

Nora Abo-Sido
MD 2018
CASTLE SOCIETY
First-year HMS and HSDM student volunteers provide mentorship and tutoring to students at Mission Grammar School in Boston. Initiated by MD and Castle Society student Mark Zaki (not pictured), the medical and dental students lead group learning sessions, engage the students in sports and other activities, and provide one-on-one tutoring. Here, Thomas Thompson (right) answers a question posed by DMD and Castle Society student Ryan Lisann.
London Society MD-PhD student Dylan Neel (left) studies liver cancer in zebrafish in the lab of Wolfram Goessling, HMS director of the Harvard-MIT Division of Health Sciences and Technology (HST) and associate professor of medicine at Brigham and Women’s Hospital and Dana-Farber Cancer Institute.
PROGRAM IN MEDICAL EDUCATION

New Curriculum Evolving

Now in the third year of the Pathways curriculum, the School has successfully passed a major transitional milestone, with students from both the new and previous curricula participating simultaneously in Principal Clinical Experience clerkships, resulting in a two-class overlap at Harvard Medical School teaching hospitals. Dean for Medical Education Edward Hundert, the Daniel D. Federman, M.D. Professor in Residence of Global Health and Social Medicine and Medical Education, credited faculty mentors, clinical clerkship directors, staff and students with successfully managing the complex logistics of hosting more than 300 students in core clerkships over a six-month period.

The entering Class of 2021 was the first to participate in a new community engagement program. Designed to have HMS students connect more closely with people in the communities in which they will be learning and working, the program provides students with a better understanding of the health challenges patients face.

Taken before and after the clerkship year, the new two-part Essentials of Medicine: Evidence, Ethics, Policy and Social Medicine course provides students with a broad overview of health policy, social medicine, health disparities, population science, clinical epidemiology and medical ethics in a case-based format that approaches complex issues from a systems perspective. Third- and fourth-year students are immersed in mentored scholarly projects, new advanced integrated science courses (AISCs) and electives.

HMS continues to more closely align the clinical and basic sciences. Beginning in January 2018, laboratory scientists and clinicians will team teach the new AISCs. This synergy demonstrates for students how lab discoveries can lead to advances in patient care and how clinical care is relevant in fields such as cancer biology, neuroscience and immunology research. These required courses will follow the clerkship year, after students have been exposed to clinical medicine and can more fully appreciate the interface of basic science and clinical practice.

Launched this year, the Institute for Health Professions is linking students with interprofessional health care teams at affiliate hospitals where students can obtain a variety of experiences, such as conducting patient-care simulation exercises with physical or occupational therapists.

To train greater numbers of physician-scientists who are exceptionally qualified to care for patients, pursue biomedical research, and transform the detection, diagnosis, treatment and prevention of diseases, HMS is planning to expand its MD-PhD program, which currently enrolls 14 students per year. The training of physician-scientists is also the goal of the jointly administered Harvard-MIT Health Sciences and Technology (HST) program, which combines a unique blend of medical and biological engineering education that leads to the MD degree. The HST program focuses on training physicians skilled at designing the biological tools of the future, such as laboratory analytics, diagnostic instruments, or patient care devices, including prosthetics and artificial organs.

STUDENT AFFAIRS

Supporting Well-Being

Recognizing the challenges and rigors of medical education, the Office of Student Affairs, led by Dean for Students Fidencio Saldaña, assistant professor of medicine at Brigham and Women’s Hospital, has created the Wellness and Mental Health Initiative aimed at assessing current resources and developing a comprehensive four-year program that will help foster and support student resilience and well-being. A task force will make recommendations in areas such as mentorship, peer support and community building. Another initiative developed this year was the Sharing Struggles and Building Resilience series of talks, in which both faculty and students explored and addressed the challenges students face during medical training. The new Thrive@Harvard smartphone app, a Harvard-wide health and wellness platform, provides students with school-specific information about HMS safety and health services, academic enrichment activities, social events, and food and entertainment resources. Helping to guide career choices, a team of five advisory deans is connecting students in each HMS society with key professional resources, such as clinical specialists who mentor students, helping them choose a specialty, prepare for the residency match, or connect with opportunities to do research or pursue international experiences.

INFORMATION TECHNOLOGY

Platform Expansion

The HMS Office of Information Technology has made significant progress in updating technologies and services that are instrumental to advancing education and research on campus, including the successful rollout of new digital platforms that support the Principal Clinical Experience. IT expansion in the past two years resulted in 250 courses being added to the learning management system. Eight hundred faculty and staff and 1,400 students across 12 programs in medical, dental and graduate education have accessed these systems, and 21,000 evaluations have been submitted into the student information system alone. More than 2,000 videos, which students use to prepare for classes, have accumulated 270,000 views and 34,500 hours watched.

In addition to upgrading security systems and privacy firewalls, the IT team completed major updates to the data management, storage and networking infrastructure. These improvements are essential to research that requires high bandwidth, such as genetics and biomedical informatics.

To provide technology training across the HMS community, the IT team has been offering online and in-person instruction, including new Drop-In Ed Tech Clinics and live remote training via online conferencing.
Zecai Liang is a PhD student in the new interdepartmental Molecular Mechanistic Biology program, an interdisciplinary initiative focused on understanding biochemical and biophysical mechanisms at the molecular level. Here, Liang, in the lab of Stephen Liberles, professor of cell biology, studies the physiological function of orphan G protein-coupled receptors expressed in vagal sensory neurons. She is exploring their roles in the gut-to-brain sensory circuit.
With an eye to overcoming many of the world’s more pressing health challenges, Harvard Medical School aims to develop collaborative, multidisciplinary teams focused on making profound contributions to biological science and human health. The Program in Graduate Education, led by Dean for Basic Science and Graduate Education David Golan, the George R. Minot Professor of Medicine at Brigham and Women’s Hospital and professor of biological chemistry and molecular pharmacology at HMS, is dedicated to training scholars who are focused on improving the health and well-being of populations around the globe.

DOCTORAL STUDIES

The School’s PhD program offers training in nine disciplines. In 2017, 870 students were enrolled. The six programs in the Division of Medical Sciences include bioinformatics and integrative genomics, biological and biomedical sciences, immunology, neuroscience, and virology, as well as speech and hearing bioscience and technology. Three programs—biophysics, chemical biology and systems biology—are collaborations with Harvard’s Faculty of Arts and Sciences. This past year, training grants for several of these programs were renewed, and efforts are underway to identify funding to support additional PhD students, including those in the MD-PhD program. The goal is to continue attracting the most gifted candidates from around the world.

MASTER’S PROGRAMS

The HMS master’s programs experienced significant growth over the past six years with total enrollment now at 188. Participants are focused on the following professional goals:

MMSc in Clinical Investigation: To translate findings about the fundamental processes of health and disease into treatments that ease human suffering.

MMSc in Global Health Delivery: To interact with local and international communities to deliver medical care to people in underserved regions.

MMSc in Immunology: To work at the cellular and molecular levels to unlock the potential of the human body’s defense mechanisms.

MMSc in Medical Education: To find innovative ways to educate the next generation of medical students.

Master of Bioethics: To address the ethical challenges that arise from lifesaving medical advances, scientific research, and changes in demographics and policy.

Master of Biomedical Informatics: To integrate biomedical informatics into scientific and clinical practice. In 2017, HMS launched a second, separate degree track for postbaccalaureate students.

COLLABORATIVE SCIENCE

HMS continues to shape new training programs in collaborative science.

Molecular Mechanistic Biology Concentration: This nondegree cross-departmental program, which had 14 PhD students enroll in its first class, helps students understand how the molecular machinery of life works so they can apply that knowledge to their specific fields of biomedical study.

Therapeutics Graduate Program: In 2017, the first class of PhD students graduated from this five-year-old interdisciplinary program, which stimulates investigations that hold promise for new drug discoveries.

Landry Cancer Biology Consortium and Research Fellowships: Now entering its third year, this enrichment program, a collaboration between HMS and the Faculty of Arts and Sciences, annually awards five two-year fellowships and brings together PhD students from across the Harvard Integrated Life Sciences programs to explore how their field of study can contribute to a deeper understanding of cancer biology. Since the program’s inception, 99 Harvard faculty and 260 students have worked together to apply findings about fundamental cancer mechanisms, such as cell signaling and chromosome separation, to the field of cancer biology to create new research directions and potential therapeutics.

Harvard Graduate Program in Bacteriology: Earning a perfect score in the National Institutes of Health application process, this program, which spans HMS and the Harvard TH. Chan School of Public Health, was awarded a five-year, $4.7 million training grant to prepare scientists for careers in bacteriology and infectious diseases. Beginning next year, the grant will support a total of eight PhD students during their second and third years. It also extends a long tradition at HMS and the Harvard Chan School of offering interactive symposia and meetings in the biological and biomedical sciences, microbiology, immunology, virology and public health dimensions of infectious diseases.

FOR MORE ON EDUCATION:
hms.harvard.edu/education
RESEARCH HIGHLIGHTS

Harvard Medical School is in the vanguard of biomedical breakthroughs that promise to improve human health and transform the human condition. HMS is advancing this new era of possibility by merging a passion to heal with a true spirit of collaboration and innovation.

The combined research efforts of HMS and the Harvard School of Dental Medicine resulted in $233,087,919 in federal awards and $68,944,168 in nonfederal awards for sponsored research programs, for a total of $302,032,087. Of those grants, $208,041,171 was awarded by the National Institutes of Health.

Harvard Cryo-Electron Microscopy Center  In a move that advances the School’s leadership in structural biology, HMS, Harvard University, Boston Children’s Hospital, Dana-Farber Cancer Institute and Massachusetts General Hospital formed a consortium to acquire two state-of-the-art cryo-electron microscopes to be installed in early 2018 in the Seeley G. Mudd building. The massive automated instruments of the Harvard Cryo-Electron Microscopy Center for Structural Biology in the Longwood Area will maximize the number of research projects that can utilize this sophisticated technology. This will allow scientists to obtain atomic-level images of cells and proteins at cryogenic temperatures in their native environment, not stained or fixed, providing a significant research advantage.

Laboratory of Systems Pharmacology  To help explain why some cancer patients respond to chemotherapy and others don’t, scientists in the HMS Laboratory of Systems Pharmacology have developed a novel method for digital histology that captures 20 times more data from tissue biopsies. The project is supported by the Ludwig Center at Harvard and was developed within the Harvard Program in Therapeutic Science (HiTS), which was founded by and is chaired by Peter Sorger, the Otto Krayer Professor of Systems Pharmacology. Buttressed by a new $4.3 million grant from the Massachusetts Life Sciences Center, the laboratory will continue to develop this and other methods into clinical-grade tests to diagnose and monitor disease.

Office of Technology Development  Pursuing its mission to spur innovation and improve lives, the Harvard Office of Technology Development (OTD) published The Inventor’s Handbook, a guide to help researchers translate technologies invented at Harvard into useful products that can be made available to benefit society. This year, university-wide, OTD successfully launched 14 new startup companies, granted 46 technology licenses and raised $51 million in new research funding through corporate partnerships.
HARVARD CATALYST
Making a National Impact

Now in its tenth year, Harvard Catalyst | The Harvard Clinical and Translational Science Center is influencing clinical research across the nation. Led by Harvard Catalyst, the SMART IRB speeds multisite clinical trials by hastening translation of scientific discoveries that will make a positive impact on human health. A second initiative, Accrual to Clinical Trials (ACT), uses electronic health records (EHRs) to identify patients with specific demographic and clinical characteristics who might be eligible for clinical trials. Both SMART IRB and ACT now drive collaboration among clinical and translational science centers (CTSCs) across the U.S.

Master reliance agreements, the backbone of SMART IRB, were conceived and developed by Harvard Catalyst to address the major regulatory burden of protracted and redundant multi-institutional IRB approval processes faced by investigators opening clinical trials across Harvard. These master reliance agreements now enable a second IRB to rely upon the regulatory review conducted by the first IRB. Once the master reliance agreement is executed, institutions can cede IRB review to one another. All Harvard schools and 15 affiliated academic health centers are participating and, to date, nearly 2,000 cross-institutional protocols have been approved and rapidly implemented.

Harvard Catalyst also organized all New England CTSCs into a single network with a common master reliance agreement and the infrastructure that enables cede review. With Harvard Catalyst broadly sharing its expertise and tools, CTSCs in California, Texas, Ohio and Wisconsin also established independent statewide reliance networks.

The National Center for Advancing Translational Sciences (NCATS) then selected Harvard Catalyst to be a SMART IRB lead site, collaborating with the University of Wisconsin and Dartmouth College CTSCs to develop a national master reliance agreement and infrastructure. With the support of Clinical and Translational Science Award (CTSA) principal investigators, officials at all 64 national CTSCs signed the SMART IRB Master Reliance Agreement in 2017. More than 275 research institutions now have access to millions of patients across the country and can collaborate with investigators at remote U.S. institutions.

The Harvard Catalyst informatics program i2b2SHRINE allows Harvard investigators access to EHRs at several of Harvard’s academic health centers and identifies patients eligible for clinical trials. Tools, infrastructure and legal agreements permit the identification of de-identified patients who share specific common clinical characteristics. Harvard shared the open-source program, and other CTSCs implemented it. NCATS adopted the system, which connects EHRs at multiple CTSCs and improves accrual to clinical trials. By the end of 2017, 21 CTSCs will be connected, and investigators at these sites will be able to query EHRs across the ACT consortium to determine how many patients have specific clinical characteristics. A Harvard Catalyst-led effort will aid each local ACT CTSC in re-identifying patients at their sites who might be eligible for a clinical trial at another CTSC. It is projected that by 2020 approximately 40 CTSCs will have joined the ACT Network.

BIOLOGICAL CHEMISTRY AND MOLECULAR PHARMACOLOGY

Discovery of a New DNA Repair Pathway

Before cell division, human DNA is duplicated so that one copy of the genetic blueprint can be passed on to each daughter cell. During duplication, the two strands of the DNA double helix are separated, or unwound. However, this unwinding process is sometimes blocked by chemicals that create DNA interstrand cross-links (ICLs). Failure to repair ICLs causes mutations and cancer. Until recently, it was thought that the only way to repair ICLs was to cleave DNA on either side of the lesion, which leads to dangerous DNA breaks. As reported in Cell, the laboratory of Johannes Walter, professor of biological chemistry and molecular pharmacology, discovered a new pathway in which ICLs are repaired by the enzyme NEIL3, which cuts the ICL itself, leading to resolution of the lesion without inducing DNA breaks. The researchers also obtained evidence that the NEIL3 pathway is preferred, opening potential new avenues for cancer treatment.
BIOMEDICAL INFORMATICS

Misdiagnosis of Heart Conditions

Genetic testing has improved the detection of potentially lethal heart anomalies among asymptomatic people who have family members who have experienced cardiac arrest or sudden cardiac death. Now, a study in the *New England Journal of Medicine* led by Isaac Kohane, the Marion V. Nelson Professor of Biomedical Informatics and chair of the department, with Arjun Manrai, instructor in biomedical informatics, revealed that in black Americans these lifesaving tools may disproportionately misdiagnose hypertrophic cardiomyopathy (HCM), a thickening of the heart muscle that can spark fatal arrhythmias in seemingly healthy young adults. Using statistical analyses, the researchers showed that inadequately designed clinical studies, using predominantly white populations as controls, led to a higher incidence of false-positive HCM diagnosis in black Americans. The findings demonstrate that genetic test results need to be interpreted against diverse control populations to ensure that normal genetic variations common in one ethnic group do not get misclassified as disease-causing in another.

CELL BIOLOGY

Promising Therapy for ALS

HMS scientists have identified a key factor that ignites nerve-cell damage in amyotrophic lateral sclerosis, or ALS, a progressive and fatal neurodegenerative disorder also known as Lou Gehrig’s disease. As published in *Science*, a team led by Junying Yuan, the Elizabeth D. Hay Professor of Cell Biology, showed that the mechanism of axonal injury and death involves RIPK1, a regulator of inflammation and cell death. When RIPK1 is out of control, it can set off a chemical chain reaction that strips the protective myelin off axons and triggers axonal degeneration, the hallmark of ALS. Yuan’s research team also identified a protective strategy by which RIPK1 activity was blocked by a chemical called necrostatin-1. This promising therapy, which stopped nerve-cell damage in mice with ALS, is currently under development for testing in humans.

GENETICS

The Yin to Insulin’s Yang

To metabolize and lower blood sugar, the body produces insulin, which is counterbalanced by blood sugar-raising hormones such as glucagon. Disrupting this equilibrium can lead to diabetes, which today affects 29 million people in the U.S. alone. Using a new fruit fly model of type 2 diabetes, a research team led by Norbert Perrimon, the James Stillman Professor of Developmental Biology, focused on the mechanisms exploited by glucagon. It found that a chronic high-calorie diet can lead to high blood sugar simply by boosting the gut hormone activin beta, which in turn stimulates activity of the fly version of glucagon—without affecting insulin. The findings, published in *Cell Metabolism*, provide a deeper understanding of how diabetes can arise from a high-calorie diet, and they support existing efforts to find ways to regulate the body’s response to glucagon as a potential alternative to insulin for managing diabetes.

GLOBAL HEALTH AND SOCIAL MEDICINE

Undetected Infection in Ebola ‘Hot Spot’

The 2013–16 Ebola outbreak in West Africa led to a massive international response to treat people with symptoms of the infection. But there was limited evidence of Ebola infection in individuals presenting no symptoms. Focusing on a hot spot village in Sierra Leone, an initiative headed by Paul Farmer, the Kolokotrones University Professor of Global Health and Social Medicine and chair of the Department of Global Health and Social Medicine, that was supported by colleagues working in the field, used the ELISA blood test to compare 187 study participants with 162 control subjects, including 152 with low likelihood of previous Ebola exposure and 30 Ebola survivors. They identified 14 seropositive individuals not previously known to have had the infection; two who reported only fever during the outbreak and 12 who experienced no symptoms. These findings, reported in the journal *PLOS Neglected Tropical Diseases*, indicate that Ebola presents with a spectrum of clinical manifestations, including minimally symptomatic infection, and they suggest that a significant portion of Ebola transmission may have gone undetected during the outbreak. Further studies are needed to understand the potential risk of transmission and clinical sequelae in individuals with previously undetected infection.

HEALTH CARE POLICY

Opioid Prescribing by Emergency Physicians

Overuse of opioids may be driven in part by physician prescribing practices, but the extent to which individual physicians vary in prescribing patterns was unknown, as were the long-term implications of these practices. Now, research reported in the *New England Journal of Medicine* and led by Anupam Jena, the Ruth L. Newhouse Associate Professor of Health Care Policy, studied 377,629 Medicare patients who had visited an emergency department and had not been prescribed opioids within the six months before the visit. Within each hospital, emergency physicians who cared for these patients were categorized as either high-intensity or low-intensity opioid prescribers, resulting in a research sample of 215,678 patients receiving treatment from high-intensity prescribers and 161,951 from high-intensity prescribers. Patient characteristics—including diagnosis by the emergency department physicians—were similar in the two groups. The researchers discovered a wide variation in opioid prescribing rates among physicians in the same emergency department. Comparing the rates of long-term opioid use, defined as six months of prescriptions supplied to patients in the 12 months following an emergency visit, the researchers found higher rates of long-term opioid use among patients who were initially treated by high-intensity opioid prescribers.
MICROBIOLOGY AND IMMUNOBIOLOGY

Bacteria Form Potentially Infectious Prions

In a first-of-its-kind discovery, bacteria were found to form potentially infectious prions, self-propagating clumps of misfolded proteins that are notorious in mammals for causing several rare but fatal neurodegenerative conditions, including bovine spongiform encephalopathy, also known as mad cow disease. In a study published in Science, Ann Hochschild, the Maude and Lillian Presley Professor of Microbiology and Immunobiology, and Andy Yuan, research fellow in cell biology, identified a protein with prion-forming potential in the bacterium Clostridium botulinum. This protein, called Rho, normally functions to control which genes get turned on or off. But the HMS study showed that the C. botulinum Rho protein can also make self-propagating prions that form telltale protein deposits called amyloids. Using the bacterium Escherichia coli as a model, the researchers demonstrated that the switch to the prion form caused many previously silent genes to turn on, suggesting that prions could help bacteria respond to stressful conditions, which would render them less vulnerable to antibiotics and other environmental assaults.

NEUROBIOLOGY

Unlocking the Blood-Brain Barrier

Extolled for their health benefits, omega-3 fatty acids also appear to play a critical role in preserving the blood-brain barrier, which protects the central nervous system from harm but is also a major hurdle for delivering therapeutic compounds into the brain. Reporting in Neuron, a team led by Chenchua Gu, associate professor of neurobiology, provided the first molecular explanation for how the barrier remains closed: by suppressing transcytosis, a process for transporting molecules across cells in vesicles, or small bubbles. Her team found that the formation of these vesicles is inhibited by the lipid composition of blood vessel cells in the central nervous system, which involves a balance between omega-3 fatty acids and other lipids maintained by the lipid transport protein Mfsd2a. Blocking Mfsd2a activity may be a way to get drugs across the barrier and into the brain to treat psychiatric disorders or diseases such as brain cancer, brain infections and Alzheimer’s.

STEM CELL AND REGENERATIVE BIOLOGY

New Vistas for Brain Disorder Research

To study human brain development and disease, scientists have increasingly turned to organoids—organ models cultured from induced stem cells. But until now, these organoid cultures could be sustained for only short periods of time. A team headed by Paola Arlotta, professor of stem cell and regenerative biology, co-director of the nervous system disease program at the Harvard Stem Cell Institute and institute member in the Stanley Center for Psychiatric Research at the Broad Institute of MIT and Harvard, described in Nature a new method that allows brain organoids to grow for nine months or longer, which gives them time to attain unprecedented levels of cell maturation, including the development of active neural networks and light-sensitive cells. The researchers also provided the largest molecular map to date of the diversity and reproducibility of cell types generated in brain organoids, suggesting that three-dimensional brain organoids have the potential to serve as a platform to understand the brain’s synaptic building blocks, which could provide insights into neurodevelopment and psychiatric disorders.

SYSTEMS BIOLOGY

Precision Timing in a Cell

HMS researchers have developed a synthetic biological clock that rivals the precision of naturally occurring systems in living cells. The starting point for their work was a gene-based oscillator that jump-started the field of synthetic biology 17 years ago by showing that simply linking three gene repressor proteins together could generate periodic pulses of gene expression. However, the original genetic circuit was highly irregular, with oscillations quickly drifting out of phase and most cells not oscillating at all. Subsequent oscillators slightly improved performance by adding more layers of control. As reported in Nature, researchers led by Johan Paulsson, professor of systems biology, developed a major upgrade, by removing rather than adding features, based on theory for random processes and systematic measurements of errors in single cells. The precision of this streamlined gene circuit, which oscillates in phase for hundreds of generations without cell-to-cell communication, may help advance areas of scientific inquiry, both in terms of understanding natural oscillators and building other precise circuits, for example, the design of drug-delivery systems in which the drug’s efficacy depends on the cycle of the targeted cell.

HARVARD SCHOOL OF DENTAL MEDICINE

Repressing Early Signals in Liver Cancer

Understanding how malignant tumors are initiated is key to cancer prevention, early detection and successful treatment. A genetic study by Yingzi Yang, professor of developmental biology at HSDM, has revealed how interacting pathways can restrain tumor initiation and proliferation in liver cancer. Her research team focuses on signaling pathways involving Hippo, Wnt/ß-catenin and Notch, which work together to maintain liver size and suppress hepatocellular carcinoma, the second-leading cause of cancer mortality worldwide. Previous studies in her lab showed that removal of the Hippo kinases Mst1 and Mst2 led to rapid tumor formation by activating a signaling pathway involving the transcription regulator YAP/TAZ. The team’s recent studies, published in the Journal of Clinical Investigation, revealed that to promote rapid tumor growth, the Notch signal forms a positive feedback loop with YAP/TAZ and that this interaction can be inhibited by the Wnt/ß-catenin signal. These results provide key insights for developing molecular targets to treat liver tumors arising from distinct genetic mutations.
To fully weave the goals of diversity and inclusion into the fabric of HMS, Dean George Q. Daley formed the Task Force on Diversity and Inclusion, led by Dean for Diversity and Community Partnership Joan Reede. This cross-institutional group of more than 30 individuals includes senior and junior faculty, trainees, students from various degree programs and staff. The group is charged with determining how to best assess the current state of diversity and inclusion on campus and with considering the multiple dimensions of diversity that each community member offers, including, but not limited to, race, ethnicity, sex, gender identity, sexual orientation and disability. The group is also tasked with identifying goals, recommending policies and proposing an implementation plan that promotes a culture of respect and acceptance.

Metrics to track factors such as admissions, hiring, retention, advancement, productivity and job satisfaction are being formulated, and these evidence-based measures will shape future directions. This School-wide initiative is informed by diversity policies currently being formalized by Harvard University.

To further advance diversity inclusion, the 15-year-old Advanced Placement (AP) Biology Hinton Scholars Program was among a wide range of community enrichment programs offered this year. Designed to help students from underserved neighborhoods pass AP biology exams, each year the program brings 80 students from four Boston high schools into HMS labs to be tutored by medical and graduate students and postdoctoral fellows. In the 2014–2016 program years, Hinton students on average passed the AP biology exam at greater percentages than other students in Boston Public Schools. In addition to learning concepts that will help them pass the exam, students were introduced to a range of biomedical career options.
The guiding mission of the Office for Academic and Clinical Affairs is to advance academic excellence, diversity, ethical standards and service at Harvard Medical School. It does so by promoting and supporting the dedicated researchers, educators and physicians among the more than 11,000 HMS faculty on the Quad and at our 15 affiliates. Led by Dean for Academic and Clinical Affairs Nancy Tarbell, the HMS C.C. Wang Professor of Radiation Oncology at Massachusetts General Hospital, its work involves the combined efforts of the School’s offices for faculty affairs, diversity inclusion and community partnership, and academic and research integrity, as well as other cross-institutional collaborations. Interdisciplinary science formed the springboard for two new collaborations spearheaded by the office this year, bringing the total portfolio of HMS centers and initiatives to 13.

HMS Initiative for RNA Medicine RNA science is the centerpiece of the new HMS Initiative for RNA Medicine, launched this year with Beth Israel Deaconess Medical Center. Scientists have increasingly recognized that RNAs play a key role in the growth, division, survival and migration of cells, which makes the molecules promising targets for treating a wide range of diseases, including cancer and neurodegenerative disorders. By sharing RNA research and harnessing its power, the new initiative aims to create breakthrough medicines for patients.

HMS Center for Glycoscience The new HMS Center for Glycoscience brings together expertise from many disciplines to delineate the role of glycans, sugar-molecule combinations found in cells, connective tissues and bodily fluids. Alterations in glycans result in different blood types and are implicated in cancer, congenital disorders, and inflammatory, infectious and autoimmune diseases. Based at Beth Israel Deaconess, the new program expands research capabilities and educational initiatives in glyobiology across HMS and its affiliates.

Foundation Funding for Junior Faculty Also managed by the Office for Academic and Clinical Affairs is the distribution of awards to junior faculty through the Foundation Funds Program. Funding totaling $7,055,000 was available in 2016 from private foundations that limit the number of faculty an institution can nominate. This year’s successful HMS nominees included faculty from the Quad, Dana-Farber Cancer Institute, Brigham and Women’s Hospital and Mass General, who secured a total of $2,615,000 in awards from six foundations, which represents 37 percent of all available foundation funds.

FACULTY AFFAIRS

Led by Dean for Faculty Affairs Maureen Connelly, the Office for Faculty Affairs supports the recruitment, retention and academic advancement of the School’s faculty by, among other things, managing promotions and appointments and organizing leadership and fellowship programs. The office continued to advance several initiatives designed to improve searches and streamline promotions processes.

Resources to Support Faculty Careers In tandem with a redesigned website, the office released the first comprehensive faculty handbook in more than a decade: the Governance, Appointment and Promotion Handbook. Faculty can now find information from school bylaws to the Harvard CV format to procedures for faculty appointments in one accessible document.

Tools for Faculty Searches The office has begun implementing the recommendations of the Task Force on Faculty Searches to develop two online tools: a training module on how to conduct faculty searches, including strategies for overcoming unconscious bias and recruiting candidates of diverse backgrounds, and a method that helps search committees document decision-making pathways in real time.

Opportunities for Advancement Dean Daley has appointed a task force to analyze the criteria by which faculty are evaluated for promotion. In AY17, promotions reached a record high: 92 faculty were promoted to professor, including 34 women and six faculty from populations underrepresented in medicine; 142 were promoted to associate professor and 370 were promoted to assistant professor. New professors were introduced at Faculty of Medicine meetings, and new assistant and associate professors were celebrated at a spring reception.

Career Support Established in 1995, the Eleanor and Miles Shore 50th Anniversary Fellowship Program provided fellowships this year to 81 junior faculty, offering critical career support to help faculty balance teaching, research, grant writing, publishing and clinical practice with increasing family or other responsibilities. Outcomes of improved rates of promotion and retention for fellowship recipients were published in Academic Medicine. A three-day course promoting leadership in academic medicine attracted 77 faculty, many of whom will become tomorrow’s senior leaders at HMS and beyond.

Salary Equity With a focus on improving work experience and career development for women, the HMS Joint Committee on the Status of Women held its fourth annual Salary Equity Symposium to raise awareness of gender issues and mechanisms that drive clinical and research compensation.

INTEGRITY AND COLLEGIALITY

Academic year 2017 was the first full year following an update to the School’s conflict of interest policy, which was recrafted under the guidance of Dean for Faculty and Research Integrity Gretchen Brodnicki. By successfully petitioning the HMS Standing Committee on Conflicts of Interest, 19 faculty explored new forms of collaboration with industry in an effort to ethically advance new technologies developed at HMS.

The Ombuds Office, headed by Melissa Brodnick, provided confidential, impartial and informal conflict-resolution services to 392 faculty, staff, students and trainees from the HMS, Harvard School of Dental Medicine and Harvard T.H. Chan School of Public Health community who were seeking to resolve 573 self-reported issues. Common concerns included authorship of research studies and harassment and fair treatment issues. Fifty-eight interactive practical training workshops were also provided to 1,642 members of the Harvard Longwood community. Some focused on conflict resolution and negotiation skills, exit strategies and effective mentoring, and all were designed to foster a culture of civility and respect, both on campus and within affiliates. The Ombuds Office staff also provided 21 general presentations for 863 participants.
ADVANCING DISCOVERY AND CLINICAL CARE

Each year, Harvard Medical School’s 15 internationally renowned affiliates care for thousands of patients using the latest medical knowledge and technologies while conducting research in basic, clinical and population sciences.

This year, in an effort to develop a personalized vaccine against acute myeloid leukemia, a clinical trial at Beth Israel Deaconess Medical Center showed markedly improved outcomes, with more than 70 percent of patients remaining in remission for an average follow-up period of more than four years. Boston Children’s Hospital developed a new color-coding tool that enables scientists to better track live blood stem cells over time, a key to understanding how blood disorders and cancers such as leukemia arise.

Offering new hope in combating malaria and other infectious diseases, Brigham and Women’s Hospital and collaborators developed a capsule designed to reside in the stomach and release a daily dose of medicine for weeks at a time. Cambridge Health Alliance’s Internal Medicine Residency program introduced a required social medicine and health advocacy course, which includes a yearlong didactic course of study and a research-based project in which residents investigate a socioeconomic factor that negatively influences patient care.

Dana-Farber Cancer Institute has identified unique genomic changes that may be integral to the development of testicular cancers, explaining why the great majority are highly curable with chemotherapy, unlike most solid tumors. Harvard Pilgrim Health Care Institute found that various components in ventilator bundles, a group of care procedures for patients undergoing mechanical ventilation, vary in their value to patient outcomes. Beneficial components include head elevation, sedative interruption, spontaneous breathing and thromboembolism prevention, but daily oral care using the disinfectant chlorhexidine and stress-ulcer prevention procedures were found to possibly be harmful to some patients.

A Hebrew SeniorLife Institute for Aging Research study found that feeding-tube insertion rates among nursing home residents with advanced dementia and eating dependency dropped by approximately 50 percent over a recent 14-year period, a decline that parallels the emergence of expert opinion discouraging this practice and promoting a palliative approach. Joslin Diabetes Center identified a route by which fat can deliver a form of small RNAs called microRNAs that help regulate many other types of tissues, a discovery that may lead to new diagnostics and gene-based treatments for metabolic diseases such as obesity, type 2 diabetes and fatty liver disease.

The Judge Baker Children’s Center created Parent Talk, a website designed to improve the lives of youth who may be experiencing depression and to educate parents about depression and show them how to maintain a positive influence on their child’s functioning. Investigators at Massachusetts Eye and Ear used a series of hearing tests they developed to link symptoms of difficulty understanding speech in noisy environments with evidence of cochlear synaptopathy, a condition known as hidden hearing loss.

Imaging studies at Massachusetts General Hospital revealed that super-agers, a group of remarkable older adults whose memory performance equals that of younger individuals, have areas of their brains that resemble those of young people. Preliminary evidence from a new longitudinal study at McLean Hospital suggests that medical marijuana, often low in the plant’s primary psychoactive component, may not impair and, in many cases, may actually improve executive functioning in adults. Mount Auburn Hospital created an Interprofessional Leadership Academy, a nine-month course that joins clinicians and nonclinical staff in a training program designed to enhance work efficiency and improve patient outcomes. In studies of robotic machines fastened to patients’ legs that gently prod them to walk, Spaulding Rehabilitation Network found that patients gain stability largely by adjusting their stride in response to a change in the length, but not the height, of their step, pointing to the need for future customized rehabilitation robots that incorporate other factors involved in how the brain interprets gait and balance.

The VA Boston Healthcare System discovered that sleep may be regulated in part by several brain-based immune proteins collectively called NLRP3 inflammasome, which unleashes a cascade of immune molecules in response to inflammation and infection. The findings may become the basis of therapies for people with chronic sleep disorders and disturbances.
In addition to the more than 151 faculty based on the HMS campus, there are nearly 12,000 faculty at the School’s 15 affiliated hospitals and research institutions who provide patient care and clinical training while mentoring aspiring physicians and scientists in research programs that transform medical.

This year alone, researchers at HMS affiliates attained a remarkable range of achievement. In cancer research, investigators at Beth Israel Deaconess Medical Center discovered that a pseudogene, an RNA subclass that has lost the ability to produce proteins, has a role in causing cancer. On the bioengineering front, investigators at Boston Children’s Hospital developed a protein-based scaffolding that can help the anterior cruciate ligament (ACL) repair.

In neurologic studies, researchers at Brigham and Women’s Hospital discovered a gene variant that may help patients with multiple sclerosis better respond to a certain medication. As a result of its efforts to improve health care systems, Cambridge Health Alliance ranked among the top performers in a national pilot program aimed at reducing hospital readmission rates.

Early results of a clinical immunotherapy trial at Dana-Farber Cancer Institute revealed that a cancer vaccine combined with an anti-angiogenic drug improved survival in certain patients with relapsed glioblastoma tumors. Harvard Pilgrim Health Care Institute has been chosen by the U.S. Food and Drug Administration to lead the Sentinel System, a program that uses health care data to monitor the safety of FDA-regulated drugs and other medical products.

Investigators in the Institute for Aging Research at Hebrew SeniorLife found that imperceptible vibrations applied to the soles of feet improved balance and gait in elderly study participants. At Joslin Diabetes Center, studies focusing on bacteria in the digestive system’s microbiome showed that the host’s genes interact with microbial genes to boost insulin resistance and other metabolic disorders.

Judge Baker Children’s Center is working on multiple initiatives with the Commonwealth of Massachusetts and others to improve mental health care for children. Massachusetts Eye and Ear | Schepens Eye Research Institute researchers computationally reconstructed the ancestral state of a viral capsid that is highly effective as a synthetic vector to deliver gene therapies to the liver, muscles and the retina.

A team at Massachusetts General Hospital created a bioartificial replacement forelimb suitable for transplantation in humans. McLean Hospital investigators uncovered a potential treatment for Parkinson’s disease that involves existing antimalarial drugs. Mount Auburn Hospital opened a multidisciplinary program to track patients with lung nodules, aiming to identify and treat cancerous lesions earlier. Researchers at Spaulding Rehabilitation Hospital found that a medicine to treat attention deficit hyperactivity disorder may also help patients with post-traumatic stress disorder.

Studies at the VA Boston Healthcare System showed signs of accelerated aging in the brains of U.S. veterans injured by bomb blasts. The scope and breadth of the impressive accomplishments that HMS partners have realized in the past year are truly extraordinary.
connecting the world
GLOBAL HEALTH AND SOCIAL MEDICINE

Chaired by Paul Farmer, the Kolokotrones University Professor of Global Health and Social Medicine, the Department of Global Health and Social Medicine continues to expand its reach in a broad humanitarian effort.

Nexus of Asia, Africa and Europe The Harvard Medical School Center for Global Health Delivery–Dubai focuses on translating medical knowledge into methods, tools and policies that improve health care delivery systems worldwide. New initiatives this year include the Cooperative Research Awards program, with 25 researchers in 20 countries working with Harvard faculty who are providing project support in diabetes and obesity, surgical care delivery, mental health and infectious diseases. The Global Scholars Program enrolled 12 professionals—nine in the Global Health Delivery Intensive, a rigorous nondegree program that trains public health leaders and practitioners, and three in the Program in Clinical Effectiveness, which hones the analytical skills required for clinical research and health care administration.

Mental Health Because an estimated 25 percent of all health-related conditions are caused by mental disorders, HMS is stepping up its global outreach programs, among other projects, by working with teens in Haiti to identify mental health conditions that impair their ability to function and by creating new programs to overcome the social stigma of getting help.

Infectious Diseases HMS faculty continue to partner with practitioners globally to combat infectious diseases such as Ebola (Liberia and Sierra Leone), HIV/AIDS (Haiti, Lesotho, Malawi, Peru, Rwanda and Uganda), cholera (Haiti) and tuberculosis (Peru). Among several initiatives launched to reduce TB rates, HMS faculty are collaborating with the Harvard Faculty of Arts and Sciences to leverage the arts and humanities to promote literacy, civic engagement and social change programs that are focused on combating disease.

Noncommunicable Diseases and Injury One-third of the disease burden in the poorest nations is the result of noncommunicable diseases (NCDs), such as type 1 and malnutrition-associated diabetes mellitus, heart disease, lymphoma and other cancers, blood and kidney disorders, epilepsy, appendicitis and trauma in its various manifestations. Providing leadership to launch the Lancet Commission on Reframing NCDs and Injuries for the Poorest Billion, HMS faculty are developing systems and policies to improve service delivery to people in impoverished regions who are vulnerable to noncommunicable illness and injury.

Access to Surgery More than 5 billion people worldwide lack access to needed surgical care. To help address this need, HMS is working alongside local providers to improve surgical safety, affordability and access. Among recent collaborative projects is a 300-bed teaching hospital in central Haiti with six operating rooms jointly run by Partners In Health and the Haitian government. In Uganda, anesthesiologists at Mbarara Regional Referral Hospital are now linked via an electronic database to Massachusetts General Hospital, and ultrasound-guided regional anesthesia has been introduced to improve surgical care and outcomes.

Master of Medical Sciences Combining training in biosocial research methods with a mentored, field-based project, the Master of Medical Sciences in Global Health Delivery degree program now provides a rigorous curriculum focused on developing the tools needed to investigate social issues, service delivery and policies in resource-limited settings. This year, 14 new students from 11 countries enrolled in the program. Throughout the past five years, a total of 23 students have earned this degree.

From right: Salmaan Keshavjee, associate professor of global health and social medicine and director of the HMS Center for Global Health Delivery–Dubai, and Nasreen Molla Adamjee, lecturer on global health and social medicine and director of research and programs for the HMS Center for Global Health Delivery–Dubai, converse with a young patient and his family at the Center for Autism in Dhaka, Bangladesh.

BIOMEDICAL INFORMATICS

The Department of Biomedical Informatics (DBMI), chaired by Isaac Kohane, the Marion V. Nelson Professor of Biomedical Informatics, is at the forefront of efforts to bring quantitative methods to biomedicine and to elucidate global patterns of disease. This year it reached several milestones.

Faculty and Enrollments Faculty nearly doubled, as did the number of postdoctoral and graduate students enrolled in DBMI programs. Attracted by the opportunity to combine data science with groundbreaking research, 140 prospective students applied to the PhD Program in Bioinformatics and Integrative Genomics, which provides interdisciplinary training in interpreting the massive amounts of data generated in fields such as molecular biology and genetics.

Bioinformatics Education To help train the biomedical informaticians critically needed in academia and industry worldwide, HMS offers two separate tracks leading to a master of biomedical informatics degree: a 36-credit program for postdoctoral fellows, physicians and medical students and a 48-credit program for postbaccalaureate students, one of three programs launched at the University as part of the broader Harvard Data Science Initiative. In 2018, a new bioinformatics elective for third-year medical students will be introduced as part of the HMS curriculum.

Undiagnosed Diseases With HMS as its coordinating center, the Undiagnosed Diseases Network created by the NIH accepted 639 patients with unexplained medical conditions for clinical research evaluation and genetic testing. Thus far, nearly 100 participants have received a diagnosis, an outcome made possible by nationwide collaboration and sophisticated data analysis conducted by DBMI investigators.

DNA’s Fourth Dimension Faculty are leading the Data Coordination and Integration Center of the NIH’s 4D Nucleome (4DN) network, which aims to understand DNA’s four-dimensional organization within the cell nucleus, not only spatially but also over time. In collaboration with MIT, faculty are developing a data portal that the scientific community can use to access reference maps of nuclear architecture in a variety of cells and tissues using novel data visualization tools.
Data Standards Setting A DBMI-led initiative called Sync for Science (S4S) is working with four commercial electronic health records systems at a dozen U.S. health care providers to implement a standards-based, nonproprietary interface for patient-mediated sharing of clinical data. S4S will enable participants in the NIH All of Us Research Program (previously known as the Precision Medicine Initiative Cohort Program) to independently contribute data, such as pertinent demographics, allergies, immunizations, medications, laboratory results and vital signs.

SPRINT Trial Contest Building on the NIH-funded SPRINT trial to reduce blood pressure, the HMS bioinformatics team joined forces with the New England Journal of Medicine to stage an online data interpretation challenge. With submissions from 143 international applicants, the contest blossomed into a webcast conference that attracted more than 5,000 registrants who explored novel ideas for data sharing that may help accelerate advancements in medical science.

CENTER FOR PRIMARY CARE

Facing a shortage of primary care physicians in the U.S. and an even larger shortfall worldwide, the Center for Primary Care is working to develop training and efficiency models to close the gaps. Directed by Russell Phillips, the William Applebaum Professor of Medicine at Beth Israel Deaconess Medical Center, the Center focused on five initiatives this year.

Worldwide Expansion Capitalizing on the success of the HMS Academic Innovations Collaborative (AIC), which served more than 100,000 patients in 28 Boston-based primary care practices, the Center is helping community health organizations overseas, such as the Abundant Health project in Vietnam, to introduce similar management principles. The AIC model is also being exported to other U.S. medical schools.

Advancing Teams With grant support from the U.S. Health Resources and Services Administration, the Center is working to integrate oral health and mental health into patient care at community health centers that are managing patients with complex medical and psychosocial needs.

Family Medicine Careers Family medicine specialists provide approximately 40 percent of primary care in the U.S., and the Center is providing resources for students pursuing careers in family medicine.

Corporate Outreach The Executive Education program held a three-day course, “Charting the Future of Primary Care,” which attracted more than 60 health care executives from around the world. These professionals came to HMS to focus on how health care systems can improve the use of primary care practices.

Financing Primary Care The Center is developing mathematical models that help primary care practices test the financial impact of administrative practice changes, providing statistics on best practices for the addition of staff, provision of nonvisit care and incorporation of new payment systems.

EXTERNAL EDUCATION

The Office for External Education is creating educational courses and platforms that are reaching a growing range of new learners around the world, from the general public to aspiring medical students to medical and business professionals. Below is a sampling of the portfolio created in the past three years under the leadership of Dean for External Education David Roberts, the Steven P. Simcox, Patrick A. Clifford and James H. Higby Associate Professor of Medicine.

Executive Education Engaging with corporations and businesses from the information technology, pharmaceutical, finance and health insurance sectors, HMS has created learning programs customized for executives whose work influences, affects or relies on the health care industry. A recent program designed for a financial services company introduced its advisors to concepts that will shape the future of cancer care in the U.S. An experiential curriculum was designed for a large pharmaceutical company that seeks to better understand how physicians arrive at clinical decisions. This year, the first open enrollment course on topical health policy issues was launched.

HMX Fundamentals This expanding set of online courses is available to any student seeking a better grasp of fundamentals in health sciences, such as immunology, genetics, physiology and biochemistry. In addition to offering courses at select international universities and medical schools, HMS is making the courses available directly to high school and college students with biomedical career aspirations and to members of the general public who want to understand science more deeply. Recently, an HMX course was purchased by corporate partners in order to provide foundational medical concepts to their employees operating in the health sector.

Harvard Health Publishing The public looks to HMS for reliable and timely consumer health updates. A new daily HMS faculty blog is drawing more than 1.1 million unique visitors a month to the Harvard Health Publishing (HHP) website, which itself attracts 5 million visits per month. More than 1.7 million people follow HHP on Twitter, and a weekly e-newsletter provides a wrap-up of health topics. Last spring, HHP collaborated with HarvardX to create OpioidX, a free online course addressing the opioid crisis in the U.S. The course consists of a seven-module multimedia curriculum that can be used in corporate wellness programs. In a venture that supports patient engagement in clinical care, HHP is developing electronic patient and provider education materials focused on cardiovascular care.

Global and Continuing Education This year, HMS more closely aligned global and continuing education. Among new initiatives is the HMS Global Academy, which, in November 2016, launched a web portal for doctors, researchers and other health care professionals worldwide who are interested in taking distance-learning classes designed by HMS faculty. A timely offering for physicians included the three-course Opioid Use Disorder Education Program that was produced with grant support from the National Institute on Drug Abuse. The Global Academy also launched two new blogs: “Trends in Medicine,” which examines clinical and health care issues worldwide, and “Lean Forward,” which explores controversial issues in public health, medical ethics and health care delivery. More than 18,600 physicians earned continuing medical education credits by attending live courses covering more than 42 specialties or by enrolling in self-paced online courses. This year, 1,043 physicians, scientists and health care professionals from 60 countries participated in the Global Clinical Scholars Research Training Program and other blended global programs that provide advanced instruction in clinical research, cancer biology and therapeutics, as well as training in quality, safety and informatics.
TAMI LIEBERMAN IS HARVARD MEDICINE

Tami Lieberman had always been fascinated by mathematics, medicine and evolution. It is no small wonder that she landed in the Systems Biology PhD program at Harvard Medical School—the one place that allowed her to pursue research at the intersection of all three disciplines.

Through classes and mentorship from her HMS lab advisor and colleagues, Lieberman learned quickly how to apply computational approaches to biological problems. Her work in the lab of Roy Kishony, formerly professor of systems biology at HMS, focused on studying how bacteria evolve within people during chronic infections.

“The program really launched my career,” she said. “It gave me the opportunity to combine evolutionary biology and medical microbiology in new ways, propelling me to the forefront of this new interdisciplinary field of within-person evolution and giving me a relatively unique perspective from which to ask questions about the human microbiome, which is the basis of my new lab.”

A graduate fellowship from the Lynch Foundation, which covered full tuition plus a stipend, meant that Lieberman didn’t have to worry about how to pay for her education. A new $1 million gift from the foundation this year advances The World Is Waiting: The Campaign for Harvard Medicine and allows HMS to support two new Systems Biology PhD candidates each year.

“These emerging scientists are an integral part of the lab. They are often underfunded and need help,” said Peter Lynch, president and chairman of the Lynch Foundation, member of the HMS Board of Fellows and co-chair of the HMS Discovery Council.

Lieberman understands the funding challenges acutely. After earning her PhD at Harvard in 2014 and completing her postdoctoral training at MIT, she is on the cusp of launching her own lab at MIT, where she will need to cover 25 percent of her lab costs through grants.

“Private funds are critical to early- and mid-career researchers because they support promising risks, whereas the NIH grant review process tends to favor established investigators with a proven track record of success,” she said.

Nearly 10,000 alumni, faculty, staff, volunteers and friends have made a gift to support HMS’s transformative fundraising campaign. To learn more and make a gift during the final year of the Campaign, visit hms.harvard.edu/campaign.
**Honors and Awards**

2017 Breakthrough Prize in Life Sciences
Stephen Elledge, the Gregor Mendel Professor of Genetics and of Medicine at Brigham and Women’s Hospital, was a co-recipient with Harry Noller, University of California, Santa Cruz, Roeland Nusse, Stanford University, Yoshinori Ohsumi, Tokyo Institute of Technology, and Huda Yahya Zoghbi, Baylor College of Medicine.

2017 Warren Alpert Foundation Prize
Gordon Freeman, professor of medicine at Dana-Farber Cancer Institute, and Arlene Sharpe, the George Fabyan Professor of Comparative Pathology, were co-recipients with James Allison, University of Texas MD Anderson Cancer Center, Liping Chen, Yale University, Tasuku Honjo, Kyoto University, and Michael Atkins, Georgetown University Medical Center.

2017 Gruber Genetics Prize
Stephen Elledge, the Gregor Mendel Professor of Genetics and of Medicine at Brigham and Women’s Hospital, was a co-recipient with Craig Venter, the founder and president of the J. Craig Venter Institute, and John Sulston, the Nobel Laureate in Medicine.

National Academy of Sciences
Four faculty members were elected: David Ginty, professor of medicine at Harvard Medical School, David Scadden, the Gerald and Darlene Jordan Professor of Medicine at Massachusetts General Hospital, chair of the Department of Stem Cell and Regenerative Biology, and co-faculty director of the Harvard Stem Cell Institute.

2016 Faculty Scholars, Howard Hughes Medical Institute (HHMI), the Simons Foundation and the Bill and Melinda Gates Foundation
One faculty member was elected as an HHMI-Simons Faculty Scholar: Thomas Bernhardt, professor of microbiology and immunobiology.

American Academy of Arts and Sciences
Five faculty members were selected as HHMI Faculty Scholars: Fernando Camargo, professor of stem cell and regenerative biology; Benjamin Ebert, professor of medicine at Harvard Medical School; Chenghua Gu, associate professor of neurobiology; Stephen Liberles, professor of cell biology; and Jayaraj Rajagopal, associate professor of medicine at St. Jude Children’s Research Hospital.

American Association for the Advancement of Science
Three faculty members were elected: Welcome Bender, the Harold T. White Professor of Biological Chemistry and Molecular Pharmacology; Timothy Hla, the Patricia K. Donahoe Professor of Surgery at Boston Children’s Hospital; and David Scadden, the Gerald and Darlene Jordan Professor of Medicine at Massachusetts General Hospital, chair of the Department of Stem Cell and Regenerative Biology, and co-faculty director of the Harvard Stem Cell Institute.

American Society for Cell Biology
One faculty member was selected as an inaugural fellow for lifetime achievement: Marc Kirschner, the John Franklin Enders University Professor of Systems Biology and chair of the Department of Systems Biology.

2016 Careers in Medicine Excellence in Medical Student Career Advising Individual Advisor Award, Association of American Medical Colleges
Fidencio Saldana, dean for students and assistant professor of medicine at Brigham and Women’s Hospital.

2016 William W. Stead Award for Thought Leadership in Informatics, American Medical Informatics Association
Isaac Kohane, the Marion V. Nelson Professor of Biomedical Informatics and chair of the Department of Biomedical Informatics.

American Society for Cell Biology
One faculty member was selected as an inaugural fellow for lifetime achievement: Marc Kirschner, the John Franklin Enders University Professor of Systems Biology and chair of the Department of Systems Biology.

Three faculty members were appointed fellows: Joan Brugge, the Louise Foote Pfeiffer Professor of Cell Biology and co-director of the Ludwig Center at Harvard; Timothy Mitchison, the Hasib Sabbagh Professor of Systems Biology; and Tom Rapoport, professor of cell biology.

National Cancer Institute Outstanding Investigator Award
William Kaelin, professor of medicine at Dana-Farber Cancer Institute; and A. Thomas Look, professor of pediatrics at Dana-Farber Cancer Institute.

2016 Pew Scholars Award in the Biomedical Sciences
Dagmara Rogulja, assistant professor of neurobiology.

2016 Award for Excellence in Molecular Diagnostics, Association for Molecular Pathology
Eric Lander, professor of systems biology and president and founding director of the Broad Institute of MIT and Harvard.

2016 Pew Scholars Award in the Biomedical Sciences
Dragana Rogulja, assistant professor of neurobiology.

2017 Early-Career Award, American Society of Human Genetics
Inaugural recipient: Daniel MacArthur, assistant professor of medicine at Massachusetts General Hospital.

2017 TED Prize
Rajesh Panjabi, instructor in medicine at Brigham and Women’s Hospital.

Presidential Early Career Awards for Scientists and Engineers
Anna Greka, assistant professor of medicine at Brigham and Women’s Hospital.

Maria Lehtinen, assistant professor of pathology at Boston Children’s Hospital.

NIH 2016 Pioneer Award
Bradley Bernstein, professor of pathology at Mass General.

Stephen Liberles, professor of cell biology.

Seok-Hyun "Andy" Yun, professor of dermatology at Mass General.

NIH 2016 Transformative Research Award
Amir Choudhary, assistant professor of medicine at Brigham and Women’s Hospital.

George Church, the Robert Winthrop Professor of Genetics.

Wendy Garrett, associate professor of medicine at Dana-Farber Cancer Institute.

Cammie Lesser, associate professor of medicine at Mass General.

Chao-ting Wu, professor of genetics.

Bruce Yankner, professor of genetics.

NIH 2016 New Innovator Award
Daniel Bauer, assistant professor of pediatrics at Boston Children’s Hospital.

Isaac Chiu, assistant professor of microbiology and immunology.

Eric Lieberman Greer, assistant professor of pediatrics at Boston Children’s Hospital.

Dragana Rogulja, assistant professor of neurobiology.

Matthew Steinhauser, assistant professor of medicine at Brigham and Women’s Hospital.

2016 Medal of Honor for Basic Research, American Cancer Society
Joan Brugge, the Louise Foote Pfeiffer Professor of Cell Biology and co-director of the Ludwig Center at Harvard.

2017 Special Recognition Award, American Society of Clinical Oncology
Lowell Schnipper, the Theodore W. and Evelyn G. Berenson Distinguished Professor of Medicine in the Field of Oncology at Beth Israel Deaconess Medical Center.

2017 JDRF Mary Tyler Moore and S. Robert Levine Excellence in Clinical Research Award
Lloyd Aiello, professor of ophthalmology at Joslin Diabetes Center.

2017 JDRF Mary Tyler Moore and S. Robert Levine Excellence in Clinical Research Award
Lloyd Aiello, professor of ophthalmology at Joslin Diabetes Center.
HMS Leadership

HARVARD MEDICAL SCHOOL

George Q. Daley, MD, PhD
Dean of the Faculty of Medicine

HARVARD SCHOOL OF DENTAL MEDICINE

R. Bruce Donoff, DMD, MD
Dean

ACADEMIC AND ADMINISTRATIVE LEADERSHIP

Lisa Muto, PhD
Executive Dean for Administration

Lisa Boudreau, BA
Dean for Alumni Affairs and Development

Gretchen Brodnicki, JD
Dean for Faculty and Research Integrity

Maureen Connelly, MD, MPH
Dean for Faculty Affairs

David Golan, MD, PhD
Dean for Basic Science and Graduate Education

Edward Hundert, MD, MA
Dean for Medical Education

Simone Leary, BS
Interim Chief Human Resources Officer

Willy Lensch, PhD
Chief of Staff

Stephen Maiorisi, BS, AIA
Chief Campus Planning and Facilities Officer

Elaine Martin, MSLS, DA
Director and Chief Administrative Officer, Countway Library

Lee Nadler, MD
Dean for Clinical and Translational Research

Joan Reede, MD, MPH, MS, MBA
Dean for Diversity and Community Partnership

David Roberts, MD
Dean for External Education

Fidencio Saldaña, MD
Dean for Students

Deborah Corwin Scott, BS, MBA
Chief Information Officer

Nancy Tarbell, MD
Dean for Academic and Clinical Affairs

Gina Vild, BA
Associate Dean for Communications and External Relations and Chief Communications Officer

Mike White, MS
Chief Financial Officer

PRECLINICAL DEPARTMENT CHAIRS

Stephen Blacklow, MD, PhD
Chair, Molecular Genetics

Gustavus Adolphus Pfeiffer Professor of Biological Chemistry and Molecular Pharmacology

Chair, Biological Chemistry and Molecular Pharmacology

Paul Farmer, MD, PhD
Chair, Global Health and Social Medicine

Molecular Pharmacology

Chair, Systems Biology

Wade Harper, PhD
Bert and Natalie Vallee Professor of Neurobiology

Chair, Cell Biology

Marc Kirschner, PhD
John Franklin Enders University Professor of Systems Biology

Chair, Systems Biology

David Knipe, PhD
Higgins Professor of Microbiology and Molecular Genetics

Interim Co-chair, Microbiology and Immunobiology

Isaac Kohane, MD, PhD
Marion V. Nelson Professor of Biomedical Informatics

Chair, Biomedical Informatics

Barbara McNeil, MD, PhD
(Acting Dean of the Faculty of Medicine, Aug. 2016 – Dec. 2016)

Ridley Watts Professor of Health Care Policy

Chair, Health Care Policy

David Scadden, MD
Gerald and Darlene Jordan Professor of Medicine

Chair, Stem Cell and Regenerative Biology

Arlene Sharpe, MD, PhD
George Fabyan Professor of Comparative Pathology

Interim Co-chair, Microbiology and Immunobiology

Clifford Tabin, PhD
George Jacob and Jacqueline Hazel Leder Professor of Genetics

Chair, Genetics

COUNCIL OF ACADEMIC DEANS

Anne Klibanski, MD
Laurie Carrol Guthart Professor of Academic Medicine

Dean for Partners HealthCare System

Orah Platt, MD
Professor of Pediatrics

Faculty Dean for Academic Programs

Boston Children’s Hospital

Barrett Rollins, MD, PhD
Linde Family Professor of Medicine

Faculty Dean for Academic Programs

Dana-Farber Cancer Institute

David Silbersweig, MD
Stanley Cobb Professor of Psychiatry

Academic Dean for Partners HealthCare System

Vikas Sukhatme, MD, ScD
Victor J. Arzoumanian Professor of Medicine

Faculty Dean for Academic Programs

Beth Israel Deaconess Medical Center

FOR MORE ON HMS AWARDS

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FUNDRAISING HIGHLIGHTS

Harvard Medical School depends on a generous philanthropic community whose support helps people the world over live longer, healthier lives.

The School’s circle of supporters—made up of more than 3,700 alumni, board members, volunteers, faculty, staff, foundations, corporations and friends—gave more than $116 million in fiscal year 2017 to support the School’s four priorities: education, discovery, service and leadership. These generous gifts support The World Is Waiting: The Campaign for Harvard Medicine, a transformative $750 million fundraising initiative that has raised more than $700 million, representing 93 percent of the School’s goal as of June 30, 2017.

In education, these gifts are enabling HMS to lift the burden of student debt, create state-of-the-art spaces for teaching and learning, and expand postgraduate and external and global education programs.

In the area of discovery, philanthropy propels the largest biomedical research engine in the world—from gleaning new insights into the human brain and neurodegenerative disorders to advancing pathbreaking investigations in fields like human genetics and regulatory science.

HMS service initiatives are being amplified through gifts bolstering the School’s commitment to transforming health care systems in the U.S. and abroad. These initiatives include supporting tuberculosis treatment, improving the delivery of surgical care worldwide, transforming primary care practice and education, addressing evolving ethical questions and shaping policy.

Finally, in the area of leadership, discretionary gifts enable the School to act swiftly on unanticipated opportunities and provide the flexibility to invest in innovative ideas that have the greatest potential to improve human health.

Learn more about the impact of philanthropy through the School’s Honor Roll of Donors at: hms.harvard.edu/honor-roll.

BY THE NUMBERS

As of September 2017
Total faculty 11,436 | Tenured and tenure-track faculty on campus in 10 preclinical departments 187 | Voting faculty on campus and at affiliates 5,924 | Full-time faculty on campus and at affiliates 9,379
Nobel Prizes (cumulative) Physiology or Medicine: 9 prizes, 15 recipients | National Academy of Sciences members (current) 74 | National Academy of Medicine members (current) 150 | Howard Hughes Medical Institute (current): Investigators 32, Faculty Scholars 6
Total students: MD 719 | PhD 875 (870 HMS, 5 HSDM) | MD-PhD 183 | basic sciences 164, social sciences 19 (total included in MD and PhD counts) | DMD 137 | MMSc 168 (121 HMS, 47 HSDM) | MBE 42 | MBMI 25 | DMSc 30 | Trainees (residents and postdoctoral fellows) 8,833
MD applicants 6,749 | Admitted 235 (3.5%) | MD entering 2017 165 (includes 13 MD-PhD) | Men 84 (51%) | Women 81 (49%) | Underrepresented in medicine (African-American, Hispanic, Mexican-American, Native American) 33 (20%) | Asian 56 (34%)
Entering 2017: PhD 146 | DMD 35 | MMSc 84 (71 HMS, 13 HSDM) | MBE 32 | MBMI 17 | DMSc 10
Additional joint degree programs: MD-MBA; MD-MPH; MD-MPP
Medical school living alumni: 9,923 (MD and MMSc)

THE WORLD IS WAITING: THE CAMPAIGN FOR HARVARD MEDICINE

Fundraising progress to date:

Collaborations across Harvard

Broad Institute of MIT and Harvard
Harvard Catalyst | The Harvard Clinical and Translational Science Center
Harvard Stem Cell Institute
Wyss Institute for Biologically Inspired Engineering

Affiliated HMS hospitals and research institutions

Beth Israel Deaconess Medical Center
Boston Children’s Hospital
Brigham and Women’s Hospital
Cambridge Health Alliance
Dana-Farber Cancer Institute
Harvard Pilgrim Health Care Institute
Hebrew SeniorLife
Joslin Diabetes Center
Judge Baker Children’s Center
Massachusetts Eye and Ear | Schepens Eye Research Institute
Massachusetts General Hospital
McLean Hospital
Mount Auburn Hospital
Spaulding Rehabilitation Network
VA Boston Healthcare System
Ensuring the financial stability of Harvard Medical School is one of our highest priorities. When I became dean this past January, I was immediately impressed with our community’s collective resolve to strengthen the financial health of HMS while continuing to support our mission. In partnership with Harvard University leadership, we are putting into place a sustainable financial model that will guide our planning in the years to come.

Together, we will continue to advance our world-class research and our educational mission by ensuring that existing faculty are supported; investing in new research technologies, such as the newly launched Harvard Cryo-Electron Microscopy Center for Structural Biology in the Longwood Medical Area; and expanding programs that extend our educational influence while strengthening the School financially, including External Education programs, which are delivering HMS mission-based content to a global community.

Our commitment to the educational mission of the School will be sustained. The remarkable students in our MD program are benefiting from the redesigned Pathways medical education curriculum, and while this has resulted in a temporary increase in costs for the School, the investment is core to HMS’s mission of training physicians who will become world leaders in medicine and science. We will also continue to expand our growing complement of master’s programs in FY18 and beyond.

HMS closed FY17 with a $44 million operating deficit. In FY17, operating revenues totaled nearly $668 million, an increase of more than $11 million compared to the previous year. The School’s research revenue grew by 4 percent from $271 million to nearly $282 million. Total operating expenses increased by $19 million to total $771 million; these increases were anticipated and budgeted for.

In FY18, several major initiatives will help improve our long-term financial performance. These involve cultivating philanthropy and further evaluating the School’s real estate portfolio. Our financial health is a community endeavor, which has the full and active support of our academic and administrative units.

As a community, we will honor the School’s storied history while embarking on an ambitious plan that will ensure that HMS continues as the leading institution it is today.

—George Q. Daley


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