

Yale School of Medicine adapts to the COVID-19 pandemic

YSM's clinical, scientific, and educational efforts all overcame major challenges

The COVID-19 outbreak forced the Yale medical community to remake clinical care, research, and education at almost unimaginable speed. Doctors and nurses played new and unfamiliar roles; patients were moved between hospitals or cared for by video link. Surgeries were postponed and labs closed. Methods of educating students changed significantly, and some researchers turned on a dime to study the disease. And everyone Zoomed—a lot.

It was trial by fire for Nancy J. Brown, MD, the Jean and David W. Wallace Dean of Medicine and C.N.H. Long Professor of Internal Medicine, whose job began in February.

“There’s nothing like a good crisis to help you learn an institution quickly,” Brown said. What has impressed her most about her new school? “How committed and generous our faculty and staff have been, how willing to pitch in, how collaborative they are,” she said. “It’s been really a pleasure to see people rise to the occasion.”

THE CLINICAL RESPONSE

On March 13, the first COVID-19 patient was admitted to Yale New Haven Hospital while the Department of Internal Medicine had already been preparing for a month, led by its chair Gary V. Desir, MD, Paul B. Beeson Professor of Medicine.

Beginning in mid-March, elective procedures were postponed across the health system, freeing 700 inpatient beds. The // **Pandemic** (page 3)



A nearly empty walkway marked the departure of many School of Medicine personnel from labs and offices when they were sent to work at home as a safety precaution.

A vigorous recovery, and appreciation

After delicate brain cancer surgery, a grateful patient generously supports Yale

“Yale has taken me full circle,” says pediatrician Susan Beris, MD. “My professional life began here when I did my residency training.” After that came a thriving private practice in western Connecticut. But then, she says, “two years ago I returned, this time as a patient with a brain tumor.” Beris says she is grateful both to “a fantastic team of physicians” and to Yale for the intricate surgery she received and the strong recovery she has made.

Beris believes in giving back. To that end, she has pledged a generous portion of her estate to Yale School of Medicine, to be shared by the departments of Neurosurgery and Pediatrics. The funds will be directed to the Susan Beris, MD, Fund for the Yale Brain Tumor Surgery Program and the Susan Beris, MD, Fund for the Pediatric Residency Program. This gift follows others she has



Susan Beris' career as a pediatrician came to a sudden end when she was diagnosed with glioblastoma, an aggressive brain cancer. She underwent a delicate surgical procedure at Yale and her convalescence has been vigorous. Now, she is expressing her gratitude for the care she received and her continuing longevity.

made to support the brain tumor surgery program.

“I don’t think I was ever a philanthropic person until now,” she says,

“But surviving a brain tumor, your perspective changes. I thought, ‘Let me put my money to good use.’” Two passions have // **Brain tumor** (page 4)

Donors step up to help YSM respond to COVID-19 needs

Since the early stages of the pandemic, the Yale community has acted quickly and generously to support the university’s response to the COVID-19 crisis, with many individuals and groups coming forward to contribute not only with funds, but with vital supplies. Now that the coronavirus has become an enduring, and evolving, threat to public health, many continue to support the sustained action that Yale must take to combat the virus in New Haven, and around the world.

“This is the worst enemy the world has faced in 70 years, and it is ruthless,” said entrepreneur Jonathan Rothberg, MPhil ’87, MS ’87, PhD ’91, as the emergency was beginning early in the spring. “But we know the enemy, and we can defeat it by supporting each other in our generation’s finest hour,” said Rothberg, a scientist and founder of multiple life science and medical device companies that include // **Donors** (page 5)

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INSIDE THIS ISSUE

2 Lifelines

Nenad Sestan rose from a small town in Croatia to investigate brain mechanisms that distinguish us from other species.

5 Support for dyslexia center

Philanthropist Karen Pritzker funds research to benefit members of what she calls “the world’s largest secret fraternity.”

8 Elections to major societies

Two YSM faculty members were elected to the National Academy of Medicine, and two others named to the AAAS.

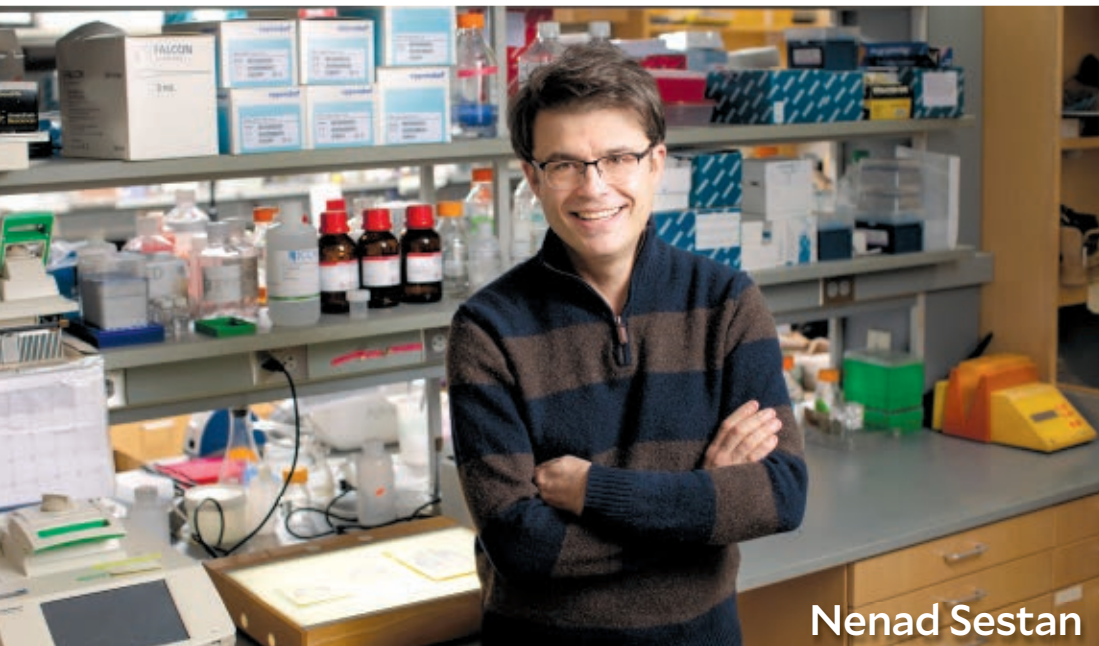
Grants & Contracts is moving online. “YSM Events” will have more information.

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Nenad Sestan

An extraordinary journey has brought Nenad Sestan from a village in Croatia to his lab at Yale, where he investigates how genes and the neurons of the brain make humans different from other species in how they process information.

ANTHONY DECARLO

A singleminded pursuit of science

Meticulous preparation leads to investigation of what makes us human

Few pivotal life moments can be traced to a single letter. But Nenad Sestan, MD, PhD, Harvey and Kate Cushing Professor of Neuroscience, and professor of comparative medicine, of genetics, and of psychiatry, vividly remembers flipping the thin pages of a medical encyclopedia set that his mother bought him during grade school. He arrived at the letter ‘M’ for mozak, or brain, in his native Croatian.

Sestan recalls saying to himself, gripped with fascination, “I am going to study the human brain and I will work with this person.” That person was the author of the neuroanatomy entry: Ivica Kostović, professor of anatomy and neuroscience at the University of Zagreb and a future vice president of Croatia, whose research specializes in human developmental neuroanatomy.

Sestan describes an idyllic childhood, growing up in the small village of Zemunik Donji and working on his family farm surrounded by relatives of his father, who served as a sergeant in the Yugoslav navy, and his mother, a postal worker. From that initial spark, Sestan’s perseverance has shaped a career in developmental neurobiology, which he modestly credits partly to luck. “I really feel like I was born at the right time, the right place,” he says.

During his first week of medical school at the University of Zagreb, Sestan walked straight to Kostović’s office, asking to work in his lab. Kostović explained to the eager student that he needed to finish anatomy and neuroscience classes first. Undeterred, Sestan asked a postdoctoral fellow who worked in Kostović’s lab to give him a job. In a few days, Sestan was waking up at odd hours at night to retrieve human brains donated for research from the morgue and prepare them for the lab. One evening Kostović

caught Sestan in his lab. “He said, ‘Okay, you are obviously crazy.’ I do remember he used the word ‘crazy,’” Sestan says, tears coming to his eyes as he recalls attending his first lab meeting.

In the early 1990s, Croatian researchers requested journal article reprints via handwritten notes. Kostović needed someone to do this. Sestan volunteered. “Everybody thought I was an idiot,” he says. But through that exercise, Sestan learned by heart the names of important neuroscientists around the world, including those he would later meet at Yale.

With his university largely spared from the Yugoslav wars, Sestan continued lab experiments after his mentor became Croatia’s vice president. “The biggest thing at the time was the Nobel Prize discovery of nitric oxide as a signaling molecule,” Sestan says, describing how he examined human brain samples for the enzyme that makes nitric oxide. He found it, but sat on the findings; he wanted to determine if other species expressed this same gene in the cerebral cortex region of their brains. (That question would not be settled until Kenneth Kwan, a graduate student in Sestan’s lab, finally concluded, and the lab published in 2012, that this process is very species-specific, and greatly dependent on when during development the enzyme is expressed.)

In 1994, Sestan applied for a doctoral degree at Yale. “This was the Mecca if you wanted to study the cerebral cortex, the outside part of the brain that processes our senses, commands motor activity, and helps us perform higher-order cognitive functions like language,” he says. He lists his important mentors—whose names he recognized from requesting those reprints—who were, and still are, in Yale’s neuroscience department: Amy Arnsten, PhD, Albert E. Kent Professor of Neuroscience and professor of psychology; Michael Schwartz, PhD, associate

professor of neuroscience and associate dean for curriculum; and Gordon Shepherd, MD, professor emeritus of neuroscience. Sestan enlisted Pasko Rakic, MD, PhD, Dorys McConnell Duberg Professor of Neuroscience and professor of neurology, as his PhD adviser. He knew he also needed to understand genetics and molecular biology. Sestan asked Spyros Artavanis-Tsakonas, PhD, now professor emeritus of cell biology at Harvard Medical School, to co-advise him. In 2002, at age 31, Sestan became an assistant professor at Yale.

His research has focused primarily on how certain genes control the ability of neurons to acquire distinct identities and form proper connections—collectively called the connectome—in the developing cerebral cortex. “The connections that connect different parts of the cortex, and the cortex with the rest of the central nervous system, I think are key,” Sestan says. He compares the connectome to the Internet’s ability to revolutionize how information is shared without changing the information itself. Sestan and his lab members focus on pyramidal cells, which make long connections originating in the brain’s cortex area.

While following this path, Sestan and his team also took a bit of a detour to find out if they could trace neuronal connections in postmortem brain tissue. Using a perfusion technology they invented, called BrainEx, and a unique liquid that made it work, they restored circulation and some neuronal function in the brains of pigs that had been dead for several hours. They reported their results in *Nature* in April 2019. Meantime, Sestan continues his primary work uncovering how connections in the human brain differ from those in other species.

“I want to understand what makes us human. No animal can write poetry,” Sestan says. “If I find out what makes us human, I would die a happy scientist.”

Yale is placed on Hartwell list of top 10 biomed centers



Richard Pierce

Yale University has been designated by The Hartwell Foundation as a Top Ten Center of Biomedical Research for

2020, garnering this distinction for its strengths in child health research in alignment with the foundation’s philanthropic mission.

As a Top Ten Center, Yale will have the opportunity to submit an increased number of applications to The Hartwell Foundation’s Individual Biomedical Research Award program, which supports early-stage, innovative, and cutting-edge biomedical research with the potential to benefit children in the U.S.

“The Hartwell Foundation’s support of innovative research with the potential to benefit children stands out among philanthropic organizations,” said Nancy J. Brown, MD, the Jean and David W. Wallace Dean of Yale School of Medicine and C.N.H. Long Professor of Internal Medicine.

“I am grateful for this recognition of Yale’s excellence in this area and look forward to seeing continued impacts made by those supported by The Hartwell Foundation.”

The designation comes after 10 years of continuous participation by Yale in the foundation’s awards process, through which Yale has won eight Individual Biomedical Research Awards and received five postdoctoral fellowships. The most recent Yale awardee was Richard Pierce, MD, assistant professor of pediatrics (critical care), in 2019.

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Hall arrives to take charge of the Yale Center for Genomic Health



Ira Hall

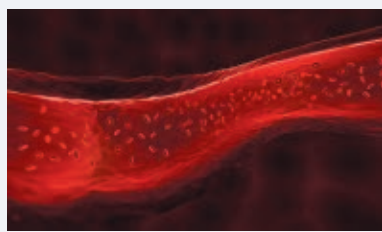
The Yale Center for Genomic Health, founded in 2018 as the home of Generations, a comprehensive DNA sequencing project, has entered a new phase with the recruitment of Ira

M. Hall, PhD, an expert in human genome sequencing and integrative data science, as the center’s director. Hall comes to Yale from Washington University in St. Louis.

The center under Hall’s leadership will have goals that include creating and leading studies of human genome variation and

disease; enhancing the university’s abilities in computational genomics, bioinformatics, and data science; and leading efforts at Yale to implement genomics in health care. According to Hall, the clinical component of the center’s work will emphasize making health care delivery more equitable.

Blood vessels made in lab show strength



When patients need a vascular graft, as during heart bypass surgery, surgeons often use blood vessels from elsewhere in the body, but these are not always available.

As an alternative, Yale researchers led by Yibing Qyang, PhD, associate professor of medicine (cardiology) and of pathology, are developing grafts in the lab using human induced pluripotent stem cells differentiated into smooth muscle cells, which are then seeded onto tube-shaped scaffolds and grown into blood vessels in a bioreactor.

In the past, vessels generated this way were weak and often swelled. To generate stronger vessels, Qyang and colleagues applied surges of radial pressure to the developing vessels, stretching them as if they were pulsing with blood. When grafted onto the aortas of rats, as reported in *Cell Stem Cell*, these grafts carried blood without bloating and proved nearly as strong as grafts used in the clinic today.

Next, Qyang plans to develop grafts that are stronger still and universally compatible, i.e. able to avoid immune rejection. These could be ready for clinical use within five to 10 years, Qyang says.

CRISPR and T cells target glioblastoma

Immunotherapies, which unleash the immune system on cancers, have revolutionized cancer treatment but have so far had limited efficacy against the deadly brain cancer glioblastoma.

Many immunotherapies spur T cells to go after tumors by blocking checkpoint proteins that normally restrain the immune cells. To look for immunotherapy targets that might help treat glioblastoma, Sidi Chen, PhD, associate professor of genetics, used the gene-editing technique CRISPR to knock out genes encoding various cell-surface and membrane proteins in mouse T cells, then injected these CRISPR-edited T cells into mice with glioblastomas.

As reported in *Nature Biotechnology*, Chen and colleagues found that mice injected with T cells from which the gene *Pdia3* had been knocked out using CRISPR gene editing survived longer than those injected with T cells that were not edited. Further, according to experiments done in cell culture, chimeric antigen receptor (CAR)-T cells engineered to attack glioblastoma were more effective if *Pdia3* was knocked out.

The results, says study co-author and Chen lab postdoc Lupeng Ye, PhD, suggest that targeting *Pdia3* in CAR-T cells could make them better killers of glioblastoma.

// **Pandemic** (page 1) move also preserved precious personal protective equipment. Led by Gail D'Onofrio, MD, MS, chair and Albert E. Kent Professor of Emergency Medicine and professor of epidemiology (chronic diseases), and Andrew Ulrich, MD, professor of emergency medicine and vice chair of operations—along with a multidisciplinary taskforce—the emergency department rapidly developed new protocols for patient flow and the safety of patients and staff, including outdoor triage tents. Developing innovative techniques for high-risk procedures such as intubations, along with the constant adaptability of the staff, reduced exposures and improved patient care.

Hospital authorities decided to house COVID-19 patients on the top three floors of Smilow Cancer Hospital, which were originally built to allow for negative-pressure ventilation if necessary. Cancer inpatients were transferred one by one via ambulance to the Saint Raphael campus. The move from her workplace on the 14th floor went smoothly, said Maggie Zampano, RN. “It was a beautiful dance. There was not one thing chaotic about it,” she said, “because all the oncology floors came together and worked as one for the greater good of our patients.”

Within minutes of the final patient's departure, Zampano added, electricians arrived to prepare the unit for COVID-19 patients. “That's how quickly Yale reacted,” she said. Additional COVID-only units were set aside at the York Street and Saint Raphael campuses.

Thanks to a backup-staffing plan led by Lynn Tanoue, MD, MBA, professor of medicine (pulmonary) and vice chair for clinical affairs (internal medicine), numerous Yale physicians stepped up to help the Department of Internal Medicine take the lead in caring for COVID patients. By late March, Tanoue was calling for additional ICU volunteers, saying it was an “unprecedented, all-hands-on-deck situation, which will require the united efforts of all our physicians.”

The sickest COVID-19 patients can have an outsized effect on hospital capacity. Normally, patients in the medical intensive care unit (MICU) experience three- to four-day lengths of stay, according to Jonathan M. Siner, MD, associate professor of medicine and then-medical director of the MICU. But by late March, it emerged that COVID-19 survivors' average stays lasted 14 to 21 days, while those who did not survive typically were there for seven days before succumbing. Those statistics worried Siner and other critical care specialists.

“You don't necessarily need to have that many more admissions per day [to affect the ICU] if the length of stay goes up by that degree,” Siner told a Dean's Workshop audience on March 31, as he described the Section of Pulmonary and Critical Care's shift to a quasi-wartime footing.

Attending physicians who specialize in pulmonary and critical care led teams of attendings with less ICU experience. In all, nearly 200 attending faculty, residents, and fellows from



Mahalia Desruisseaux (r), shown in her lab prior to the pandemic with Oscar Ndunge, PhD, associate research scientist, was going to devote much of 2020 to investigating cerebral malaria. COVID-19 changed her plans. She signed on as principal investigator for a clinical safety study evaluating convalescent plasma.

the departments of Anesthesiology, Neurology, Dermatology, Pathology, Surgery, Radiology, Psychiatry, and Pediatrics cared for COVID-19 inpatients, along with dozens of community physicians. Infectious-disease physicians played a stewardship role, reviewing charts and advising each patient's physician.

For frontline providers, the work was grueling. Because many consultants were working remotely and most visitors were no longer allowed, it could be isolating, too. Desir said, “There's much less foot traffic on the floors. All the doors are closed. The hallways are empty. It's a very different place compared to the bustling atmosphere when you work on the medicine floor” in normal times. Some clinicians working multiple long shifts or who needed to self-isolate away from family slept in hotels in downtown New Haven, their rooms covered by the medical center.

To help providers manage the stress of COVID care, the psychiatry department arranged for virtual stress and resilience town halls, a web-based hotline, and peer support.

By Tuesday, April 7, admissions and discharges of COVID-19 patients were beginning to balance out—a hopeful sign. At last, on April 13, Yale Medicine CEO and Deputy Dean for Clinical Affairs Paul A. Taheri, MD, MBA, reported that the number of inpatients was declining. Field hospitals of last resort went unused.

“As predicted, we are now in the midst of the anticipated surge of COVID-19 patients and expect to remain so for several weeks. Our planning has paid off and operations are running smoothly,” Taheri commented on April 15.

“Those beds [in Smilow] filled up, they filled up, they filled up. It was kind of like watching water in a bathtub. It came right up to the top, but it didn't overflow,” said Edward H. Kaplan, PhD, the William N. and Marie A. Beach Professor of Operations Research and professor of public health and of engineering.

Telehealth, where doctors can see patients virtually without an office visit, has long been seen as the treatment option of the future, with years of pilot programs looking to pave the way. With the COVID-19 emergency, which increased concerns about in-person visits to

medical offices and made it crucial to conserve PPE, telehealth took off, with thousands of outpatient visits that had previously been conducted almost exclusively in person now being done via video or phone. “We converted to 30% telehealth within the span of a month—it was amazing,” Desir said. While, in January, only 100 telehealth visits took place, in March their number approached 7,000, in April there were nearly 25,000, and in May there were more than 28,000 such visits. By June there was an average of 1,200 visits per day, and total telehealth visits for all of 2020 exceeded 500,000.

CLINICAL STUDIES

Many clinical studies went on hold, although those that involved patients receiving drug infusions for such diseases as cancer did continue.

With a pressing need to better understand how the virus affects patients, researchers and clinicians scrambled to stand up new studies. By May 19, a vastly busier institutional review board had approved more than 180 new COVID-related human-subjects protocols or adaptations to existing protocols, meeting seven days a week to go over proposals. “To the great credit of the institutional review board, they were basically meeting every day by Zoom, doing accelerated reviews so that researchers could get started on COVID-related studies,” noted Brian R. Smith, MD, the deputy dean for scientific affairs (clinical departments); professor and chair of laboratory medicine; professor of biomedical engineering; and co-director of the Yale Center for Clinical Investigation (YCCI).

Smith added that it also had been especially important to understand how COVID-19 affects Black and Latino patients, who have suffered higher numbers of hospitalizations and deaths due to the virus. Through its longstanding Cultural Ambassadors program, YCCI connected with these communities effectively. “We held town halls with our partners from the African Methodist Episcopal Zion Church and Junta for Progressive Action to listen to their concerns,” he said. “They were able to help distribute masks and health literature to their constituents, and // **Pandemic** (page 6)

OUT & ABOUT

This issue's events took place before the COVID-19 pandemic upended our lives. We wish good health to all until we can gather closely together again.

November 7, 2019 The Yale Child Study Center Associates Annual Meeting

convened in the Yale Child Study Center (YCSC) and was followed by a reception in Harkness Ballroom. The focus of the 2019 meeting was development across the lifespan. **1.** From left, **Cary A. Koplin** YC '66; **Linda C. Mayes**, MD, director of YCSC, Arnold Gesell Professor of Child Psychiatry and deputy dean for professionalism and leadership, Office of the Dean; and **Thomas C. Israel** YC '66, chairman and CEO, Ingleside Capital Co., Inc. **2.** From left, **Andrew Klingenstein** YC '80, president of Klingenstein Philanthropies; **Caroline Simmons**, senior specialist for policy innovation and impact at Elevate; **Megan Smith**, DrPh, MPH, associate professor of psychiatry and in the Child Study Center; and **Eliot Brenner**, PhD '95, executive director of Klingenstein Philanthropies.



ANTHONY DECARLO (2)

November 20, 2019 At an Innovations and Discoveries on the Horizon Dinner

held at the Boyer Center, faculty and researchers from the medical school, including Hugh S. Taylor, MD, Elena Ratner, MD, and Alessandro Santin, MD gave presentations on the theme of "Medical Advances for Women" to prospective donors. From left, **Caroline C. Herrick**; **Hugh S. Taylor**, MD, chair and Anita O'Keefe Young Professor of Obstetrics, Gynecology, and Reproductive Sciences; and **Theodore D. Sands** YC '67.



JUDY SIROTA ROSENTHAL

January 12, 2020 At a Yale Reception held at the 38th Annual JP Morgan Healthcare Conference in San Francisco

Roy S. Herbst, MD, PhD, Ensign Professor of Medicine (Medical Oncology) and chief of medical oncology at Yale Cancer Center, and **Stephanie Double**, director of shared interest groups with the Yale Alumni Association, greet attendees at the start of the event.



JULIE PARR



TONY SMERIGLIO

November 21, 2019 A **Celebrity Fundraiser Breakfast** at the Italian Club of Stamford featured Brian Cashman, general manager for the New York Yankees, as keynote speaker for Yale Eye Center's annual fundraiser, where \$93,000 was raised. From left, **Bobby Valentine**, legendary baseball player and manager; **Brian Cashman**, general manager of the New York Yankees; **Lucian V. Del Priore**, MD, PhD, chair and Robert R. Young Professor of Ophthalmology and Visual Science; and **Gene Rubino**, chair, Yale Eye Center Advisory Board.



JULIE PARR

February 19, 2020 More than 40 medical school alumni and friends gathered for a **Yale Medicine Discovers Symposium** in Palm Beach, Fla., to hear presentations by **Matthew Ellman**, MD, professor of medicine and director of Yale Internal Medicine Associates; **David A. Hafler**, MD, chair and William S. and Lois Stiles Edgerly Professor of Neurology; **Roy S. Herbst**, MD, PhD, Ensign Professor of Medicine (Medical Oncology); **David J. Leffell**, MD, David P. Smith Professor of Dermatology; **Elena Ratner**, MD, associate professor of obstetrics, gynecology, and reproductive sciences; and **Peter G. Schulam**, MD, PhD, then chair of the Department of Urology.

// **Brain tumor** (page 1) driven Beris throughout her life: her work and her commitment to fitness. Every day she works out in her home gym, riding her exercise bicycle. But her career as a pediatrician abruptly ended in August 2018, when she was diagnosed with glioblastoma, an aggressive and almost universally fatal tumor.

"At work that morning, a nurse asked me a question and I answered in gibberish," she says. "I felt my head shake. I thought I was having a stroke, but it was a seizure."

Beris was transported to a nearby hospital, where scans showed a brain tumor perilously near the motor strip. Lacking the expertise to remove it, the medical team offered the option of a biopsy. "Call me a snob—but I didn't want a general neurosurgeon," she says. "I wanted the most specialized neurosurgeon with the best technical skills."

She was given the name of Jennifer Moliterno, MD, associate professor of neurosurgery at Yale School of Medicine and chief of neurosurgical oncology, who specializes in surgeries

for complex tumors located in highly functioning brain (speech and motor areas). "The moment I met Jen I knew she was perfect for me," says Beris. "I loved the fact that she only does brain tumor surgery. She is very smart and also trained at Yale. We were both chief residents, 20 years apart."

Moliterno presented a treatment plan that called for total resection, or complete removal, of the tumor. Studies show a significant improvement in survival in glioblastoma patients who have total resection, as opposed to just a biopsy or even subtotal removal. "Given the location, I planned for an awake craniotomy, so we could test her strength with her awake while I removed the tumor," says Moliterno. "We have excellent results with this type of surgery in our hands, using a well-designed protocol that includes a highly specialized team of neurophysiologists and neuroanesthesiologists, as well as intraoperative imaging. We can be as aggressive surgically as is safely possible, which is important in this disease."

While the notion of awake brain surgery strikes fear in the hearts of many, Beris was all in when she learned that it offered the best chance of removing the tumor while preserving motor function. The procedure was successful, with all of the tumor removed and Beris maintaining her strength. She experienced no pain or anxiety and she made a quick recovery. She went home two days after surgery and just one month later, she completed a 10K run, a fundraiser for the Connecticut Brain Tumor Association.

Few patients with glioblastoma survive for two years beyond surgery and Beris is happy to be one of them. Her health intact, she is focused on philanthropy. "Thinking about all I've been given, I wanted to support this program," she explains. "Other brain tumor patients should have access to the same excellent care I had."

"I am so happy with how well Susie has done and beyond grateful for her incredibly generous gift," says Moliterno. "We'll use these funds

to support a series of educational programs for patients and the medical community, informing them about the exceptional care Yale has to offer." One such event is the Susan Beris, MD, Brain Tumor Symposium, tentatively scheduled for spring 2021 if COVID-19 restrictions permit, with smaller continuing medical education seminars in the interim.

The Department of Pediatrics plans to use its gift to support residency training. "It will enable us to provide enhanced educational experiences designed to enhance critical thinking skills for our residents," says Clifford W. Bogue, MD, chair and Waldemar Von Zedtwitz Professor of Pediatrics. "The fund may also support our resident education tracks where residents receive focused educational experiences in areas such as advocacy, quality improvement, medical education, child health research, and global health." Bogue adds, "Susie Beris is an incredibly positive force for good, and Yale Pediatrics is very proud to call her one of our own."

Seeing genetic steps of IPF in human lung



About half of people diagnosed with idiopathic pulmonary fibrosis (IPF), in which patches of lung become damaged, die within three to five years of diagnosis. To probe the mechanisms behind this disease, a Yale-led collaboration investigated the gene expression patterns found in samples from fibrotic and healthy human lungs.

Naftali Kaminski, MD, Boehringer Ingelheim Pharmaceuticals, Inc. Endowed Professor of Medicine (Pulmonary), and colleagues took multiple samples to capture different levels of fibrosis. Their results were published in *JCI Insight*.

Levels of fibrosis-associated gene products did not gradually increase or decrease as samples became more fibrotic. Rather, different RNA molecules—messenger RNAs and microRNAs—characterized distinct stages of the disease. Further gene-expression changes seemed to precede fibrosis. In lungs from IPF patients, non-fibrotic samples that appeared similar to those from control lungs nonetheless had very different patterns of gene expression.

Knowledge of gene expression changes associated with each stage of disease should help researchers develop stage-specific therapies, the authors write.

RNA molecule seeks out resilient tumors

Because many viruses have RNA genomes, the immune system has developed systems for detecting and attacking foreign RNA. Yale researchers have exploited this system to set the immune system on cancers, as reported in the *Journal of Experimental Medicine*.

Researchers, led by Akiko Iwasaki, PhD, Waldemar Von Zedtwitz Professor of Immunobiology and professor of molecular, cellular and developmental biology, and Anna Marie Pyle, PhD, Sterling Professor of Molecular, Cellular, and Developmental Biology and professor of chemistry, induced melanoma growth in mice, then injected the tumors with a solution of an RNA molecule called SL14. The RNA injection slowed tumor growth, increased survival, and boosted the effects of an immunotherapy drug.

Current immunotherapies, which ramp up the immune response, can only kill tumors that stimulate an immune response in the first place. Accordingly, immunotherapies do not work on many tumors. Iwasaki, Pyle, and colleagues found that SL14 injection stimulated immune responses against what are usually non-immunogenic tumors, perhaps making them more immunogenic.

Dyslexia center receives Pritzker gift

The funding supports an effort to study the course of dyslexia over a lifetime

“If you have dyslexia,” says Karen Pritzker, a filmmaker and philanthropist, “you are part of one of the world’s largest secret fraternities.” Dyslexia affects one in five Americans, including Pritzker. It is an unseen challenge which results in difficulty reading for people who otherwise have the intelligence to be much better readers. “That’s a lot of people who don’t talk about it, struggle, and deal with it every day.”

Through her recent gift to Yale Center for Dyslexia & Creativity, Pritzker aims to shed light on the challenges of people with dyslexia. It forms part of her long-standing support of the center’s founders and co-directors, Bennett Shaywitz, MD, Charles and Helen Schwab Professor of Pediatrics (Neurology); and Sally Shaywitz, MD, Audrey G. Ratner Professor of Pediatrics (Neurology).

The Shaywitzes, both elected members of the National Academy of Medicine, are leaders in dyslexia research who have been featured in the science section of the *New York Times* and awarded the 2019 Genius Award from the Liberty Science Center for their contributions to understanding dyslexia. “The center has illuminated both the positives and the unexpected of dyslexia, as well as the understanding of what interventions are most helpful to the members of this secret society of which my father was a part, as are I and three of my children,” says Pritzker.

The Shaywitzes conduct the groundbreaking Connecticut Longitudinal Study, which they began in 1983 to follow an epidemiologic sample survey of 445 kindergarteners, and continued through high



school graduation and beyond to their current age of 42.

The study is responsible for major breakthroughs in the understanding of dyslexia. Before their study, dyslexia was thought to only affect boys, which their data have proven untrue. “Dyslexia is universal,” says Sally Shaywitz. “It affects all racial, ethnic, and socioeconomic groups.”

The study also demonstrated the prevalence of dyslexia: 20% of Americans, and it revealed an achievement gap beginning in first grade and persisting. “When we saw that, we said, ‘we have to take action,’” says Sally Shaywitz. The Shaywitz DyslexiaScreen early screening test is an efficient, evidence-based test for children in K-3. The Shaywitzes also developed a screening test for adolescents and adults.

“This gift allows the Shaywitzes to answer a lot of big questions, and provide for insight into how dyslexia affects people at every stage and age,” says Pritzker. Today, the Shaywitzes are following up on the study’s now-adult subjects. “We are looking to connect outcomes to predictors,” Sally Shaywitz says, which is possible because of the long timeline of their data. “We want to

Sally Shaywitz (left) and Bennett Shaywitz will use a gift from philanthropist Karen Pritzker to delve more deeply into dyslexia. Those affected by dyslexia are what Pritzker calls “one of the world’s largest secret fraternities.”

understand not only the consequences, but the factors that exacerbate or ameliorate the outcomes. We will be in the extraordinary position to act on the knowledge to the immediate benefit of people with dyslexia.”

This means not only outlining the challenges of people with dyslexia, but also revealing their hidden strengths which are captured in their sea of strengths model of dyslexia. “They read more slowly but comprehend at a high level,” Sally Shaywitz says. “From a longitudinal perspective, we are trying to develop insights that can be helpful early on, but also to have everyone know you can be dyslexic and be highly intelligent.” This understanding can lead parents and schools to recognize dyslexic children and help them reach their full potential, say the Shaywitzes.

“We always want new knowledge, but in the case of dyslexia, we have sufficient knowledge to move forward,” says Sally Shaywitz. “We must bring 21st century science together with education. We must and we will.”

// **Donors** (page 1) Butterfly Network, the maker of the world’s first handheld whole-body ultrasound scanner. He and his wife, Bonnie E. Gould Rothberg, MD ’94, PhD ’09, MPH ’05, FACP, an oncology hospitalist working on the frontlines of patient care at Smilow Cancer Hospital during the pandemic, were early contributors to Yale’s effort to address the pandemic with a \$2 million gift in April. The gift has aided Yale’s ongoing clinical and research response to the coronavirus emergency.

The Ludwig Family Foundation also made a substantial early gift to fund investigators at Yale School of Medicine who were at work on developing vaccines to prevent future outbreaks, as well as treatments for people who already are infected.

“Given the time pressure to find treatments and ultimately prevent COVID-19 and the terrible loss of life and economic disruption that are damaging the well-being of individuals, families, and entire countries,” says Carol Ludwig, MD, president of the foundation, “we felt it was

important to lend early support to this group of talented Yale scientists who are working tirelessly to find approaches with the potential to benefit large numbers of people.”

One of the grantees, Richard Bucala, MD, PhD, Waldemar Von Zedtwitz Professor of Medicine (Rheumatology) and professor of pathology and of epidemiology (microbial diseases), worked on a scalable vaccine for COVID-19 as well as future pandemic viruses. Bucala’s approach was based on a self-amplifying RNA that lends itself to being reproduced on a mass scale and had previously shown promise against viruses.

The Ludwig Family Foundation gift also included funding for research led by Akiko Iwasaki, PhD, Waldemar Von Zedtwitz Professor of Immunobiology and professor of molecular, cellular and developmental biology, in collaboration with Aaron M. Ring, MD, PhD, assistant professor of immunobiology, and Craig B. Wilen, MD, PhD, assistant professor of laboratory medicine and of



Lisa Lattanza, who led the effort at the height of the pandemic to acquire personal protective equipment for caregivers, stands next to a shipment delivered to Yale West Campus.

immunobiology. Their combined laboratories were analyzing components of the blood and immune systems of COVID-positive patients via flow cytometry and other methods.

Ring was also collaborating with Andrew Wang, MD, PhD, assistant professor of medicine, on answering the important question of whether a patient’s cells are destroyed directly by the SARS-CoV-2 virus, or by powerful elements of the infected person’s immune system triggered by the virus. Additionally, David // **Donors** (page 8)

// **Pandemic** (page 3) also provide valuable leadership on how to engage them in clinical research. They have been instrumental full partners in directing and driving our research agenda.”

VERSATILITY

Infectious disease specialist Mahalia Desruisseaux, MD, associate professor of medicine (infectious diseases), never thought she would find herself leading a hematology study. In addition to seeing patients, she normally had run a lab that investigates cerebral malaria. Desruisseaux had arranged to take time off from clinical work to focus on that research. Then her lab

In early March, researchers on the medical campus founded a laboratory working group that came to be known as IMPACT (Implementing Medical and Public Health Action against Coronavirus, [Connecticut, CT]). It was headed by Albert Ko, MD, professor and chair of epidemiology (microbial diseases) at the School of Public Health, and professor of medicine (infectious diseases). The group began to test patient samples for the coronavirus, characterize the virus, and map the human immune response.

“In our work at Yale, we had a giant head start” because of a preexisting collaboration between Ko and

an in-house COVID-19 test. It was the first laboratory-developed COVID-19 molecular test outside of a national reference laboratory to receive emergency use authorization from the FDA. Testing went live on March 13, and the first Yale New Haven Hospital patient to test positive was diagnosed that same day. The Yale Virology Lab was soon testing hundreds of people a day.

The effort to refine testing did not stop there. In August, a saliva-based laboratory diagnostic test created by researchers at Yale School of Public Health received an emergency use authorization by the FDA. SalivaDirect was developed by Anne Wyllie, PhD, associate research scientist in epidemiology (microbial diseases), Nathan D. Grubaugh, PhD, assistant professor of epidemiology (microbial diseases), and other members of Grubaugh’s lab, and validated as a test for asymptomatic individuals through a program that tested players and staff from the National Basketball Association. It is simpler, less expensive, and less invasive than the method that was most widely used earlier in the pandemic, known as nasopharyngeal swabbing. “We simplified the test so that it only costs a couple of dollars for reagents, helping to make large-scale testing more affordable,” said Grubaugh.

Meanwhile, IMPACT built a biorepository of clinical samples from health care workers and COVID-19 patients. This library has become a rich resource for researchers studying immune responses to the virus.

Iwasaki, the Waldemar Von Zedtwitz Professor of Immunobiology and Molecular, Cellular and Developmental Biology and Howard Hughes Medical Institute investigator, formed numerous collaborations to study the human immune response to the virus, including with Ko, Grubaugh, and Craig B. Wilen, MD, PhD, assistant professor of laboratory medicine and of immunobiology and medical director of the Immune Monitoring Core Facility. Wilen studies how the virus infects airway cells, how it compares to other lethal coronaviruses, and which human genes permit infection.

Though some federal grants became available, funding was, for many, a scramble. Discretionary departmental and medical school funds covered some expenses, while private donors stepped up to pay for others. Wilen’s experiments required that he upgrade some equipment in Yale’s biosafety level 3 containment lab. Thanks in part to alumni, Dean Brown came up with funding the same day, he recalls.

Many other researchers studied the pandemic from home offices. Kaplan, for example, created “scratch” mathematical models to predict the course of the local outbreak; his results helped inform the university’s decisions about re-opening.

Summer was the time when clinical trials to evaluate the safety and efficacy of COVID-19 vaccines proceeded in earnest. Led by principal investigator Onyema Ogbuagu, MBCh, associate professor of medicine, Yale ran clinical trials for the

mRNA vaccine developed by Pfizer and Germany’s BioNTech. Efforts by Ogbuagu and colleagues, and those who volunteered for the trials, helped establish a 95% efficacy rate for the vaccine and a strong safety profile. On December 11, the Food and Drug Administration gave emergency use authorization to the vaccine, and three days later vaccinations began in New Haven and other locations around the country. Ogbuagu said he was thrilled to be one of the first recipients. “You study a drug, you find out it works, and then you become part of receiving it yourself and experiencing the benefit.”

TESTING/SCREENING/SAFETY

As early as January 2020, the Yale New Haven Health System began laying in extra supplies of PPE. In February, it began buying them from the industrial sector. New protocols reduced the rate at which PPE was used up and discarded, but the need to conserve it grew so pressing that it contributed to halts in elective surgeries and student clerkships.

With most operations in her department postponed for the duration, Lisa L. Lattanza, MD, professor and chair of orthopaedics and rehabilitation, threw herself into the battle to secure more PPE. With the usual vendors unable to meet demand, she fielded and made countless phone calls about possible sources, always weighing the risk of receiving PPE that was fraudulent or ineffective. Lattanza worked with the Coalition for Health Innovation in Medical Emergencies, an initiative of Yale’s Center for Engineering Innovation and Design, to develop a way to test whether donated and third-party N95 and KN95 masks were safe to use. She also worked with Connecticut manufacturers of sporting goods and other consumer products to repurpose their plants to create masks, face shields, and gowns.

Patrick A. Kenney, MD, assistant professor of urology and clinical vice chair of Yale Medicine Urology, is the medical director of corporate supply chain for YNHHS. Kenney led a team including Richard A. Martinello, MD, associate professor of pediatrics and of medicine (infectious diseases), and medical director, infection prevention; Mark Russi, MD, MPH, professor of medicine (occupational medicine) and of epidemiology (environmental health); and Ben Chan, PhD, research scientist. They demonstrated that vaporized hydrogen peroxide is able to eliminate virus on respirators. A reprocessing facility was rapidly built with the capacity to reprocess more than 200,000 respirators per week. It was used to sterilize respirators for YNHHS and other entities including Emergency Medical Services. Kenney’s team also sourced thousands of elastomeric respirators, crafted a sterilization and distribution plan, and deployed them across multiple sites of care.

Efforts to reduce PPE utilization, such as by care redesign and extended use of respirators, had a dramatic impact including // **Pandemic** (page 7)



Onyema Ogbuagu, who had led clinical trials at Yale to evaluate the safety and efficacy of the first COVID-19 vaccine, received it on December 14.

had to close as part of a university-wide safety protocol, a situation that made her feel useless.

“I had slated that time to do lab work. Then not only was I not on the floor seeing patients, but I wasn’t doing research,” Desruisseaux said.

When she learned the U.S. Food and Drug Administration (FDA) was authorizing emergency access to convalescent plasma for COVID-19 patients, she signed on as a principal investigator for a clinical safety study. “It was very therapeutic to do this,” she said. “I did feel like I was actually doing something to help.”

Desruisseaux’s was in the majority of research labs across the university that were forced to close because of the need for physical distancing.

“Obviously in a research lab, you’ve got lots of people crowded around,” Smith said. “All of that came to a halt.”

Some labs were able to change course to study COVID-19. In fact, the pandemic seeded an extraordinary network of collaborations among researchers at the School of Medicine and across the university.

Dean Brown founded the COVID-19 Response Coordination Team (CoReCT), which fostered collaborations among clinicians; researchers from the Yale Schools of Medicine, Nursing, Public Health, and Engineering; and social scientists affiliated with the Yale University Faculty of Arts and Sciences or with the Tobin Center for Economic Policy. Smith called CoReCT “terrific,” adding that “people who really may not previously have known [that each other] existed suddenly began talking about research they could do together.”

Akiko Iwasaki, PhD, in the Department of Immunobiology,” said Ruth R. Montgomery, PhD, professor of medicine and of epidemiology (microbial diseases); director of the Yale CyTOF Facility; and associate dean for scientific affairs.

“Because Albert is a real live epidemiologist and had very recently been through the Zika epidemic in Brazil, he knows how to handle an outbreak,” Montgomery said. “They just jumped fast.”

Montgomery’s own lab made a “natural pivot” to COVID-19, she said, since she studies human responses to viruses. Using high-throughput technology and advanced computational analysis, she began to study the proteins produced by COVID-infected airway cells.

Testing was an urgent problem, and Yale’s Department of Laboratory Medicine rose to the challenge. In late February, Marie-Louise Landry, MD, professor and vice chair of laboratory medicine, professor of medicine (infectious diseases), and medical director of Yale’s Clinical Virology Laboratory, began working to create a reliable version of the CDC’s diagnostic test adapted to the equipment available on site. It was a process fraught with difficulties regarding regulations, obtaining scarce reagents, and most important, getting access to the virus to validate that the test would be accurate.

By mid-March, Landry, supported by IMPACT and working with David Ferguson—her former lab manager who returned for the assignment—and the clinical virology molecular leadership staff Robin Garner and Jody Criscuolo, had created and validated

Senior leadership appointments made at School of Medicine in 2020



Jessica Illuzzi



Anthony Koleske



Samuel Ball



Jonathan Grauer



Rochelle Smith



Sarwat Chaudhry



Erica Herzog



Marcella Nunez-Smith

Jessica Illuzzi, MD, MS '06, has been appointed deputy dean for education at Yale School of Medicine, effective January 1, 2021. A graduate of Harvard Medical School, Illuzzi has been at Yale since starting her residency in 1998. She is professor and chief of the obstetric specialties and midwifery division of the Department of Obstetrics, Gynecology & Reproductive Sciences and has served as medical director of the Vidone Birthing Center at Yale New Haven Hospital's Saint Raphael Campus since 2014. She served as clerkship director in obstetrics and gynecology until 2013 and thereafter as director of electives and sub-internships for the School of Medicine.

Anthony J. Koleske, PhD, assumed the role of deputy dean for scientific affairs (basic science departments) in April. Koleske is Ensign Professor of Molecular Biophysics and Biochemistry and professor of neuroscience. A graduate of the University of Wisconsin and Massachusetts Institute of Technology, Koleske is internationally recognized for his work defining the Abl family kinases as regulators of the cytoskeleton and elucidating mechanisms that control neuronal development and connectivity. Koleske succeeded Michael Crair, PhD, William Ziegler III Professor of Neuroscience and professor of ophthalmology and visual science, who has stepped into the role of Yale University's vice provost for research.

Samuel Ball, PhD, professor of psychiatry, and **Jonathan N. Grauer, MD**, professor and vice chair of orthopaedics and rehabilitation, became associate deans for faculty affairs, representing non-surgical and surgical departments respectively, effective at the start of 2020. Ball and Grauer oversee faculty development and mentoring initiatives across the school, using best practices for faculty development along differing career paths and working with departments to develop and streamline their mentoring programs. They serve as liaisons between the Office for Faculty Affairs, the Teaching and Learning Center, Yale Medicine, and the Yale Center for Clinical Investigation, and as resources for faculty, departments, and deputy deans across the school.

Rochelle D. Smith, MS, assumed the role of associate dean of diversity and inclusion and associate chief diversity officer. She came to Yale from Washington University in St. Louis, where she had been assistant provost for diversity initiatives. Smith founded the Washington University Diversity Pipeline Consortium for STEM, and her experience also included co-designing two faculty-of-color retention programs at Washington University that resulted in a record number of these faculty receiving tenure. In addition, she led the MD/PhD diversity effort and founded three student affinity groups at the university.

Sarwat Chaudhry, MD, associate professor of medicine (general medicine), and **Erica Herzog, MD, PhD**, professor of medicine (pulmonary), now lead the Office of Student Research (OSR) as associate deans. Both are physician investigators with deep ties to the New Haven community, the Graduate School of Arts and Sciences, and professional schools on the main campus. They succeeded John N. Forrest Jr, MD, now professor emeritus of medicine, who had led OSR since it was established in 1986.

Marcella Nunez-Smith, MD, MHS, was appointed the inaugural associate dean for health equity research at Yale School of Medicine in August. Nunez-Smith is associate professor of medicine (general medicine) and of epidemiology (chronic diseases) and associate professor at the School of Management. She is founding director of the Equity Research and Innovation Center (ERIC), deputy director for health equity research and workforce development at the Yale Center for Clinical Investigation (YCCI), and director of the Pozen-Commonwealth Fund Fellowship in Health Equity Leadership. She also has taken a position in the new Biden Administration, leading the White House effort to improve health equity.

// **Pandemic** (page 6) a roughly 90% reduction in respirator burn on a per patient basis compared to baseline. Based on the successful efforts of YNHHS Supply Chain, Kenney was asked during the crisis to provide information and advice to Vizient membership, the U.S. Defense Logistics Agency, the World Bank, and FEMA.

EDUCATION FROM HOME

On March 11, the university asked students not to return to campus after spring break, announcing that classes would resume online. Within a week, faculty and the Office of Education had created remote-learning experiences for medical and physician associate students—a “heroic” effort requiring intensive faculty training in the online tools, said Michael Schwartz, PhD, associate professor of neuroscience; director of medical studies in neuroscience; and associate dean for curriculum in the School of Medicine's Office of Education. Fortunately, many lectures were already available by video or podcast.

More disappointing and disruptive news came on March 16. Postponed procedures and the need to conserve PPE and limit the number of people at patients' bedsides led Dean Brown and Richard Belitsky, MD, the Harold W. Jockers Associate Professor of Medical Education, associate professor of psychiatry, and deputy dean for education, to cancel clinical clerkships and electives, followed by nearly all subinternships on March 28. “Our ability to provide you with meaningful educational experiences during your clerkships has been eroded,” Brown wrote the students in an open letter.

“You can imagine the angst that the students are going through that need these [clerkships and subinternships] for graduate residency matching,” Schwartz said. Though the problem is nationwide, which led the Association of American Medical Colleges to discourage away rotations and recommend virtual interviews, that was small consolation, he said: “While the environment has changed for almost everybody, competing in it doesn't make the student feel good.”

Under Schwartz's leadership, faculty, students, and the Medical Education staff quickly created six new electives, particularly aimed at students whose rotations and subinternships were on hold. In one, students practiced management of acute disease processes through virtual case scenario simulation; another covered research methods, focusing on critically appraising literature about COVID-19, which often has not been peer reviewed. Two explored the pandemic through interdisciplinary lenses and two allowed students to rejoin clinical teams through telehealth.

While sheltering at home, students found additional ways beyond electives to help with the pandemic effort. Some helped in COVID-related clinical studies. Others assisted clinical teams by performing literature searches or calling patients for follow-up. In addition, many took it upon themselves to be as useful as possible to members of the New Haven community in need.

Second Look Weekend, Match Day celebrations, Medical Education Day, and Commencement were successfully moved online.

REOPENING

On April 21, COVID-19 admissions peaked, with a census of 791 inpatients across the health system. On April 29, at last, more patients were being discharged than admitted. It was time to discuss reopening laboratories and childcare, resuming clinical trials and elective procedures, and bringing students back to the wards. Some clinical electives and subinternships resumed in late May, and clerkship clinical rotations resumed on July 6. Preclinical students made up for lost time with accelerated courses.

Some COVID-19-related changes are likely to become the new normal, such as telehealth.

“I don't think the patients or the doctors want to go back” to mostly in-person visits, said outgoing urology chair Peter Schulam, MD, PhD, who spent much of the pandemic working on COVID-19 testing protocols in his role as chief innovation and transformation officer at YNHHS (Schulam has since left Yale for a senior position at Johnson & Johnson). “This is the silver lining,” he said. “This may be the one good thing. The rapid adoption of telemedicine may improve the efficiency of our health care delivery.”

In the meantime, weary frontline providers were thinking about the next wave. “Phase two, scaling down to some unknown COVID plateau, on top of our usual hospital volume, is the current challenge. Preparing for the likelihood of recurrent surges in the future is the next challenge,” Tanoue said. “There's this huge uncertainty. Where will the bottom [of the pandemic curve] be? Where will

it settle out? Will there be recurrent surges? If so, how big will they be? We can try to plan ahead, but it is challenging with so much unknown.”

Desir said teams needed to be ready to “flex up” for that reason. He was part of discussions about how many people needed to be on infectious-disease or intensive-care teams. “We don't quite know yet how big [these teams] should be, but I think we should be ready to serve as the referral center for Connecticut if we have another peak,” Desir said.

Meeting the COVID-19 challenge has brought out remarkable energy in doctors and nurses, Tanoue said. “It's just amazing, how much people are willing to give, how committed they are to the mission.”

Zampano, who spent 16 years caring only for gynecologic oncology patients, staffed an end-of-life care unit for the first time during the pandemic, as well as a COVID-19 rapid evaluation clinic. The pandemic was awful, she said. “I've had my share of tears. I hope I never see another pandemic in my lifetime.”

But, she added, her glass is half full. “I've worked with some unbelievable people. The camaraderie that has come out of this and the ability to be flexible have been amazing!” Zampano said. “I wouldn't consider myself a flexible person. I'm a nest-builder. And I have flown out of my nest beyond anything I thought I would ever do.”

“I am pleased that we were able to do what we did—it was really extraordinary,” Desir said. “The entire system came together really quickly to make major, major changes. The idea of one team really came together.”

YSM faculty elected to National Academy of Medicine and AAAS

Experts in psychiatry, cell biology, environmental health, and dyslexia

Daniel A. Colón-Ramos, PhD, and Michelle L. Bell, PhD, have been elected to the National Academy of Medicine (NAM), the academy announced in October.



Daniel Colón-Ramos

Colón-Ramos is Dorys McConnell Duberg Professor of Neuroscience and Cell Biology at Yale School of Medicine. He joined the Yale faculty in 2008, and has worked with the nematode *Caenorhabditis elegans* to uncover fundamental principles of the cell biology of the synapse and how it underpins animal behaviors. A particular interest has been how neurons self-organize to form brains, and how they convert sensory information into behavioral responses. His discoveries have informed fundamental and conserved principles of neuropil formation, synaptic cell biology, and circuit function that underpin behaviors.

Colón-Ramos also has been very active in helping his native Puerto Rico obtain both scientific and material

support, particularly after Hurricane Maria in 2017 and during the current COVID-19 pandemic. A nonprofit he co-founded in 2006, Ciencia Puerto Rico, and its affiliated Yale Ciencia Academy, also provide professional development and leadership training to PhD candidates from minoritized backgrounds, particularly from



Michelle Bell

Puerto Rico. Bell is the Mary E. Pinchot Professor of Environmental Health at Yale School of the Environment with a secondary appointment as professor of environmental health at Yale School of Public Health. She joined the Yale faculty in 2004. Her research investigates how human health is affected by atmospheric systems, including air pollution and weather. Other research interests include the health impacts of climate change and environmental justice. The research is designed to be policy-relevant and contribute to well-informed decision making to better protect human health and benefit society.

These distinguished faculty members are among 100 new members who were selected for their

outstanding contributions to the field of medicine. They join 52 other faculty members from Yale who have been elected to the NAM, one of the highest honors in medicine.

The American Association for the Advancement of Science (AAAS) has named two Yale School of Medicine researchers as AAAS Fellows for their distinguished efforts to advance science. John H. Krystal, MD, Robert L. McNeil, Jr. Professor of Translational Research, chair and professor of psychiatry, profes-



John Krystal

sor of neuroscience and of psychology, and co-director of the Yale Center for Clinical Investigation; and Sally Shaywitz, MD, Audrey G. Ratner Professor of Pediatrics (Neurology), are among 489 association members awarded the honor in 2020 by AAAS.

Krystal is being honored for his transformative contributions to human neuroscience, particularly research on glutamate signaling and the resultant development of ketamine as a novel rapid antidepressant. In the early 1990s, Krystal and fellow psychiatrists at Yale discovered that chronically depressed patients experienced almost

immediate relief from symptoms after taking the anesthetic ketamine. In 2019, the Food and Drug Administration approved a new antidepressant, esketamine, that is now available by prescription. Esketamine is a nasal spray derived from ketamine. “Yale has been and continues to be an incredible home for translational neuroscience,”



Sally Shaywitz

Krystal said. “There were very few other places in the world where we could have conducted our research.” Shaywitz, co-director of the Yale Center for Dyslexia & Creativity, is being honored for distinguished contributions to the public’s understanding of the biological basis and natural history of dyslexia and communicating these discoveries to the public. In addition to her more than 350 scientific publications with Bennett Shaywitz, MD, Charles and Helen Schwab Professor of Pediatrics (Neurology), she is author of the best-selling book, *Overcoming Dyslexia*, which has transformed people’s understanding of dyslexia and provided practical approaches and specific interventions for parents and educators.

// **Donors** (page 5) A. Hafler, MD, chair and William S. and Lois Styles Edgerly Professor of Neurology, and professor of immunobiology, worked to develop immunotherapies to treat COVID-19 with funds from the Ludwig Family Foundation.

The G. Harold & Leila Y. Mathers Foundation generously awarded funds for COVID-19 research to Bucala, as well as Ring’s investigation of methods to take advantage of adaptive immunity to treat and prevent COVID-19. The foundation granted these awards in direct response to the need for research posed by the pandemic and built upon the foundation’s long-standing history of supporting biomedical research at Yale.

Yale researchers also received Fast Grants, which accelerate typically lengthy research grant mechanisms. Expedited within 14 days, Fast Grants were funded by Emergent Ventures, a program at George Mason University. Yale researchers who were funded include Naftali Kaminski, MD, Boehringer Ingelheim Pharmaceuticals, Inc., Endowed Professor of Medicine (Pulmonary); Akiko Iwasaki, PhD, Waldemar Von Zedtwitz Professor of Immunobiology and professor of molecular, cellular, and developmental biology; Craig B. Wilen, MD, PhD, assistant professor of laboratory medicine and of immunobiology; Nathan D. Grubaugh, PhD, assistant professor of epidemiology (microbial diseases); Ellen F. Foxman, MD, PhD, assistant professor of laboratory medicine and of immunobiology; and Stephanie Eisenbarth, MD, PhD, associate professor of laboratory medicine, of immunobiology, and of immunology.

Personal protective equipment, or PPE, was one of the first and most

immediate necessities in addressing the pandemic, and the Yale community responded to this urgent need in the form of PPE donations. Lisa L. Lattanza, MD, professor and chair of orthopaedics and rehabilitation, worked tirelessly to lead the effort to collect donations of PPE to Yale. “We need to protect our frontline health care workers first and foremost,” she said. “If they get sick, there is no one to take care of the community.”

PPE donors showed creativity and perseverance in bringing vital supplies to frontline workers in New Haven.

Jiankan Guo, PhD, a research scientist in Yale School of Medicine’s Section of Nephrology, partnered with Zhenzhen Wu, Steve Xu, Shanshan Zeng, and Jason Zhao to lead a KN95/N95 drive with more than 170 local Chinese-American volunteers to solicit PPE donations in both Connecticut and China. “I realized it was the time to stand up and do something,” said Guo. “I grew up in China and have a lot of connections there, so I reached out to see how I can help.”

Hyung Chun, MD, associate professor of medicine and director of translational research of the Yale Pulmonary Vascular Disease Program, also acted immediately, and the response was similarly quick. After reaching out to colleagues, Chun was able to deliver a donation of about 6,000 gloves, along with disposable gowns and shoe covers, to Yale the following day.

The New Haven-based Yale-China Association assisted an effort by a coalition of nongovernmental organizations (NGOs) in China and the United States to send 23,000 N95 masks. The Yale Chinese Parents Club donated 108 hazmat suits. In addition, 2,000 surgical masks were donated by

employees and families at Boehringer Ingelheim, Danbury Chinese Alliance Church, and the Western Connecticut Chinese Association. Also in April, more than 21,000 KN95 face masks were donated by AMT Consulting in Shanghai, China.

Yale’s long-standing partnerships in China also proved crucial. Shanghai Jiaotong University (SJTU), one of Yale’s partner institutions, sent a donation of 5,000 N95 masks in April, a time of high demand for PPE.

Lattanza herself, who had just joined the Yale faculty in 2019 from the University of California, San Francisco, resourcefully obtained emergency PPE from her own contacts when Connecticut’s pandemic was at its height. “I worked there for 20 years and reached out to colleagues for help when their COVID burden was so small and ours very large.”

Students and faculty also worked together to found and contribute to grassroots efforts to aid the local community. Meals4Healers, spearheaded by Claudia-Santi F. Fernandes, EdD, LPC, an associate research scientist in General Internal Medicine, mobilized to provide a different kind of aid, as well as gratitude, to Yale frontline workers, while simultaneously supporting local restaurants. Working with New Haven restaurants Tavern on State and Roia, Meals4Healers delivered meals to hospital house staff who were home in isolation, as well as those who were displaced due to COVID-19.

Other school- and community-based groups made masks, raised funds for hospital maintenance and custodial workers, delivered snacks to physicians and nurses caring for COVID-19 patients, delivered essential medications to psychiatric patients

who could not reach a pharmacy, and raised essential funds for local households in urgent need.

Yet another aspect of hardship created by the pandemic has been its financial impact on Yale medical students and their families. The YSM class that matriculated in August 2019 was the most economically diverse in the school’s history. Fifteen of its 104 members were the first in their family to attend college. Twenty-nine come from groups underrepresented in medicine.

Within the student body there are exceptionally resilient young people who not only study medicine, but also work to support their extended families, children, or spouses who may have lost their jobs. For many, COVID-19 has exacerbated these challenges, as they try to focus on their medical educations.

The School of Medicine Student Assistance Fund covered urgent, unexpected needs for more than a dozen students, including costs of traveling home as well as such essentials as food and medication, taking the boards in a new location, unexpected babysitting costs, and broadband connections to be able to attend classes online. A special gift to the fund came at the height of the COVID-19 emergency from medical school alumni Stephen C. Knight, MD ’90, MBA ’90, and Elizabeth Q. Knight, MD ’94, PhD ’94, who already had been generously supporting student scholarships prior to the pandemic.

The need for members of the Yale community to harness their ingenuity, resourcefulness, and compassion will continue as long as the pandemic does, and Yale School of Medicine is grateful to all donors who have made it possible for the school to construct an effective and sustained response.