## DISCOVERIES

## A virus unknown, challenges fraught-

Ve Hved,

How a university and academic medical center are confronting a pandemic unprecedented in modern times, emerging stronger and better across intertwined missions of research, clinical care and education.

learned,

## cared and taught.



## DISCOVERIES

**VOLUME 11 / 2021** INNOVATIONS IN RESEARCH, HEALTH CARE AND EDUCATION

Founded in 1960, the University of California San Diego is consistently ranked among the top research universities in the nation and in the world, with 12 divisions and schools and a total enrollment exceeding 40,000 students.

UC San Diego Health Sciences is comprised of UC San Diego Health, UC San Diego School of Medicine, Skaggs School of Pharmacy and Pharmaceutical Sciences and the Herbert Wertheim School of Public Health and Human Longevity Science.

UC San Diego Health is the region's only academic health system, and includes UC San Diego Medical Center, Jacobs Medical Center, Sulpizio Cardiovascular Center, Moores Cancer Center, Shiley Eye Institute, Koman Family Outpatient Pavilion and the Altman Clinical and Translational Research Institute, plus primary care and same-day clinics throughout Southern California.

See an expanded, interactive version of this issue at: **DISCOVERIES.UCSD.EDU** 

INTRODUCTION

## Learn. Evolve. Prepare.

"UC San Diego continues to be an exemplar. In a changing world, we are changing too. We continue to learn, evolve and fulfill our goals to not only make the world better, but also better prepared for the future."

THE MAGAZINE you hold is called *Discoveries*. an apt name that encompasses the overarching missions of the University of California San Diego, from research that reveals and explains the mysteries of our world to the education of new doctors, artists and engineers who serve our communities to the development of therapies, art and technologies that shape our everyday lives. This is a special issue, a focused look at how UC San Diego scientists, doctors, students, staff and others responded to the COVID-19 pandemic, and how they continue to rise to its many challenges. You might call this issue *Recoveries*. The pandemic has been difficult for everyone, at times tragic. More than 760,000 Americans have died from COVID-19 and millions more became sick, some with lingering symptoms. These numbers echo around the world. From small villages to great cities, no place has been immune. In the 21 months since the World Health Organization officially declared COVID-19 to be pandemic, we have been working to mitigate its consequences. UC San Diego did not escape the pandemic's adverse effects. In this issue, we recall not only what happened, but also how we responded (and continue to respond) through lessons learned. There have been many remarkable achievements, unplanned perhaps, but not surprising. Our nationally recognized Return to Learn program made it possible to restore in-person instruction and research on our campus, and our innovative partnerships with regional government, the San Diego Padres and area businesses created California's first vaccination super station. These are just two of the programs and initiatives that positively impacted public health, served our community and kept our economy moving.



As one of the world's great research universities and academic medical centers, UC San Diego is flush with talent, expertise and resources. Confronted by a public health crisis that spanned the globe, our people and programs rose to meet the complex challenges of the pandemic head on. And throughout, our world-class health care system – UC San Diego Health – has shined brightly, a nimble and innovative leader within our state and across our nation.

UC San Diego continues to be an exemplar. In a changing world, we are changing too. We continue to learn, evolve and fulfill our goals to not only make the world better, but also better prepared for the future.

Sincerely

PRADEEP K. KHOSLA Chancellor University of California San Diego

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Contractor of







### **Tested and Testing**

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Concern for his pregnant wife prompted one scientist's obsession with COVID-19 testing, ultimately leading to a new lab that helps keep the campus and community safe, and enables research.

BY HEATHER BUSCHMAN, PHD

### It Began with Seven Tea Kettles

Frontline staff at UC San Diego Health recollect the first days of the pandemic, a time marked by fear, uncertainty and endless acts of kindness.

BY MICHELLE BRUBAKER, JACKIE CARR AND JEANNA VAZQUEZ

### Tales In and Out of School

During the pandemic, innovation and adaptability became virtual realities as the campus reopened classrooms, residences and opportunities.

**BY YADIRA GALINDO** 

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### **About This Issue**

At press time, the COVID-19 pandemic is more than 21 months old, and in much of the world (and in swaths of the United States), it still rages. This special issue chronicles the first year and a half of the pandemic, as experienced by students, staff and faculty at University of California San Diego and UC San Diego Health, and by the residents of the region. It is a testament to them.



For a fuller recounting, point your camera phone at the QR code (*left*) or visit *Discoveries* magazine online at **DISCOVERIES.UCSD.EDU** 

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### VOLUME 11 / 2021

INNOVATIONS IN RESEARCH, HEALTH CARE AND EDUCATION



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**COVID-19** Timeline

# THEN, now and BEYOND

Key events and moments at UC San Diego, in San Diego and around the world

Open to see the pandemic unfold

### January 20 First confirmed cases

outside mainland China are reported in Japan, South Korea and Thailand. The first U.S. case is confirmed the next day, a man in Washington State after returning from a trip to Wuhan.

March 9

March 11

WHO officially

in 114 countries.

First reported

community case

of COVID-19 in

San Diego County,

a woman in her 50s.

declares COVID-19 to

time, there are 118,000

cases and 4,291 deaths

be pandemic. At the

First documented case (retroactive) of COVID-19, a 55-year-old man from the Hubei province in China.

November 17



Chinese government seals off Wuhan, ordering a regional quarantine of 18 million people.

### Local government of Wuhan, China confirms it is treating dozens of cases of a new disease caused by an unknown virus.

December 31

### February 5 UC San Diego Health

receives its first four patients suspected of having COVID-19, all evacuees from Wuhan. Health system declares a Code Orange, implementing Hospital Command Center to coordinate emergency response.

### February 11 World Health

Organization (WHO) formally names the disease caused by the novel coronavirus SARS-CoV-2: COVID-19 (CO for corona, VI for virus and D for disease).

### March 20

UC San Diego Health partners with five leading diagnostics manufacturers to begin COVID-19 testing program.

COVID-19 death of a San Diego County resident, a man in his 70s.

### March 22

First reported

### UC San Diego Health

joins Phase III clinical trial of Astra-Zeneca COVID-19 vaccine.

### September 16

September 2

The Expedited COVID IdenTification Environment or EXCITE lab, opens on the UC San Diego School of Medicine campus to provide COVID-19 testing to the campus, local schools and first responders.

### September 28

Global death toll from COVID-19 reaches 1 million.

August 17 COVID-19-related

June 18

California Governor

makes face coverings

mandatory after local

mandates experience

UC San Diego Health

ioins Phase III clinical

trial of Moderna

COVID-19 vaccine.

Gavin Newsom

pushback.

Julv 24

deaths exceed 170,000, elevating the disease to the third most deadly behind heart disease and cancer.

### August 28

Newsom unveils state's color-coded tier system to track case rates and benchmarks for reopening.

October 1

UC San Diego Health joins Phase III clinical trial of Johnson & Johnson (Janssen) COVID-19 vaccine.

### San Diego school districts announce they will close classrooms,

March 16

at least temporarily.

March 13

UC San Diego announces all instruction will shift to online and vacates on-campus residential living.

### March 19

California becomes the first state to issue a stay-at-home order.

April 6 U.S. reports thirdhighest death toll from COVID-19, hitting 10,000 mark.

Return to Learn program, designed to help UC San Diego resume in-person campus activities in the fall, is announced.

### January 7

San Diego County records its peak number of reported COVID-19 cases in one day: 4,550.

Station at Petco Park

opens, in partnership

with county, city and

San Diego Padres. It is

the first mass vaccina

vaccinate up to 5,000

US BELLE

tion site in the state,

with the capacity to

### January 11 Vaccination Super

the smartphone-based exposure monitoring tool was developed

December 7

**CANOTIFY** 

and piloted at

UC San Diego.

December 11

vaccine.

December 15

expands statewide:

FDA authorizes emergency use of Pfizer's COVID-19

UC San Diego Health receives first shipment of Pfizer vaccine.

### January 15

persons daily.

UC San Diego Health begins vaccinating eligible patients. San Diego County records peak number of COVID-19 deaths in one day: 58.

### December 16

UC San Diego Health begins administering Pfizer vaccine to health care workers.

### December 18

FDA authorizes emergency use of Moderna vaccine.

### December 22

UC San Diego Health receives first shipment of Moderna COVID-19 vaccine.

### February 22

Total COVID-19 death toll in U.S. passes 500,000.

### February 25

UC San Diego installs vending machines on campus that dispense COVID-19 self-tests. up to 2,000 per day.

### February 27

FDA grants emergency use authorization to single-dose J&J vaccine for COVID-19.

UC San Diego Health researchers announce participation in a new national clinical trial of college students, to assess how well vaccination prevents transmission and infection.

### April 15

All Californians age 16 and older become eligible for COVID-19 vaccination.

### April 17

Global death toll from COVID-19 pandemic surpasses 3 million persons.

### April 19

All U.S. adults now eligible for COVID-19 vaccinations.



Pfizer vaccine given emergency use authorization for adolescents 12 through 15 years of age.

### Mav 24

Working with coalition of U.S. companies and Mexican government, UC San Diego Health deploys mobile clinic to vaccinate 10.000 maguiladora workers over seven days. Operations would subsequently expand to vaccinate thousands more.

### in U.S. since January 2021.

vaccine administered

March 20

March 8

Petco vaccination site closes; more than 225,000 doses administered.

UC San Diego Health receives its first ship UC San Diego Health ment of J&J vaccine. announces partnership with County of San March 19 Diego to conduct One hundred millionth SARS-CoV-2 detection dose of COVID-19

February 8

UC San Diego opens

vaccination super

the athletic center

on the main campus.

station at RIMAC,

February 11

and testing pilot

program at local

centers.

schools and childcare

President Biden targeted this date to have 70 percent or 160 million American adults inoculated with at least one dose of a COVID-19 vaccine. Actual per centage reached is 67, translating to 3.4 to 5.2 million eligible adults who remained unvaccinated.

### July 15

University of California finalizes COVID-19 vaccination policy requiring all students, faculty and staff to be vaccinated for the fall quarter.

### Sentember 1

San Diego County becomes first in nation to officially declare health misinformation to be a public health crisis.

### Sentember 6

Proof of compliance to UC COVID-19 vaccination policy due for all students, faculty and staff.

### otember 22

FDA authorizes COVID-19 Pfizer vaccine booster for Americans 65 and older and those at high risk of severe COVID-19 illness. One day later CDC panel concurs, but CDC Director **Rochelle Walensky** overrules panel, expands access to those in high-risk jobs and settings, such as health care workers.

### September 23

UC San Diego resumes in-person classes. California announces plan to immediately begin administering additional Pfizer vaccine doses to eligible state residents.

### June 1

**RIMAC** vaccination site closes, more than 195,000 doses administered.

### June 4

UC San Diego Health administers 500,000 doses in roughly six months.

### June 15

California lifts all COVID-19 mandates, except in select situations.

### June 29

UC San Diego Health is first in nation to launch digital vaccine record for patients, providing easy proof of vaccination.

### August 13

UC San Diego Health conducts its one mil lionth COVID-19 test.

### Auaust 17

Delta Surge: San Diego County reports 1,738 new COVID-19 cases, the most cases in a single day in the region since late January.

### August 31

California reaches vaccine milestone, with more than 80 percent of eligible people having received at least one dose of the COVID-19 vaccine. San Diego Unified School District school year begins, with children and teachers required to wear masks indoors.

### September 9

President Biden announces federal vaccine mandate for as many as 100 million Americans, including health care workers, federal contractors and private sector employees.

### September 20

At 675.000, national death toll from COVID-19 pandemic surpasses 1918 influenza pandemic.

DISCOVERIES

## Research Clinical Education

## Life Became a Laboratory

LIFE IS CHANGE. It's about adapting to new situations and circumstances that ensure not just survival, but a presumably better, stronger future. Viruses are especially good at this, mutating constantly and continuously, often at dizzying rates, for billions of years.

The coronavirus known as Severe Acute Respiratory Syndrome Coronavirus 2 of the genus Betacorona*virus*, or slightly more colloquially, SARS-CoV-2, isn't new at this game of life. It likely existed in other forms in other animals before jumping species, but it was new to us.

Now, we are painfully familiar. The unexpected debut of SARS-CoV-2 in late 2019 and the pandemic that followed have provoked all manner of subsequent change in all manner of ways. Like the virus and its variants, life as we knew it will never be the same.

We are changed and changing, often in ways that have made us wiser, stronger and better. Nowhere is that more evident than in the response of faculty, students and staff at UC San Diego, who pivoted their attentions, expertise, talents and resources to confronting and combatting this highly infectious, often deadly virus festooned with trade mark spikes of protein on its surface.

The scope of these efforts and contributions are astounding, from helping pin down the virus' origins in China, Europe and North America to parsing the threat of aerosolization and understanding the critical performance of neutralizing antibodies. While much of society necessarily shut down, research at UC San Diego continued, affected but unabashed, even expanding in some cases. For example, we built from scratch a new biosafety level 3 lab, capable of handling highly infectious pathogens, and pop-up labs for measuring viral loads in patients. We created high-throughput systems to process thousands of COVID-19 test samples daily, including wastewater from our buildings, and to sequence and analyze all viral genomes. We developed a cellphone-based technology to alert users when someone close to them tested positive. Researchers shifted priorities, moving robots and equipment around to create new programs in a matter of days, when the norm is more often measured in years. It was hard, often exasperating, work. A working scientist might get only one scheduled day in the lab each week, part of vital and exacting safety protocols. It might be only enough time to do a bit of "wet work," then go home to analyze the data. Zoom calls multiplied like, well, viruses. People grumbled, but they carried on and important work was done.

Perhaps nowhere was the depth and breadth of our expertise more obvious than in our participation in three of the four first and biggest clinical trials for a COVID-19 vaccine: Moderna, AstraZeneca and Johnson & Johnson. UC San Diego Health scientists and the thousands of San Diegans who volunteered in these trials were players in the development of these vaccines. With critical help from the Altman Clinical and Translational Research Institute, they moved the needle.

We have learned a lot. We have earned a lot: To date, more than \$30 million in new grants specifically funding COVID-19-related projects, with more in the works. And from these lessons and efforts, we prepare to change even more with an aptly named project called PREPARE, which will bring together people, programs and infrastructure to be ready for pandemics to come.

"When you are finished changing, you are finished," Ben Franklin once said. The pandemic changed everything, but not our research mission to make the world a better, healthier place. That remains unchanged and our work unfinished.

Sincerely,

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DAVID A. BRENNER, MD Vice Chancellor, UC San Diego Health Sciences

## **EXERCISED OVER** NOTHING

Study finds masks don't impair breathing or cardiopulmonary function

**BY SCOTT LAFEE** 

SOME OF THE RESISTANCE to wearing masks during the pandemic was fueled by the notion that the nose-andmouth coverings impaired breathing, and thus cardiopulmonary function, especially during physical activity.

But a November 16, 2020 study published in the Annals of the American *Thoracic Society* by UC San Diego School of Medicine researchers, with colleagues in Canada and Washington state, found that while masks might feel uncomfortable, perhaps making one's face hot and sweaty, there was virtually no empirical evidence that they significantly impaired lung function, even during heavy exercise.

"There might be a perceived greater effort with activity, but the effects of wearing a mask on the work of breathing, on gases like oxygen and CO2 in blood or other physiological parameters are small, often too small to be detected," said first author Susan Hopkins, MD, PhD, professor of medicine and radiology.

Hopkins and co-authors reviewed all known scientific literature on the topic, including analyses of inhaled and exhaled gases, blood oxygen levels, effects on muscle blood flow, cardiac function and blood flow to the brain.

There were no detectable physiological differences based on gender or age. The only exception were persons with severe cardiopulmonary disease, in which even the smallest resistance to breathing might prompt dyspnea, the medical term for shortness of breath.



%

Reduced risk of SARS-CoV-2 infection when wearing a mask during high-risk exposures red to not wearing a mas

## COVID-19, NEW MOMS AND BREAST MILK

Findings suggest breast milk is not a likely source of infection for infants

### **BY MICHELLE BRUBAKER**

AS RESEARCHERS expanded investigations into how the SARS-CoV-2 virus spreads, infects and who is most vulnerable, scientists at UC San Diego School of Medicine, in part supported by the Family Larsson-Rosenquist Foundation, focused on a particular aspect: breastfeeding women and breast milk.

In particular, they launched studies to determine whether COVID-19 is transmitted via human milk and whether human milk can protect infants from COVID-19.

To the first question, the answer appears to be no. A study published August 19, 2020 in JAMA analyzed 64 samples of breast milk collected by the Mommy's Milk Human Milk Research Biorepository from 18 women across the United States infected with SARS-CoV-2. Although one sample tested positive for viral RNA, subsequent tests found that the virus was unable to replicate, and thus unable to cause infection in breastfed infants. "Detection of viral RNA does not equate to infection. It has to grow and multiply in order to be infectious, and we did not find that in any of our samples," said Christina Chambers, PhD, MPH, co-principal investigator of the study, professor of pediatrics at UC San Diego School of Medicine, director of Mommy's Milk Human Milk Research Biorepository and co-director of the UC San Diego Center for Better Beginnings. "Our findings suggest breast milk itself is not likely a source of infection for the infant."



"We want to know whether breast milk components, with their antiviral properties, might actually protect infants from COVID-19."

-LARS BODE, PHD

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08

The answer to the second question will take longer. Research is ongoing, with study volunteers in the United States and Canada being monitored while breastfeeding and following infection. Scientists will also track infant growth and development via the child's pediatrician for at least one year following infection.

"We already know breast milk contains properties that help protect infants from diseases, such as diarrhea and pulmonary infections. We want to know whether breast milk components, with their antiviral properties, might actually protect infants from COVID-19," said Lars Bode, PhD, director of UC San Diego's Larsson-Rosenquist Foundation Mother-Milk-Infant Center of Research Excellence.



## WHAT'S **OLD MAY BE NEW AGAIN**

Repurposing drugs for COVID-19

### **BY HEATHER BUSCHMAN, PHD**

A MOLECULE known as ACE2 sits like a doorknob on the outer surfaces of cells that line the lungs' passageways. Since early 2020, researchers have known that SARS-CoV-2 primarily uses the ACE2 doorknob to enter these cells and establish a COVID-19 respiratory infection. Finding a way to lock out that interaction as a means to treat infection has become the goal of many research studies.

To speed up the search, many researchers have turned to testing repurposed drugs - medicines already known to be safe for human use because they are FDAapproved for other conditions.

Before it became infamous for its role in COVID-19 infections, ACE2 was known to regulate blood pressure. And since prescription statins - widely used cholesterol-lowering drugs – can affect ACE2, UC San Diego Health researchers analyzed the electronic medical records of 170 statin-taking patients with COVID-19 to see what effect the medications had on virus vulnerability.

They found that statin use prior to hospital admission for COVID-19 was associated with a more than 50 percent reduction in risk of developing severe COVID-19, compared to those with COVID-19 who were not taking statins. Patients with COVID-19 who were taking statins prior to hospitalization also recovered faster. The study, led by Lori Daniels, MD, professor and director of the Cardiovascular Intensive Care Unit at UC San Diego Health, and Karen Messer, PhD, professor and chief of the Division of Biostatics and Bioinformatics, was published in



the American Journal of Cardiology.

Another UC San Diego School of Medicine team discovered that SARS-CoV-2 can't grab onto ACE2 without a carbohydrate called heparan sulfate, also found on lung cell surfaces, where it acts as a co-receptor for viral entry.

"ACE2 is only part of the story," said Jeffrey Esko, PhD, Distinguished Professor of Cellular and Molecular Medicine at UC San Diego School of Medicine and co-director of the Glycobiology Research and Training Center. "It isn't the whole picture."

Esko's team discovered that heparin – an FDA-approved form of heparan sulfate widely used to prevent and treat blood clots – reduces the ability of SARS-CoV-2 to infect human cells cultured in the lab by up to 90 percent. Essentially, the heparin acts as bait to lure and bind the coronavirus, keeping it away from human cells. The study was published in Cell.

Elsewhere, UC San Diego physician-scientists like Constance Benson, MD, professor of medicine, and Dan Sweeney, MD, helped

conduct clinical trials of remdesivir. an antiviral originally designed to treat Ebola and Marburg infections, and the first repurposed drug approved by the FDA for treating COVID-19. It was found to shorten hospital stays and recovery time.

Not every repurposed drug is a success story. Atul Malhotra, MD, research chief of pulmonary, critical care and sleep medicine at UC San Diego Health, led a Phase III clinical trial investigating whether tocilizumab, a monoclonal antibody treatment for arthritis and other inflammatory diseases, might significantly improve the outcomes of patients with severe COVID-19 pneumonia.

It did not, Malhotra and colleagues reported in *The New England Journal* of Medicine, though they did observe a modest decrease in length of hospital stays and days on mechanical ventilators. Even when repurposed drugs do not achieve hoped-for results, Malhotra said, lessons are learned, which can guide new studies and help focus attention where it is most effective.

## **ZOO GORILLAS TEST POSITIVE FOR CORONAVIRUS** UC San Diego Health physicians assist in treatment

### **BY SCOTT LAFEE**

EXPERTS SAY COVID-19 is a zoonotic disease. The virus that causes it - SARS-CoV-2 - jumped from one species, perhaps a bat, to humans. That assumption continues to be investigated, but one thing is clear: COVID-19 is not strictly a human disease.

Though people are its primary victims, there have been SARS-CoV-2 positive cases reported in domestic cats and dogs, minks, ferrets, cougars, lions, leopards and tigers.

In January 2021, western lowland gorillas at the San Diego Zoo Safari Park were added to the list. It became international news, in part because of what it might

portend for all life on Earth. It's not known exactly how the gorillas became infected. Best guess: They picked up the virus from an infected, but asymptomatic, wildlife care specialist. Nearly half of the pandemic's spread can be attributed to asymptomatic infections, says the CDC. Transmission is also easier when species are related. Both humans and gorillas are primates, sharing approximately 98 percent of the same DNA. "The closer you are on the evolutionary tree, the more likely you are to be susceptible to the same disease," Pascal Gagneux, PhD, associate director of the Center of



Academic Research and Training in Anthropogeny at UC San Diego, told The San Diego Union-Tribune.

Two diagnosed gorillas subsequently infected others in the eight-ape troop, but most of the apes experienced only minor symptoms - sneezing, coughing, lethargy and fatigue - and all fully recovered. A 49-year-old silverback named Winston suffered heart issues and pneumonia, but recovered after receiving experimental antibody treatment.

"UC San Diego Health was involved in consultations with the zoo," said Jess Mandel, MD, chief of the Division of Pulmonary, Critical Care and Sleep Medicine. "We helped review Winston's chest CT and also advised regarding treating him with monoclonal antibodies and other therapies. It was a unique collaboration that combined UC San Diego Health's expertise in treating patients with COVID-19 and the zoo's expertise with nonhuman primates."

In March, the zoo's four orangutans and five bonobo chimpanzees were inoculated with an experimental vaccine developed by a veterinary pharmaceutical company.

"The closer you are on the evolutionary tree, the more likely you are to be susceptible to the same disease."

PASCAL GAGNEUX, PHD

## **NECESSITY IS ANOTHER INVENTION**

Urgent needs galvanized collaboration between doctors and engineers

**BY IOANA PATRINGENARU** 

THE FIRST MONTHS of the COVID-19 pandemic were marked, contrarily, by both scarcity and abundance. Personal protective equipment, such as masks and face shields, were in short supply. Access to ventilators, critical to keeping patients breathing, was limited. That scarcity evoked an abundance of anxiety and concern.

While UC San Diego Health supply chain administrators scoured sources, known or new, for more of just about everything (often with remarkable success), students and faculty across campus stepped up to fill in the gaps with imagination and invention.

In particular, UC San Diego Health physicians and engineers at the Jacobs School of Engineering worked hand in hand to build emergency ventilators and tools to help protect clinicians and patients alike. Many labs with laser cutters and 3D-printers began making face shields.

Some of these efforts were suspended once regular supply chains were re-established, but others continue.

For example, James Friend, PhD, a professor in the Department of Mechanical and Aerospace Engineering, Lonnie Petersen, MD, PhD, also in the department and an adjunct professor in radiology at UC San Diego Health, and assistant project scientist Casper Petersen, MD, worked with students to design

and build an emergency ventilator that converted a manual ventilator (patient face mask and bag that is squeezed by hand to push air into the patient's lungs) so that it worked mechanically without constant human operation. The team worked closely with anesthesiologists and respiratory therapists to ensure the device met specifications and requirements.

The resulting ventilator's blueprints are available under an open source patent. Manufacturing costs are approximately \$500, while state-ofthe-art mechanical ventilators cost at least \$50,000. Components can be rapidly fabricated and assembled in 15 minutes. Researchers are still gathering data about the device.

"Over the next couple of years we will find new applications for this work," said Petersen.

Friend also collaborated with Timothy Morris, MD, a pulmonologist at UC San Diego Health, to develop a vacuum exhausted isolation locker, dubbed VEIL. The device is essentially a large bubble placed over a supine patient's head and upper body, creating an oxygen-rich environment that also prevents air – and possibly droplets contaminated by the SARS-CoV-2 virus – from leaving the enclosure. The project was supported by the Galvanizing Engineering in Medicine program at UC San Diego, along with seven other projects. The work also



Exhausted Isolation Locker, which provides oxygen to patients while creating a safety barrier for caregivers.

received support from the Prototyping Lab at the Qualcomm Institute. A description of VEIL was published in the journal Infection Control & Hospital Epidemiology and some of the finished devices were used in clinical practice. A second type of protective box, called Coronavirus Safety during Intubation and Extubation (COSIE), was designed to protect physicians ventilating patients from aerosols and droplets. Field tests for COSIE were published in the Journal of Cardiothoracic and Vascular Anesthesia.

Numerous other projects came to the fore. Among them: Nanoengineers led by Jessie Jokerst, PhD, associate professor, developed a color-changing test strip James Friend, PhD. also collaborated with Timothy Morris, MD, a pulmonologist at UC San Diego Health, to develop a vacuum exhausted isolation locker, dubbed VEIL.

that can be applied to face masks to detect SARS-CoV-2 on people's breath or saliva. The approach is designed for daily COVID-19 surveillance in high-density, indoor settings, such as hospitals, nursing homes, shelters and prisons. Ben Smarr, PhD, assistant professor in the Department of Bioengineering, partnered with colleagues at UC San Francisco and Massachusetts Institute of Technology to determine whether data collected by devices worn on the finger can be reliably used to detect the onset of fever, a leading symptom of both COVID-19 and the flu. Early data from a multiinstitution research study involving more than 65,000 participants,

Breathing easier: Rather than invasively intubate COVID-19 patients, UC San Diego faculty and students tested a possible alternative, the Vacuum

called TemPredict, suggests the answer is yes. Research is ongoing.

Nicole Steinmetz, PhD, professor of nanoengineering, Jon Pokorski, PhD, associate professor of nanoengineering, and colleagues are using plant viruses to develop various technologies related to COVID-19, such as probes for testing and new platforms to create stable vaccines.

UC San Diego scientists, engineers and physicians continue to press ahead on these and other ideas. Some are big and bold, some perhaps less so, like a sensor that can measure temperature and respiration, both key vital signs for monitoring patients with COVID-19 and other conditions. The sensor is tiny, literally as obvious as Lincoln's nose on a penny.

## 400,000+

By fall of 2021, the EXCITE lab had run nearly half a million COVID-19 tests for students, faculty, staff, local schools and research projects.

TESTED TESTING

*Concern for his pregnant wife and soon-to-be-born twin girls* prompted one scientist's obsession with COVID-19 testing, ultimately leading to a synergistic effort that helped keep the UC San Diego campus, local schools and community safe, and made numerous research projects possible

BY HEATHER BUSCHMAN, PHD

### SPRING 2020

EXPECTING TWIN GIRLS, Gene Yeo and Corina Antal thought it would be fun and meaningful to hold their baby shower on International Women's Day.

The couple was "beyond excited," but also anxious. They were expecting not just identical twins, but monoamniotic-monochorionic (MoMo) twins, which means the fetuses shared a single placenta and amniotic sac. It's an extremely rare type of pregnancy, occurring in just one in 60,000 pregnancies. Pregnancies with MoMo twins are considered very high-risk because of heightened dangers of umbilical cord entanglement.

That much Yeo and Antal knew. Now, a new danger loomed.

The baby shower was March 8, 2020. Earlier that week, California Governor Gavin Newsom had declared a state of emergency due to the spread of a novel coronavirus that had only recently been formally named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the cause of coronavirus disease-2019, or COVID-19.

At their baby shower, Yeo and Antal prudently asked everyone to wash their hands as they arrived. Guests laughed at the novelty of elbow bumping instead of hugging or shaking hands, still becoming accustomed to the new public health recommendation intended to help prevent the spread of COVID-19.

Over the next few days, the first local community case would be reported in San Diego County, the World Health Organization would officially declare a COVID-19 pandemic and schools throughout San Diego County would close.



Yeo and Antal held their baby shower on March 8, 2020, the same week Gov. Newsom declared a state of emergency due to COVID-19.

"As scientists, we were not only reading all the studies we could find on MoMo twins, but now we were also learning all we could about COVID-19," said Yeo, PhD, a professor of cellular and molecular medicine at UC San Diego School of Medicine. Antal, PhD, is a postdoctoral researcher at Salk Institute for Biological Studies.

Yeo leads a research team focused on RNA, how cells translate the genetic material into proteins, how these processes are regulated and how they can go wrong in diseases like adult-onset muscular dystrophy and ALS. But the COVID-19 pandemic was a crisis of global proportions, and Yeo felt he needed to do something to help make the world safer for his growing family.

### A few days after the baby shower, Yeo logged into Slack, a popular workplace messaging app. Many other local researchers were also eager to help.

With their own research programs paused, conferences cancelled, lab teams working remotely and a lot of leading-edge technology shut down and gathering dust, these bored, anxious, smart people were keen to use their time and talents to at least help blunt the coming waves of COVID-19 cases.

What started as a small online discussion for local researchers - a support group of sorts - exploded into a round-the-clock frenzy of activity. Within a few months, nearly 1,000 scientists were sharing information, forming research collaborations, offering available research reagents, technology, sourcing materials and volunteers. (The community later became screencovid.info.)

At the time, SARS-CoV-2 was not yet highly prevalent in San Diego. The main and pressing concern was personal protective equipment (PPE) for health care workers. Sudden, high demand worldwide for surgical masks, N95 respirators, paper gowns and gloves produced alarming shortages. In California, health systems had some wiggle room to shore up supply chains and implement emergency plans, but in places like New York City, hit by one of the first and worst surges of cases in the U.S., some health care workers were forced to repeatedly reuse masks, or even wear

### SARS-CoV-2: A Single-Stranded RNA Virus

THE ENTIRETY OF SARS-CoV-2's genetic code is contained in just one small length of RNA. (In contrast, the human genome is comprised of double-stranded DNA that needs to be transcribed into RNA, then translated into proteins.) SARS-CoV-2 doesn't need to carry around much else because once it enters a human cell, it relies on host machinery to do all the work of translating viral RNA instructions into proteins that ultimately result in making more viral particles.

A COVID-19 test is considered "positive" when it detects unique bits of SARS-CoV-2's RNA. One of the most reliable tests uses quantitative polymerase chain reaction (gPCR), a common laboratory technique used to detect and amplify genetic material of all types. Lab technicians isolate genetic material from a nasal swab sample, mix it with special chemicals and put it into a machine called a thermal cycler. The thermal cycler repeatedly heats and cools the mixture. If the coronavirus' RNA is present, the tell-tale genes are amplified, making many more copies of them. During this amplification process, one of the special chemicals is converted into a fluorescent molecule that is detected by the thermal cycler.

trash bags instead of medical-grade gowns. The Slack community of San Diego scientists zeroed in on the PPE problem with unprecedented clarity and cooperation. Yeo helped facilitate that effort, but he had other worries too.

"Personally, I was terrified. Here's the beginnings of a pandemic and my wife is pregnant, right smack in the middle of it. I was very worried about her and the babies. Due to the difficulty of the pregnancy, we had to go to the hospital often for checkups. I was worried about people around us being masked, about our physicians and nurses getting masks and about getting tested. All of that made me push for more testing for everyone."

But in that moment, COVID-19 testing capacity was very limited. Until late-February, nasal swabs collected from patients in the U.S. suspected of having COVID-19 needed to be shipped to the Centers for Disease Control and Prevention (CDC) in Atlanta for testing. Getting results took days. Eventually, the U.S. Food and Drug Administration (FDA) allowed hospital laboratories that meet federal regulations for clinical diagnostic testing (CLIA certification) to develop their own in-house tests for COVID-19. That included UC San Diego Health's Center for Advanced Laboratory Medicine, which ramped up quickly. In mid-March, UC San Diego Health was performing just 20 COVID-19 tests per day; a month or so later, it was performing thousands daily, a rate that continues.

With severely limited supplies, instrumentation and staffing, most testing labs prioritized patients with symptoms of COVID-19, but emerging data suggested the coronavirus was also being spread by asymptomatic people - those who carried and spread the virus without any signs of illness.

"At that time, I wished we had had a better idea of how prevalent the virus was in the community," Yeo said. "I knew I'd sleep better if we knew that people, even those without symptoms, were being regularly tested and that those testing positive were being appropriately isolated and treated. That's what they were doing in Singapore, China, Taiwan and other places. But here we had this silent spread."



"Personally, I was terrified. Here's the beginnings of a pandemic and my wife is pregnant, right smack in the middle of it. I was very worried about her and the babies."

### -GENE YEO, PHD

YEO REACHED out to a friend and colleague who also knows RNA, Rob Knight. Knight had pioneered the use of bacteria-specific RNA as a "barcode" to read what's living in a mixed sample, whether soil, ocean water, human stool or just about anything. Over the past decade, he and his team figured out how to scale up the approach. Now, in a global effort known as the Earth Microbiome Project, researchers worldwide are cataloging which bacteria and viruses live where, and determining how the makeup of each of those unique communities, called microbiomes, influence human and environmental health.

The lab of Rob Knight, PhD, (left) re-deployed staff and resources to help build the EXCITE testing platform, screen wastewater from campus buildings for the presence of SARS-CoV-2 and test surfaces for the virus.

Knight was sheltering in place at home with his partner, a bioinformatician, and their eight-year-old daughter, struggling to balance two work and one school Zooms simultaneously, in a small house not intended for it.

Knight is originally from New Zealand, a country known for handling the COVID-19 pandemic differently - and very successfully. Yet even early on, he recognized that his home country's ability to enforce stricter lockdowns and the advantage of being an island made his

family's situation a bit different than the one he faced in the U.S. Because the COVID-19 case rate was always low in New Zealand, they didn't need to invest in as much technology to solve the problem. "It's the difference between setting your toast on fire, in which case you just need a cup of water to put it out, versus your whole house is on fire and you need a fire truck," said Knight, PhD, professor at UC San Diego School of Medicine and Jacobs School of Engineering and director of the Center for Microbiome Innovation.

"So we decided to build the fire truck."

Yeo and Knight Slack-messaged and emailed everyone they could think of in San Diego to ask how many thermal cyclers they had. (See sidebar on p. 16 for testing details.)

"We had this crazy plan to bring them all together in one spot to run tests." Yeo said. "And then Louise chimed in on Slack and said that she not only had the instruments, she'd been miniaturizing the COVID test and it's all in her lab, just one floor up from mine."

At the time, **Louise Laurent** already had what sounds like multiple jobs. As a perinatologist, she cares for women with high-risk pregnancies. She runs a research lab focused on understanding the molecular mechanisms involved in human development and looks for molecular clues that could help predict or diagnose pregnancy complications. She's also a mother of four: two in high school and two in college.

"I've long been interested in the process of fetal development, labor and birth — something we all go through, yet we don't understand all that well. Women's reproductive health has always been a little bit of a second-priority type of thing when it comes to research and funding," said Laurent, MD, PhD, professor of obstetrics, gynecology and reproductive sciences, vice chair for translational research and co-director of the Center for Perinatal Discovery at UC San Diego School of Medicine.

The due date for Yeo and Antal's twins was fast approaching. At one of the couple's hospital visits, they were pleasantly surprised to see Laurent, the on-call perinatologist, walk into the room. She went over the monitoring and birth plan with them.

"It was so funny to suddenly see this person that I'd been talking to professionally by email about thermal cyclers, here to help us take care of our twins, too. It's so cool that Louise is both a researcher and a caregiver. She's amazing."

### -GENE YEO, PHD



**Louise Laurent, MD, PhD** (*background*) works from her living room sofa during California's stay-at-home order while two of her kids exercise.

### In early April, Antal was admitted to Jacobs Medical Center at UC San Diego Health for observation.

On April 14, at 32 weeks gestation and via Cesarean section, Antal and Yeo welcomed their MoMo twins, Emilleen and Emabelle, who each weighed approximately three pounds. Despite their umbilical cords being knotted together, there were no critical complications at birth. But because both twins were high-risk and born a bit prematurely, the girls were admitted to the neonatal intensive care unit (NICU) for observation.

Yeo and Antal visited their "California burritos," as they called them, in the NICU every day, masks on.

"I always looked around just to make sure that all the nurses and doctors had their masks on as well," Yeo said. "And it was scary, and almost surreal, that we just had these fragile babies in the middle of what felt, at times, like an apocalypse."

Between NICU visits, the quest to test helped Yeo channel his anxious energy. RNA is a notoriously finicky molecule that easily degrades. Yeo, Knight, Laurent and their teams countered with experience and resources.

Knight's lab had something most academic labs do not: Automated lab machinery that can extract RNA from many distinct samples simultaneously. Laurent's lab was already running concurrent qPCR tests on RNA as molecular clues to predict pregnancy complications and working out how to miniaturize the process so they could run even more tests with fewer materials. Yeo's lab had experience with computational biology. They introduced an information management system to keep track of samples, experiments and data.

"We glued all the pieces together, and had an idea of how we could track samples all the way through the workflow from extraction to qPCR to result," Yeo said. "But the



Emilleen and Emabelle were born April 14, 2020.

problem was still that we're not virologists or epidemiologists."

Yeo, Knight and Laurent teamed up with Slack community members Kristian Andersen, PhD, whose lab at nearby Scripps Research was known for using genomics and computational biology to investigate emerging infectious diseases, such as Zika and Ebola, and Lauge Farnaes, MD, PhD, assistant medical director at Rady Children's Institute for Genomic Medicine.

The team set up an experiment: A drivethrough site near Rady Children's Hospital-San Diego, where they could collect nasopharyngeal swabs from study participants, all of whom were invited health care workers and firefighters. In the first two months, the team screened more than 10,000 participants, mostly asymptomatic, and found that an average of two participants per every 1,000 carried SARS-CoV-2. In addition to looking for the virus itself (sign of an active infection), the researchers tested participants who hadn't been diagnosed with COVID-19 to see if they had antibodies against the virus (a sign of a past infection), to better gauge the extent to which SARS-CoV-2 was spreading undetected.

19 qPCR test. EXCITE runs COVID-19 tests in a mostly-automated assembly line, from intake to RNA extraction to qPCR and detection. Samples to be tested are barcoded so technicians don't handle private patient information. Everything is tracked by the laboratory information management system and, depending on the source, test results are reported directly to patients' electronic medical records or the physician leading a partner program. All positive results are also reported to San Diego County's public health office. A bonus is redundancy. The lab runs COVID-19 tests on a different

A bonus is redundancy. The lab runs COVID-19 tests on a different platform than the Center for Advanced Laboratory Medicine at

### SUMMER 2020

IN MID-MAY, Emilleen and Emabelle were ready to graduate from the NICU.

"When we finally got home, it's probably an understatement to say that I was a bit distracted by them," Yeo said. "There were so many meetings, even when I was chairing a session or giving a talk, where one of the babies was screaming and I had to go grab her and hold her before I could continue.

"There were so many times I had to text Rob and Louise to say that I couldn't make a meeting, but they have kids too, so they get it. Everyone has been so understanding. I even learned to delegate, to give more freedom and independence to the people in my lab, and they've done amazingly well."

The COVID-19 screening study at Rady continued to hum along, boosted by a donation from philanthropists **Gary and Jean Shekhter**, but it wasn't an easy or simple operation. Volunteers and lab staff transported samples around town, from the drive-through to Yeo and Laurent's labs on one side of UC San Diego's La Jolla campus, to Knight's lab on the other, to Andersen's lab down the street. The collection and testing process was not CLIAcertified, so any positive samples needed to be sent back

to the clinical laboratory at Rady Children's Hospital for re-testing, confirmation and communication to the participant. "Everything we did was considered part of a research study, not a clinical diagnostic test," Knight said. "The drive-through worked, but it wasn't the most efficient or cost-effective process. We tweaked and optimized, learning everything there is to know about running a largescale viral testing facility."

In early July, COVID-19 cases surged in San Diego and the drivethrough site closed down so staff could be redeployed to patient care. But soon after, the team's original dream of "everything in one place" was realized, and a new COVID-19 testing facility was born: Expedited COVID IdenTification Environment, or EXCITE.

The Department of Pathology at UC San Diego School of Medicine had two small laboratory spaces they had been reserving for new faculty, but with hiring and onboarding delayed due to the pandemic, the empty space was offered to EXCITE.

Laurent submitted the paperwork to extend an existing CLIA license, previously granted to the Biochemical Genetics Lab in the Department of Pediatrics, to include EXCITE in late-August; approval came September 4. Eleven days later, the team completed clinical validation of their COVID-19 qPCR test. Louise Laurent, MD, PhD (right) supervises in her laboratory. She oversees both a research lab and the EXCITE testing lab.

DIEGO HEALTH SCIENCES

UC San Diego Health, which Yeo says helps safeguard against shortages. If one site is down for some reason, the campus will still have the other.

Laurent says one of the upsides of the pandemic has been the opportunity to work with so many different people. Before EXCITE, she had worked with Knight on a few small projects to study changes in the gut microbiome during pregnancy. Yeo's research lab is in the same building as hers.

"But it's a lot different when you actually have to start a lab with someone – buy equipment, hire people and all that," she laughs. Yeo calls the group his "COVID buddies."

### FALL 2020

LAURENT AND TEAM quickly kicked EXCITE into high gear, managing 20 people working two shifts, seven days a week.

"We routinely run about 3,000 tests a day without really breaking a sweat," Laurent said, "and we could double that without too much trouble if we had to."

While the Center for Advanced Laboratory Medicine at UC San Diego Health continued to be the health system's primary testing facility for tens of thousands of staff, patients and other community members, EXCITE played an integral role in UC San Diego's Return to Learn program, a science-informed approach that allowed the university to continue to offer on-campus housing and in-person classes and research opportunities throughout the pandemic. Largely because EXCITE could provide regular asymptomatic testing of all students, staff and faculty, the university hosted approximately 10,000 students on campus in the fall of 2020, maintaining a positivity rate of less than 1 percent, generally 10 to 15-fold

But even Return to Learn didn't max out EXCITE's testing capacity. Testing services were soon extended to local fire departments and schools.

lower than the surrounding community.

"I'm proud that we're serving populations that weren't necessarily the first priority in the pandemic - children, students, frontline workers," Laurent said. "We're serving a need that might not otherwise have been served."

Vaccine optimism helped blunt the disappointment of the holiday season. None of EXCITE's leadership was able to see extended family: Yeo's parents live in Singapore, Laurent's in Kansas and Knight's in New Zealand. One of Laurent's daughters was unable to come home from college in Canada for fear she wouldn't be able to return to school. Knight's daughter hadn't touched another child in nine months. Yeo and Antal celebrated Emilleen and Emabelle's first Christmas quietly at home, just the four of them, opening presents with their extended family over Zoom. Then came the variants.

### **WINTER 2020**

ON DECEMBER 15, the first COVID-19 vaccines arrived in San Diego, going first to health care workers and COVID-19 testing and research lab staff. "After nine months of relentless bad news, the announcement that a vaccine was developed faster than for any virus before was an amazing piece of good news - even leading some to think the pandemic would be over soon," Knight said.

On December 29, an EXCITE technician spotted the tell-tale "S dropout" (see sidebar below) in a test sample. The team drove the sample over to Scripps Research, where Andersen's lab labored through the night to sequence the full genome of the virus in the sample. They confirmed the first known case of the B.1.1.7 variant in California. It was a local man in his 30s who had not recently traveled, indicating the variant was already spreading in the community.

"It's not random chance that we were the first to detect B.1.1.7 in California. It wasn't because it wasn't anywhere else. It's because we were looking for it," Knight said, "and because we already had highly trained EXCITE staff, sequencing built into our workflow thanks to close collaboration with Scripps Research, support from our own research lab members, as well as the cooperation of many campus administrative units that quickly turned around the various approvals we needed to be able to do this work with patient samples, between two different organizations."

### **Detecting Variants**

GENETIC MUTATIONS are extremely common in most viruses, which replicate quickly. Most variations have no effect on disease, but scientists around the world watched for the emergence of SARS-CoV-2 "variants of concern." One of the first to make headlines was detected in the United Kingdom. It was called B.1.1.7, a variant with more genetic changes than most, some of which affect the spike protein - the molecule the virus uses to bind and infect human cells Based on early data, the B.1.1.7 variant seemed likely to spread from person to person more readily.

On December 28, EXCITE received an alert from the CDC to be on the lookout for an "S dropout," a sign that a positive COVID-19 test may be the B.1.1.7. variant. In a regular positive gPCR test, three SARS-CoV-2-specific genes light up. In a positive test with S dropout, only two of the three tell-tale genes show up. What isn't detected is the bit of RNA that codes for the spike protein ("S") because it has mutated in B.1.1.7.

### —— SPRING 2021

More than a year into the COVID-19 pandemic, EXCITE has evolved into not just a high-throughput clinical testing lab, but also a research hub.

"We're available to any researcher in San Diego who has a question about the virus that we can help answer through testing and sequencing. For example, how long does the virus survive on surfaces? What kills it? How does it evolve under certain conditions?" Laurent said.

Despite increasing vaccination rates, Laurent said it's still critically important to understand where the virus lurks, who is most likely affected and how best to deploy resources.

"There are still many areas of San Diego, and the country, that are disproportionately affected by COVID-19 and experience a number of barriers to health care, testing and vaccination. We need to overcome these to reduce health disparities."

### Nicaragua: A Government in Testing Denial

**BY SUMMER 2020**, Nicaragua's hospitals were filled to capacity with patients suffering from respiratory infections. Doctors and nurses were dying. The nation's health system was collapsing.

For more than two years, the government had been suppressing protests on a variety of topics, often with guns and violence. Everything was fine, it insisted, downplaying the COVID-19 pandemic. Health care workers lacked personal protective equipment and other critical resources. Access to testing was rare. No one knew the true extent of the public health crisis in Nicaragua.

Jorge Huete-Pérez, PhD, of the Molecular Biology Center at University of Central America in Nicaragua's capital city of Managua, was alarmed and frustrated. He shared both with an old colleague: James McKerrow, MD, PhD, dean of Skaggs School of Pharmacy and Pharmaceutical Sciences at UC San Diego. The pair began collaborating to investigate COVID-19 infection rates among Nicaraguan health care workers.

They quickly discovered that a study conducted with relative ease in most countries was notably complicated in Nicaragua. A collaborator was fired for voicing concern about the failed management of the crisis. Many health care workers were afraid that they would be fired from their jobs for participating in the study.

Despite these challenges, the researchers published their findings in January 2021: approximately 30 percent of participants had been infected with COVID-19. Nearly 55 percent of those who tested positive were asymptomatic and still treating patients. —Heather Buschman, PhD To that end, Laurent is involved in two projects supported by Rapid Acceleration of Diagnostics (RADx) grants from the National Institutes of Health. One study seeks to maximize COVID-19 testing among pregnant women and children in an area of San Diego near the U.S.-Mexico border with the highest local incidence of COVID-19. In the other, a team is working to enhance asymptomatic COVID-19 testing capabilities at three regional community health centers in San Diego County.

Sequencing also remains a high priority. "We're furiously trying to expand sequencing of positive samples so we can build phylogenetic trees — maps that help us track how the virus is evolving and when and where new variants of concern may be emerging," Knight said. "Fortunately, especially compared to one year ago, we have more funding and more equipment, and we are expanding sequencing capabilities rapidly."

Sequencing SARS-CoV-2 samples also allows researchers to explore some interesting questions. For example, UC San Diego researchers are sequencing samples from patients with severe cases of COVID-19 in the intensive care unit to see if the viruses infecting them differ genetically from those causing milder disease in other people.

Another UC San Diego team is working with EXCITE to sequence SARS-CoV-2 samples repeatedly collected from the same patient over time. The patient has a blood cancer and has undergone chemotherapy,

"My wife and I ask ourselves all the time, 'How are we doing? We're doing okay, right?' It was hard at first, but as more testing happened and we were more reassured that the right behaviors were being adopted in our community, we realized that we're going to be fine. The girls are thriving now."

-GENE YEO, PHD



leaving him with next to no immune cells. For months, the patient has continuously tested positive for COVID-19 because his body has no way to get rid of the virus. As his physicians work to get him well enough to resume chemotherapy, researchers are sequencing his samples to keep tabs on how the virus may mutate as it replicates without restraint.

AS OF APRIL 2021, EXCITE had run more than 300,000 COVID-19 tests. All positive clinical and research samples are sequenced to track variants, several hundred each week.

On April 12, most of San Diego's children – including Laurent's – were finally given the option to return to in-person learning. They had been attending school remotely via Zoom for 13 months. The same week, Yeo and Antal celebrated Emilleen and



Emabelle's first birthday the same way they had all previous holidays. The four of them stayed home, Zooming with family. At one year old, the twin girls still haven't met their grandparents in person. "My wife and I ask ourselves all the time, 'How are we doing?

We're doing okay, right?" Yeo said. "It was hard at first, but as more testing happened and we were more reassured that the right behaviors were being adopted in our community, we realized that we're going to be fine. The girls are thriving now."

If there's a silver lining to the pandemic, Yeo said it's that he was able to be home all year, rather than traveling around the world giving talks, something he used to do almost on a weekly basis.

"Instead, I've had this once-in-a-lifetime opportunity to work with some amazing colleagues, to help keep people safe during a crisis and, most importantly, to learn how to be a father." ●



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## SEEING IS UNDERSTANDING

For the first few months of the pandemic, SARS-CoV-2 was called simply "the novel coronavirus," "novel," meaning scientists hadn't seen it before. And yet the ability to see really see, at the atomic level — what a microbe looks like and how it interacts with human cells is crucial in helping researchers design better methods to prevent or disrupt those interactions.

ROMMIE E. AMARO, PHD, professor in the UC San Diego Department of Chemistry & Biochemistry, and collaborators, were among the first to get a close look. They created models of the virus and its interactions with human cells, based on structural data generated from cryo-electron tomography and cryo-electron microscopy — leading-edge techniques that allow researchers to glimpse molecular structures at unprecedented resolution — and a combination of computer modeling and molecular dynamics simulations.

The models revealed a trove of information. For example, SARS-CoV-2's infamous spike protein, protrusions that help it grab hold of human cells, is coated in sugar molecules known as glycans. These glycans change the spike protein's shape — important information for researchers trying to target it with new drugs, or drum up antibodies against it with vaccines.

A. THE VIRUS. The spike proteins protruding from the virus' spherical lipid bilayer are shown in gray, with glycans highlighted in dark blue. *Image credit: Lorenzo Casalino. Modeling credit: Abigail C. Dommer, Lorenzo Casalino, Zied Gaieb and Rommie E. Amaro.* 

### B. THE SPIKE PROTEIN. This is

the SARS-CoV-2's spike protein in its open state. The spike protein is shown in cyan and the sugars forming a so-called "glycan shield" are depicted in dark blue. The spike is embedded in the viral membrane, shown at the bottom as multicolored carpeting. *Image credit: Lorenzo Casalino. Modeling credit: Lorenzo Casalino, Zied Gaieb* and Rommie E. Amaro.

C. THE INFECTION. SARS-CoV-2 (top) latches onto the ACE-2 receptor (yellow), a molecule on the surface of human cells that the virus uses like a doorknob to gain entry and establish infection. Image credit: Lorenzo Casalino. Modeling credit: Lorenzo Casalino, Abigail C. Dommer, Zied Gaieb, Emilia P. Barros and Rommie E. Amaro.







## "WE MUST ALL GET ON THE SAME PAGE"

A Q&A with **David Pride**, **MD**, **PhD**, associate professor of pathology in the UC San Diego School of Medicine and director of the Clinical Molecular Microbiology Laboratory at UC San Diego Health

### **BY SCOTT LAFEE**

In the beginning of the pandemic, there was much concern and angst regarding COVID-19 testing in terms of accuracy of results, capacity and timing. You were deeply involved in developing and advancing testing throughout the pandemic. How would you describe that experience, the highs and lows?

It was very difficult for clinical laboratories like ours early in the pandemic. We are accustomed to evaluating tests much more deeply than we were able to do before we started offering some of the tests we did earlier in the pandemic. It was also very problematic not to be able to give physicians definitive answers when they asked about the sensitivity and specificity of our tests. They simply hadn't been studied well enough for us to have those answers.

It was also quite problematic for laboratories like ours to have so many different tests simultaneously that all checked for the same virus. In general, we evaluate all the available tests and choose the one that works best or that best suits our institutional needs. Because there was such a limited supply of testing available, we often had to choose tests, even before we were able to evaluate how well they worked. This was, in essence, a lab director's worst nightmare. In retrospect, we are relieved that most of the tests we chose work really well, and most importantly, are still available on the market because of their superior performances.

There is talk of an almost instantaneous breath test for COVID-19. Do you think that might happen. maybe before the next pandemic? It will be difficult for a COVID-19 breath test to rival the sensitivity/ specificity that we have with our assays based on quantitative PCR. We find for many of the more rapid antigen assays, the sensitivity would likely be too low to have a performance that would give us confidence in telling people they are not infected.

### One observation you've made is that, even if a person isn't infected by SARS-CoV-2, they are not virus-free. Quite the contrary: Bacteria residing in and on each of us outnumber human cells, and viruses outnumber bacteria – we each carry an estimated 380 trillion viruses. Your point is that most of these viruses are not dangerous, but simply part of the human virome. What is a virome and what's

currently known about it? Regardless of whether we are healthy or sick, we've all got viromes, which essentially are just collections of viruses that inhabit the human body. Many of these viruses infect the many bacteria that also live in the human body, and thus, we probably need to think about ourselves slightly differently than we probably do. That is, that we are collections of microbes that vastly outnumber our own cells, and that our bodies are fertile hunting grounds for viruses to attack their

bacterial hosts. All of this goes on pretty much every second of every day, and we have very little insight into the fact that this is happening.

We know that most, if not all human body surfaces, are inhabited by viruses. This competition for space and resources in the human body probably plays a role in our homeostasis, but this hasn't been borne out so well by studies yet. We know that these viruses can change the bacterial communities and that these viruses can be readily shared with our close contacts. We believe that, because our bacterial microbiomes can be involved in helping determine healthy and disease phenotypes among us, the fact that viruses can attack these bacteria suggests that they may be involved in this process as well.

### You've said the development of COVID-19 vaccines, and the underlying research, was the top scientific breakthrough of 2020. Why?

Simply put, science doesn't typically move at the speed that was observed earlier in the COVID-19 pandemic. Not only were vaccines developed in record time using existing technologies, but they were also tested on thousands of people to ensure they were safe and effective prior to being rolled out to millions across the world.

This will go down as one of the top scientific breakthroughs, perhaps, of all time, and we have to thank the scientists who developed the vaccines, the people who were willing to participate in these clinical trials without having foreknowledge of the potential beneficial or deleterious outcomes and the regulatory agencies that worked closely with scientists to make all this happen.

I don't think the average person realizes how much everyone involved had to set aside their own personal biases, difficult working relationships, and even political disagreements to work together to do the most beneficial thing that they could to benefit the health of everyone.



David Pride, MD, PhD, an infectious disease specialist who studies the roles of pathogens in human health and behavior, said the development of COVID-19 vaccines in such a compressed and stressed period was a major scientific breakthrough, perhaps the most significant of all time.

Like many of your colleagues, you have cautioned about the dangers of antibiotic resistance, which you say is here to stay. But, you also argue that there is much that can be done to mitigate antibiotic resistant bacteria, a public health challenge that the World Health **Organization predicts might kill 10** million people annually by 2050. Antibiotics don't work against

viruses, which have different structures and methods of replication compared to bacteria. Apart from developing vaccines to prevent viral infections or reduce transmission, what is the remedy?

Unfortunately, bacteria respond to what we do to them by developing resistance to antibiotics. It's remarkable how bacteria will develop resistance specifically to antibiotics that are used in a particular hospital. but not some of those antibiotics that are used in other hospital systems. This reveals a key feature of bacteria: That they continually evolve to solve the problems that they are faced with, such as antibiotics.

It is interesting to see that this is exactly what we are observing in the current virus pandemic. We responded by rapidly developing vaccines that had the potential to significantly reduce, if not eradicate, SARS-CoV-2. Instead of simply going

away, the virus has evolved specific means to respond to what we have done. The virus has chosen to infect largely those who are unvaccinated, and has even mutated to become clever enough to infect some who are vaccinated.

This persistence despite our best efforts is real-time proof that this virus will continue to try to respond to what we do to eliminate it. It also strongly suggests that we must all get on the same page and have a coordinated response if we expect to eliminate it. If we do anything less, SARS-CoV-2 has proven that it will seek out refuge, mutate and then, potentially, come roaring back.

### DISCOVERIES

## Research Clinical Education

## **Amid Tears and Fears:** Determination, Hope and Unity of Purpose

IREMEMBER when I got the initial phone call from the county inquiring if UC San Diego Health would take in the first patients flying out of Wuhan, China to San Diego.

At the time, all we knew was that Wuhan was ground zero for a spreading, previously unknown viral infection. People were dying, and there was no existing medical literature, nor any test, for the virus that would be called SARS-CoV-2.

Nonetheless, Marine Corps Air Station Miramar would soon receive a military plane containing multiple Wuhan evacuees, some of whom were possibly infected by the mysterious coronavirus.

Knowing our advanced capabilities as an academic medical center, particularly in the relevant areas of infection prevention and control, public health and respiratory disease, it was actually an easy decision. "This is what we are meant to do," I thought.

We quickly opened our Hospital Command Center (HCC) and mobilized. Typically, an HCC event lasts roughly a week, maybe two. In this case, weeks became months, then months became more than a year. Time blurred. Zoom calls and masking became as routine and commonplace as handwashing. It would be 412 days between our first case of COVID-19 and the first day when we recorded no new infections.

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The pandemic has been the most extraordinary event of my career, and likely the same for many others. Every single employee of UC San Diego Health was impacted, from custodians, nurses and nutritionists, to supply chain managers, screeners, administrators and physicians. Everyone played a role in slowing or stopping the virus and saving lives.

We worked the same hours as COVID-19, which was constantly, day and night, weekends too. It was a coordinated effort of monumental proportions that led to formations of new teams and new levels of trust and innovation that propelled us forward, out of fear and into a new normal. I cannot write about the pandemic without acknowledging those who died from the virus and whose families were devastated by the loss of loved ones. These tragedies happened disproportionately in many of our underserved and under-reached communities; a historical condition and injustice that shall remain a focus of UC San Diego Health, even as COVID-19 hopefully recedes into the background and our memories. I'm often asked what about our response I am most proud of. There is no single answer. We were first in the region to treat patients with COVID-19; first to open vaccine clinical trials; first to offer a mobile ECMO (extracorporeal membrane oxygenation), a type of machine that pumps and oxygenates a patient's blood outside the body; first to vaccinate our employees; and first to open a vacci-

nation super station to the public.

### A LETTER FROM PATRICIA S. MAYSENT

We led the way on CA Notify, a mobile solution to identify new exposures of COVID-19 in the community and state. Our nurses and specialists travelled to other hospitals in the United States and Mexico to teach new lessons and insights in the art of critical care - they returned to help vaccinate too. What all of these achievements have in common are the unbounded compassion, brilliance and determination that characterizes the people of UC San Diego Health.

For every article in this magazine, I know there were hundreds more unwritten that could tell stories of bravery, drive and connectedness during the pandemic. I thank all my team members for their selfless contributions. I am so very proud of you and grateful for your service and kindness.

I would also like to express a deep and sincere gratitude to our donors, who stepped up at the same time to help us meet so many challenges. Their contributions of time and funding helped us to rapidly expand and sustain our efforts to build testing capacity, acquire ventilators and surge supplies and launch multidisciplinary research efforts into new diagnostics, therapies and ways to monitor the virus. Their generosity saved lives and will help us in the future.

With lessons learned, I believe we can move forward together, unified, a better and stronger organization.

Sincerely,

PATRICIA S. MAYSENT Chief Executive Officer UC San Diego Health

## DOSE OF HOPE FOR **HIGH-RISK SENIORS**

*Helping older patients navigate the vaccination* process

### **BY MICHELLE BRUBAKER**

IN 2020, Brenda Tanoi lost one or two family members or friends each month to COVID-19. In December 2020, the 68-year-old Logan Heights resident and retired educator from American Samoa was infected herself with the virus.

On the day in mid-April 2021 when these photos were taken, Tanoi was at home, still recovering from her bout of COVID-19, awaiting her second shot of the Moderna vaccine and a dose of hope from a nurse practitioner with UC San Diego Health's Population Health Services Organization (PHSO).

Early in the pandemic, PHSO brought together staff in social work, nursing and pharmacy to anticipate the physical and emotional needs of high-risk seniors, those aged 65 and over. The effort included a call center where staff answered questions, triaged needs, provided vaccine education and, sometimes, just offered a compassionate ear. Ten team members worked the phones, handling approximately 10 to 15 calls each per day.



By getting vaccinated, Brenda Tanoi sought to inspire others more hesitant to do the same.

PHSO's at-home service took center stage during COVID-19 vaccinations. Staff could reach out to senior patients whose health prevented them from traveling to a vaccination site. As of May 2021, there have been more than 1,000 home visits.

"We try to make doing the right thing the easy thing for our elderly patients, helping them get through this marathon," said Ming Tai-Seale, PhD, director of research and learning at PHSO.

In her visit, Tanoi gratefully and joyfully welcomed visiting nurse practitioner Janet Davis. "I am honored to tell everyone I am fully vaccinated," Tanoi said. "I want to stop going to memorial services. I want to enjoy many more birthdays and holidays with my family, for as long as I can." •



"We try to make doing the right thing the easy thing for our elderly patients, helping them get through this marathon."

-MING TAI-SEALE, PHD



## STRANGERS IN A STRANGER TIME Helping San Diego's refugee community cope with the pandemic's impact

### **BY JEANNA VAZQUEZ**

FOR REFUGEES living in San Diego, the challenges caused by a global pandemic were magnified in a city they had just begun to call home. In response, the UC San Diego Refugee Health Unit shifted its focus to supporting members of communities experiencing systemic inequities exacerbated by the public health crisis. Work began with a survey of the San Diego refugee community, the first in more than 15 years.

Surveyors learned that nearly one-third of families had canceled or missed health appointments during the pandemic. In more than 40 percent of surveyed families, at least one member had lost their job; 60 percent of families couldn't pay rent and

feared they would be evicted. "For us, our work is more about looking at the issue of systemic racism and tackling that," said Amina Sheik Mohamed, founding director of the Refugee Health Unit. "Right now, we're figuring out where the gaps are to meet the community where they are. With our approach, we collect information on what is needed, how to get these resources to the community, and then we go to the next problem. We're climbing the ladder together. It's not one group, but all of us, and it's something to be proud of."

After the survey, the Refugee Health Unit served as a conduit between the refugee community and the County of San Diego by holding meetings

with community health care workers and local government officials.

"We received weekly updates from the county on the pandemic, including vaccine eligibility and tier restrictions, and then took those updates back to our community health care workers, who disseminated the information to refugee community members," said Reem Zubaidi, manager of the Refugee Health Unit. "This was essential to the whole process. We can't overstate how important it is to provide this information in a person's primary language, from someone who they can relate to and converse with in their preferred communications method. It's not just translation, it's cultural."

## IT BEGAN

## with SEVEN

Frontline staff at UC San Diego *Health recollect the first days* of the pandemic, a time marked by fear, uncertainty and endless acts of kindness

BY MICHELLE BRUBAKER, JACKIE CARR and JEANNA VAZOUEZ

## KETTIES

On a cold morning in February, seven stainless steel electric tea kettles, filled with hot water, were delivered to patients' rooms at UC San Diego Medical Center in Hillcrest. The tea kettles were not typical, but neither were the times. The COVID-19 pandemic had begun in earnest, and the kettles represented an early act of comfort and humanity in a time that would soon demand an outpouring of both.

> ON FEBRUARY 5, 2020, UC San Diego Health activated the organization's Hospital Command Center (HCC), the central location where in-house experts gather to develop and implement a response to an emergent and urgent situation. In this case, it was the growing crisis surrounding the novel coronavirus, SARS-CoV-2, then rapidly spreading in Wuhan, China.

> Five days later, UC San Diego Health received its first patient with diagnosed COVID-19, an evacuee from Wuhan, who had previously been airlifted to and quarantined at Marine Corps Air Station (MCAS). The patient was officially the 13th case of COVID-19 in the United States and would soon be followed by others from MCAS.

> They arrived via ambulance, escorted by law enforcement vehicles and greeted by medical staff, security officers and officials from the Centers for Disease Control (CDC), all wearing masks, face shields, gloves and other personal protective equipment (PPE).

Seven new tea kettles were purchased, filled with hot water and served with sides of lemon and ginger to the first patients from Wuhan

The virus was largely unknown, as was the plan of treatment. There were more questions than answers.

"One question raised in the HCC was 'Does anyone here speak Mandarin?" recalled Lily Angelocci, transformational health care lead coach at UC San Diego Health. "From there, I spent the next two weeks at the bedside of the patients in our intensive care unit, helping to meet their physical and emotional needs."

Four evacuees were eventually transferred from MCAS to UC San Diego Health for care. Most spoke little or no English. Translators were found. Angelocci was always nearby, intent on addressing their physical needs or easing their emotional concerns. It wasn't yet clear who was infected with the SARS-CoV-2 virus and who was not, but all of the patients were far away from home, away from loved ones and afraid of a disease no one yet understood.

"At the time, we had to wait days to receive test results from the CDC in Atlanta to confirm if the patients from Wuhan were actually positive with the virus," said Angelocci. Two were.

"What initially struck me was the delicate humanity of the situation," said Francesca Torriani, MD, medical director of Infection Prevention and Clinical Epidemiology at UC San Diego Health. "In the patients' faces, I could simultaneously see fear and gratitude: fear of rejection and gratitude for us accepting and welcoming them.

"Can you imagine being evacuated from Wuhan on a windowless airplane, not knowing if you had the virus, or if you would live or die, of being targeted because of bringing a new disease into a country?"

Even with the language barrier, the patients' concerns and fears soon became apparent.



"We realized that they were not eating," transmission. Some foods, such as meats, said Jill Martin, director of food and were cut into bite-sized portions in the kitchen before delivery. nutritional services at UC San Diego Health. "We needed to devise a plan to "Normally, loved ones are in the rooms to make sure these patients were fed and

help with the meals, but that was not the case for these patients. Sometimes, patients were too weak to cut their own food, so we did that for them to make sure we were doing everything we could to help them eat and heal." The seven tea kettles were part of

that process.

"In Chinese tradition, they do not drink cold or room temperature water, only hot water. In talking with the patients, we realized they were being served cold water," said Angelocci.

Tea kettles were purchased. Patients soon received their water hot, served with sides of lemon and ginger.

Patient Experience staff added to the efforts, delivering floral arrangements to brighten up rooms and power cords, chargers and coloring books to help patients stay connected to the outside world and pass the time.

"We always teach our staff one word: the Japanese term, 'gemba'," said Angelocci. "It means 'the place where value is created." In practical terms," said Angelocci, "it means to 'see, show respect, and ask why.' It meant the world to patients and staff."

## COUNSELING PATIENTS

The unpredictable nature of COVID-19 first struck Kevin Kwak, MD, a hospitalist at UC San Diego Health, when he walked into the room of a 30-something patient with the disease.

> "WHEN I HAD SEEN the patient earlier in the day, he seemed stable overall. He did have some shortness of breath, but he was able to communicate. Later that evening, he was on six to seven liters of oxygen," said Kwak. "Seeing a patient decline like that in only about 12 hours was eye-opening. He did have some co-morbidities, but that moment stands out as when I truly realized how serious this virus is, and that it does

not discriminate."

Kwak was among the first health care workers on the scene when patients from Wuhan were admitted to a dedicated, isolated COVID-19 unit at UC San Diego Medical Center in Hillcrest.

The unit was the product of multiple departments collaborating, and was staffed by physicians and nurses who volunteered to care for the patients.

"I remember that night vividly," said Kwak. "I was asked if I would be willing to take care of the patients coming from MCAS because we were not sure of the associated risks. I am relatively young. I am healthy. I live alone. I quickly answered yes. It was definitely something I wanted to do."

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basil omelet.

felt supported. Our role is not just to

process. That was our main priority."

With assistance from Angelocci,

Martin's team visited specialty grocery

stores to purchase more familiar fare.

It brought patients and staff closer together.

"One of our chefs, Bo-Kai Liao, speaks

Mandarin and was integral in those early

days, making sure there was a strong line

day, find out about their food preferences

and customize their meals," said Martin.

porridge), spicy Mapo tofu and a Taiwanese

"We are all human, but different things

a balance of caring for these patients while

still following all the safety measures."

materials, to reduce the risk of virus

comfort and heal us," said Martin. "We found

Meals were served using only disposable

Favorites were wonton soup, egg and seaweed soup, congee (a type of rice

of communication. He would call the

patients in their rooms several times a

certain foods being offered.

provide food on a tray. Providing healthy

meals is a significant part of the recovery

Many of the patients could not digest



He said most of the Wuhan patients' symptoms were mild, but he spent considerable time trying to alleviate their uneasiness.

"As physicians, we were still learning about the trajectory of the virus. We were trying to address the patients' questions, even though we didn't know all the answers. The main questions were: Am I going to be okay? When will I be able to go home? I could only tell them with confidence that we were working around the clock to provide the highest quality of care. We were gathering as much information as possible and adapting."

All of the Wuhan patients were discharged a week or so after admittance to continue their recoveries with family and friends. By then, however, COVID-19 cases were appearing among local residents. At Hillcrest and Jacobs Medical Center in La Jolla, long-term COVID-19 units were set up for patients from the San Diego community.

"Back in February, all we knew about the virus was that it was respiratory, but we weren't sure how it was being transmitted," said Dante Segundo, RN, MSN, nurse manager at UC San Diego Health. The rising number of local cases prompted massive organizational changes.

"We transitioned from a relatively contained situation with the patients from Wuhan to one that was now affecting the community at large. Our entire hospital system had to pivot."

Processes, from testing and treatment plans to managing huge volumes of lab work, were refined daily, often spurred by evolving CDC guidelines.

"We were all learning about the swab tests, waiting three to four days for test results (from the CDC in Atlanta) and understanding what PPE we should be wearing," said Kwak. "There were so many uncertainties at that time, but we were all incredibly focused while collaborating, coordinating and communicating."

Kevin Kwak, MD, was among the first doctors to see and treat patients from Wuhan, China.

## IT TAKES A MEDICAL CENTER

Conquering COVID-19 required a team effort, from university researchers to practicing physicians, nurses and the staff that keep hospitals functioning.

"I MUST GIVE credit to the pulmonary critical care group for the daily care and management of the patients. I saw how their team, under the leadership of Dr. Jess Mandel, fine-tuned the treatments and turned the care of patients with COVID-19 into an art," said Torriani.

"Based on their observations, they developed strategies for steroid use, ventilation management and further necessary lifesaving interventions that were eventually taught to other hospitals in the United States and Mexico."

In the beginning, only physicians and nurses were permitted inside rooms with COVID-19 patients. It was a matter of prudence and safety, but it also "provided the opportunity to work closely together, which strengthened our working relationship during such a stressful moment in time," said Segundo.

"It was all hands on deck," added Kwak. "We were all in the same boat, learning about this disease together. We were supporting each other and had a deep understanding of what we were all going through and feeling. We were holding each other up through all of the exhaustion. We became like family during this time, and those strong relationships remain."

COVID-19 changed work streams throughout the hospital. It impacted the hospital's Environmental Services Department (EVS), who needed to assess and revise cleaning and disinfection protocols.

"There was a steep learning curve when the first patients arrived from MCAS Miramar and, initially, our staff did not clean the rooms when patients were there, to avoid any unintentional contraction of the virus," said Carl Solomon, director of Environmental Services at UC San Diego Health.

Instead, nursing staff kept patient rooms clean; EVS crews prepared rooms before and after patients were admitted or discharged. When community case numbers surged

in April 2020, EVS teams transitioned to cleaning rooms containing patients to better support over-taxed nurses and doctors. "Our whole team has been here every

single day, and we wanted to be here for staff and to address any concerns that may arise," said Solomon. "We had to make sure every part of the facility was clean to ensure our staff and patients were able to provide and receive care safely, and it was an honor to have such a responsibility."

Throughout the pandemic, Segundo said the tripartite mission of UC San Diego Health-outstanding patient care, groundbreaking research and inspired teachingwas tested but rose to the challenge.

"As an academic medical center, we had patient care, research and education all happening in one space at the same time. That idea of lifelong learning was an everyday normality for our unit," Segundo said.

"I'm most proud of our resilience. We found ways to be joyful, caring and critical thinkers all at the same time." • "It was all hands on deck. We were all in the same boat, learning about this disease together. We were supporting each other and had a deep understanding of what we were all going through and feeling."

-KEVIN KWAK, MD

**Everyone helped:** From the first day and the first patients, staff across all disciplines and departments at UC San Diego Health stepped up to provide exemplary care, 24/7.



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## THE IMPACT OF A 12-FOOT **CONFERENCE TABLE**

How the activation of the Hospital Command Center on February 5, 2020 made history at UC San Diego Health

**BY MICHELLE BRUBAKER** 

WHEN YOU ENTER the conference room on the first floor of UC San Diego Medical Center in Hillcrest, it looks like most spaces where meetings are held: A12-foot-long, walnut-colored table takes up the middle of the room; chairs and mostly blank walls surround it.

But in emergencies, that room becomes a sort of crisis control center, where experts, highly skilled at operating clinical and non-clinical areas and aspects of the hospital system, convene to sort out issues, make decisions and find remedies. When that happens, phones on the table start ringing constantly. The walls start to fill with pinned notes and broad sheets of butcher paper covered with names, numbers and data. A large, flat-screen TV at one end of the room is turned to local news or video feeds around the hospital. Doctors, nurses, administrators and staff hustle in and out.

The room is transformed. It is now a Hospital Command Center (HCC), a designation activated by events ranging from local wildfires or major power outages to internal issues that might temporarily and significantly disrupt services. It's a carefully structured operation with specific roles, such as Incident Commander, Safety Officer, Logistics Officer and Public Information Officer, each with its own set of responsibilities.

On February 5, 2020, the HCC was activated for what would become the COVID-19 global pandemic.

Staff across all areas of the hospital system were alerted by their pagers

suddenly and loudly pinging. It was their cue to head toward the HCC ASAP and take their seat at the table.

"What has never ceased to amaze me in the 12 years I've had the privilege and honor to be a part of the organization is that people always come in willing to help, even if they are nervous to step out of their comfort zone," said Monique Imroth, director of **Emergency Management and Business** Continuity and Telecom Operator Services at UC San Diego Health.

Carrying the communications pager and on call, Yadira Galindo, thensenior communications and media relations manager at UC San Diego Health, was among the first staffers to arrive at the HCC that February day.

"There was a frenzy of requests to develop internal and external communications, yet the command center became unnervingly quiet when a member of the infectious disease team gave an update," said Galindo. "We all hung on their every last word, afraid to miss a vital piece of information and hungering to learn more about the novel coronavirus."

Soon, Galindo was joined by colleague Jeanna Vazquez, who had only joined the communications team a few weeks prior.

"I often found myself going to work and coming home in the dark," said Vazquez. "The energy walking into that room every day was palpable. We were surrounded by such incredible minds that wanted to help and prepare our staff for this crisis as best as possible."



As the hours turned to days, weeks, months, and now more than a year, the pandemic has become the longest HCC activation in UC San Diego Health history at more than 600 days, and counting.

"The longest HCC activation prior to the pandemic was seven days during the 2007 San Diego wildfires," said Imroth.

In the beginning, the HCC was open seven days a week, with some staff members putting in 70- to 90-hour weeks. Daily topics ranged from proper PPE protocols, staffing and training for the COVID-19 units, to communicating with Chinese patients airlifted from Wuhan and how to best submit COVID-19 tests to the Centers for Disease Control in Atlanta for processing.

People who had never been part of an HCC were tapped.

"We were using our collective knowledge, skills, abilities, talents, desires and efforts to synergize and band together," said Imroth. There was also a fear factor.

"The command center sits in the hospital setting. People were wondering if they were going to catch the virus and bring it home to their families.

"Part of my job is to connect with everyone in that room and let them know I am there for them. If I found out someone in the HCC liked peanut M&Ms or had a dietary requirement or drink preference, we made sure to provide those comforts. If I knew someone was feeling uneasy, I shared my own feelings with them. I am a fan of candid conversation, and sometimes humor, to eliminate anxiety and let others know they are not alone. And during that time, we all needed to know we were not alone."

As more was learned about the novel coronavirus and COVID-19, and guidelines emerged and evolved regarding masking, physical distancing and reducing transmission risks, HCC operations settled into a sort of routine. After seven months working around that conference room table, and realizing that the pandemic was not going to end any

time soon, the decision was made to go remote. It had never been done before for a major crisis event. "We transitioned to a virtual command center slowly. It was similar to the physical command center in that we still had a plethora of meetings and briefings. We just did them over Zoom instead of across a table," said Imroth. "As things changed with the pandemic, we adapted too." The virtual HCC continues, with weekly briefings for key leaders and occasional sessions as needed. Hundreds of all-staff emails have been sent, updating employees to the situation and needs.

Recalling 2020, Imroth said some "I think what we found out is that

lessons have been carried forward. we need each other. We need each other to get through these difficult times. We need each other as cheerleaders. We need each other as support teams. We need each other to laugh with. We need each other to cry with. We need each other to rant with. We need each other." •

## Happy Orange

On the morning of February 5, 2020, with the first potential COVID-19 patients en route to UC San Diego Medical Center in Hillcrest from quarantine at Marine Corps Air Station (MCAS), a Code Orange was called.

**CODES ARE CALLED** within hospitals for a variety of reasons, usually urgent, from fire and medical emergencies, to developing community or facility issues that might impact patient care. Codes come in many colors, their meanings not necessarily uniform across health care systems.

At UC San Diego Health, a Code Orange signals an emergent internal hospital issue. In this case, it was a call to action to prepare for the incoming MCAS patients, who would include the 13th and 14th diagnosed cases of COVID-19 in the United States. Key medical and administrative staff from across the health system would come together to prepare for what might happen next.

Code Oranges typically last hours or maybe a few days. The Code Orange called on February 5 is still active, albeit in modified form. On the day it was called, Jackie Carr, executive director of communications and media relations at UC San Diego Health, brought an orange to work for lunch. There was no time to eat that day, or the next, or the next.

So, the orange sat. Around the third month, it gained a grin. It withered, but it has never stopped smiling.





## **TEST** DRIVEN

Before you can treat COVID-19 or understand the scope of the health threat – vou need to know in whom and where the virus lurks

**BY SCOTT LAFEE** 

IN THE EARLY DAYS of the pandemic, scientists and physicians struggled just to understand the scope and scale of the looming public health threat. Who was infected? How many? Where?

Answers were scarce, largely because testing was equally so and, without comprehensive testing data, no one really knew what was happening.

In late February, the Food and Drug Administration (FDA) debuted guidance permitting university-based hospital labs to develop SARS-CoV-2 diagnostic tests. Steve Gonias, MD, PhD, chief of pathology services for UC San Diego Health and chair of the Department of Pathology at UC San Diego School of Medicine, headed a committee to coordinate lab efforts among the five UC medical centers, and later represented those labs in UC's broader response to the pandemic.

In late March, UC San Diego Health announced it was partnering with five leading in vitro diagnostics manufacturers-Thermo Fisher

Scientific, Roche Diagnostics, GenMark Diagnostics, Abbott Diagnostics and Luminex Corporation (the last being a test developed at UC San Diego)-to expand testing capacity. Each manufacturer produced its own testing platform, but none alone could meet UC San Diego's overall need. In combination, however, they might help weather the coming storm.

Ordinarily, said David Pride, MD, PhD, an infectious disease specialist and director of microbiology at the Center for Advanced Laboratory Medicine (CALM) at UC San Diego Health, a single testing platform would be used for the sake of consistency.

"We took a diversified approach to meet our patient care needs. Having different platforms means we are able to maintain testing supply, even when one or more manufacturers can't meet our testing needs," Pride said.

The goal was to boost testing capacity from 1,000 to 1,500 tests per day within two to three weeks, up from the then-current rate of just a couple dozen tests per day. That ambition was quickly "We took a diversified approach to meet our patient care needs. Having different platforms means we are able to maintain testing supply..."

-DAVID PRIDE, MD, PHD

reached. Within six months, CALM had expanded capacity to 6,000 COVID-19 tests daily. Typical turnaround time was reduced to approximately 16 hours.

"In my 17 years as chair of the Department of Pathology, this is perhaps the best example of our pathology lab directors and hospital leaders coming together to accept a challenge on behalf of our entire state and country," said Gonias. "We succeeded at a high level."

In April 2020, UC San Diego Health launched serological testing, which looks for the presence of antibodies to the novel coronavirus, evidence that a person has been previously infected, even if they never experienced tell-tale symptoms.

"This is part of the next wave of testing," said Ronald W. McLawhon. MD, PhD, director of CALM and UC San Diego Clinical Laboratories and chief of the Division of Laboratory and



Genomic Medicine. "It's intended to answer those growing questions about who has been infected and who might still be vulnerable to exposure." Serological testing was conducted most often in the early months of the pandemic, but less so as vaccination rates increased, with more and more persons possessing antibodies through inoculation.

In May, UC San Diego went live with its own university-based, FDAapproved COVID-19 diagnostic test. Other UC labs soon followed. On August 31, 2021, UC San Diego Health crossed a milestone, performing its millionth COVID-19 test.

### **Return to Learn**

A MAJOR COMPONENT of bringing students back to campus and the resumption of in-person instruction was widespread testing, which began with the official launch of the Return to Learn (RTL) program in May 2020.

Testing formally began with on-campus locations providing self-administered, nasal swab-based COVID-19 tests to the approximately 5,000 undergraduate and graduate students who continued to reside on campus, with plans to expand to monthly testing of all 65,000 students, staff and faculty in the fall.

"Asymptomatic testing is important because most of the transmission of the virus is done by people who aren't having symptoms," said



Open exam: UC San Diego students are able to conduct self-tests for detecting SARS-CoV-2, following a few simple, illustrated steps.

Robert Schoolev. MD. an infectious disease specialist, professor of medicine and one of RTL's leaders.

"People who do develop symptoms begin to shed virus from the nasopharynx two or three days before those symptoms appear. These individuals feel fine, yet they are shedding larger amounts of the virus at this stage of the illness than after they become ill. This happens because in the beginning stages, the virus turns off the 'first response' elements of the immune system. These responses are responsible for the flu-like symptoms we experience in most viral infections. The virus grows unimpeded and leaves us unaware of our infection. This phase of the illness is known as the 'pre-symptomatic phase.""

In October 2020, more than 6.000 students moved into dorms, which had been reorganized to incorporate pandemic-mitigation measures, such as single-resident rooms. Those numbers expanded with the winter semester and continued to grow, along with the percentage of courses offered in person.

Throughout, testing has continued unabated, fueled by easy-to-use vending machines that dispense COVID-19 tests, the involvement of the Expedited **COVID IdenTification Environment** (EXCITE) lab (which, in tandem with CALM, doubled testing capacity) and other monitoring measures. The tests are free and available to students, staff and faculty. For more details, see "Tested and Testing" on page 14.

On September 20, the 2021 fall quarter began, with total enrollment exceeding 40,000 students. Of the nearly 12,000 undergraduate students who had moved into campus housing, only 13 tested positive for COVID-19.

### **Beyond campus**

WITH TIME, the ability and capacity of UC San Diego clinicians and scientists to test for COVID-19 expanded dramatically. It was offered in drivethrough settings, to persons requiring testing before travel and to other public institutions, such as local schools via the EXCITE lab, who needed an early detection system in order to reopen their own classrooms.

## **TRIALS BY DIRE**

UC San Diego Health was part of three of the first four clinical trials resulting in approved COVID-19 vaccines. and has conducted more than two dozen other investigations of potential drugs and therapies

**BY SCOTT LAFEE** 

ON DECEMBER 11, 2020, the U.S. Food and Drug Administration (FDA) gave emergency use authorization (EUA) to the Pfizer-BioNTech COVID-19 vaccine. Seven days later, it granted EUA to the Moderna vaccine. On February 27, 2021, an EUA was given to the Janssen-Johnson & Johnson vaccine. At the time of writing, clinical trials data for a fourth major vaccine-AstraZeneca-had not yet been submitted for FDA review.

One year earlier, none of these vaccines existed; all were the product of intense, accelerated development that included international clinical trials involving hundreds of thousands of participants and expedited review. In three of the four trials-Moderna, Janssen/Johnson & Johnson and Astra-Zeneca–UC San Diego Health and local residents played roles.

"It's not really surprising," said Gary Firestein, MD, Distinguished Professor of Medicine and director of the Altman Clinical and Translational Research Institute (ACTRI). "UC San Diego is an

international research hub where thousands of clinical trials are conceived or conducted every year, for almost every human condition imaginable.

"The ability to combine a deep bench of experienced investigators with all of the necessary tools and resources makes UC San Diego a natural, go-to destination for clinical trials, and that means San Diegans often get first access to the latest advances in medical science."

And notably, Firestein added, ACTRI investigators were "extremely successful" in recruiting trial participants from underserved and underrepresented communities, a critical element in developing therapeutics that are reflective and effective across all demographics. In the Moderna study, for example, approximately 80 percent of participants in the second (and last) month of recruitment were Hispanic/Latinx.

The Pfizer and Moderna vaccines are based on messenger RNA (mRNA) technology. These vaccines provide



cells with instructions to produce a harmless piece of the virus' characteristic spike protein. The human immune system recognizes the spike protein as "foreign" and builds an immune response against it. Later, if vaccinated persons are exposed to the SARS-CoV-2 virus, their immune systems are already prepared to help prevent infection and illness.

The Astra-Zeneca and Janssen vaccines employ an older approach: An inactivated common cold virus is modified to carry SARS-CoV-2's spike protein, which the virus uses to enter host cells, spurring the immune system to create neutralizing antibodies that essentially render subsequent exposures to the coronavirus as noninfectious.

Astra-Zeneca and Janssen are built on much-documented vaccine platforms that had worked well with other diseases, including HIV, Ebola and malaria, said Susan Little, MD, professor of medicine at UC San Diego School of Medicine and principal investigator for both UC San Diego trials.

MRNA vaccines are easier and faster to develop, but until the pandemic, the approach had never been approved for human use. "The world was facing an unprecedented crisis; millions infected, hundreds of thousands of people already dead," said Stephen Spector, MD, Distinguished Professor of Pediatrics and principal investigator in San Diego for the Moderna trial. "A vaccine was desperately needed, as soon as possible."

All of the trials, both in San Diego and around the world, were accelerated efforts, conducted over the course of months, not the usual five to ten years. That alacrity demanded spending billions of dollars and making some educated guesses.

For example, drug manufacturers said injections of the two-dose Pfizer and Moderna vaccines should be given 21 and 28 days apart, respectively, but those intervals were set, in part, to hasten data collection and speed review. Eventually, the Centers for Disease Control said dose intervals could be up to  $42 \, \mathrm{days}$  apart with no negative consequences, and longer intervals may actually produce a



more robust immune response. Initial clinical trial data indicated all of the EUA-granted vaccines were strongly effective against SARS-CoV-2. Concerns grew, however, that the vaccines were less effective against new virus variants emerging around the world, from the United Kingdom and South Africa, to Brazil and India. Subsequent data suggests the vaccines remain effective, at both preventing infection and dramatically reducing the risk of severe disease and hospitalization. Davey Smith. MD. is a translational research virologist and head of Infectious Diseases and Global Public Health at UC San Diego School of Medicine. He works in both vaccine development and in studying viral variants.

"It's the nature of SARS-CoV-2, like all viruses, to evolve and to adapt to any challenges that might threaten its survival. COVID-19 vaccines will need to be modified and improved going forward. Every year, the flu shot is a different formulation. Something similar might be necessary with SARS-CoV-2 and future variants to keep the virus under control." Much effort now focuses on



Gary Firestein, MD, (left) is Distinguished Professor of Medicine and director of the Altman Clinical and Translational Research Institute, with project scientist Deepa Hammaker, PhD.

refining current vaccines, creating new options and developing boosters. One question still to be fully resolved is how long current vaccines remain effective. One clinical trial involving UC San Diego will try to provide answers, comparing transmission and infection rates between two groups of students, one vaccinated, the other not.

### **Other clinical trials**

**VACCINES WERE** not the only target of COVID-19 trials at UC San Diego Health. More than two dozen have been launched, many assessing new or repurposed drugs and therapies.

For example, UC San Diego Health researchers have been involved in clinical trials assessing the antiviral drug remdesivir and the repurposed drugs tocilizumab, used to treat arthritis and other inflammatory diseases, and ramipril, used to treat hypertension.

They are studying the immune response to SARS-CoV-2 in cancer patients and the likely outcomes of chronic kidney disease patients with COVID-19 infections.

And they are evaluating viral transmission risk of persons fully inoculated with the Moderna vaccine and among asymptomatic children.

## **GIVING IT OUR BEST SHOT**

Vaccination super stations inoculated thousands daily

### **BY HEATHER BUSCHMAN, PHD**

"IT'S HERE!" Nancy Yam, PharmD, was chatting with colleagues outside her office at UC San Diego Medical Center in Hillcrest early in the morning of December 15, 2020, when her smartwatch pinged with the message they had all been waiting for.

The group darted for the stairs leading to the shipping and receiving area. Yam glanced at another message on her watch. "No, it's already been taken up!" The giddy group reversed course and a few moments later, they burst through the back door to the hospital's pharmacy.

There, two cardboard boxes sat on a cart. The boxes might have contained anything, but Yam and her co-workers knew exactly what lay within. They had been waiting for this shipment and this moment for months, along with the entire country.

The first COVID-19 vaccines were in the house.



Word spread and within minutes people from neighboring work areas arrived to take pictures of the boxes and to text families and friends.



It was a historic moment, but Yam, associate chief pharmacy officer at UC San Diego Health, and her team could not pause to appreciate its significance. They needed to get to work. Carefully following instructions from Pfizer and the Food and Drug Administration (FDA), they moved the vaccines into supercool freezers in the "Freezer Pharm." They collaborated with team members from the Facilities and Emergency Management team to coordinate the delivery of doses and ancillary items, such as needles, syringes and vaccine cards to Jacobs Medical Center in La Jolla. They consulted with physicians and nurses to determine how and when the vials would be thawed and reconstituted, and how nurses would administer doses.

On December 16, the following day, doctors, nurses and staff lined the hallway and cheered as the first employees were called in to receive their vaccinations. Within four weeks, more than 10,000 UC San Diego Health employees had been vaccinated, an effort led by Shira Abeles, MD; Marlene Millen, MD; and others.

"Before the vaccines became

available, we were working around the clock to prepare for surges of patients with COVID-19. to make sure that we could provide them, as well as our other patients, with outstanding care and to make sure we weren't going to run short of medications-all with so many unknowns and things changing daily," Yam said. "At the same time, many people were dealing with so much loss, anxiety, weddings delayed and kids out of school.

"That's why it was so meaningful to be able to play a part in equitable distribution of the vaccine, starting with our own health care heroes. It was a day of pride, and hope."

### Partnering to expand

A FEW WEEKS LATER, UC San Diego Health CEO Patricia Maysent was on the phone, strategizing with San Diego County and other UC San Diego Health leaders about how best to quickly and safely vaccinate all of the remaining health care workers in the region.

"That was a Wednesday, and I asked 'What would it take to get 5,000 vaccines in arms a day, starting Monday?" Maysent said, "What would that take? Can you do it?""

Everyone was eager, but one of the limiting factors was the need for a space large enough to accommodate thousands of people. Maysent thought of the San Diego Padres, with whom she had worked closely for several years. (UC San Diego Health is the Official Health Care Provider of the San Diego Padres, the region's Major League Baseball team.)

Five days later, the state's first drivethrough vaccination super station opened in the Tailgate Lot next to Petco Park, the Padres' stadium.

"The rapid buildout and staffing of the COVID-19 vaccine hub at Petco Park was a massive undertaking, and it would not have been possible without our partners at the county, city and the Padres," Maysent said. "We are extremely proud of San Diego for coming together during this crisis, leveraging the innovation and collaboration for which our region is known, to support the health and safety of the entire community."

The massive undertaking, led by Lydia Ikeda, senior director of COVID-19 operations; Will Ford,

director of project management; and others, involved 42,000 square feet of tenting, 5,700 feet of power cable, 85 laptop computers on wheels, wireless internet provided by the Padres, and a self-scheduling website integrated with UC San Diego Health's electronic health record system. The site was run by 300 clinical and administrative staff and volunteers per day. Yam's pharmacy team and their Storehouse colleagues prepared and delivered the doses and ancillary items daily, and remained on call, ready to drop everything and drive downtown with more doses if the team was able to open up more appointments. "After all that work, on the first day, when we had the first patient enter the site, the feelings I had were awe, inspiration and hope," Ikeda said. "It felt like the first step in a long journey, and it

was amazing that we accomplished it in such short order."

a week.

The community's response to the super station was overwhelmingly positive, including an outpouring on

### The Vaccination Super Station:

Below left to right, the Padres' Friar mascot; Lydia Ikeda, senior director of COVID operations at UC San Diego Health; and Nathan Fletcher, chair of the San Diego County Board of Supervisors, celebrating the 100,000th dose delivered at Petco. More than 225,000 doses would be administered before the site closed.



The vaccination super station administered approximately 5,000 vaccines per day, 12 hours per day, seven days

social media to express gratitude and pride in the San Diego region for being able to rapidly collaborate to scale-up and streamline vaccine distribution at a time when most regions were struggling to implement the basic infrastructure. More than 25,000 people signed up to volunteer.

The site was visited by many elected officials, including California Governor Gavin Newsom and representatives from other health systems. Petco site leaders were asked to present to national organizations and were interviewed frequently by local and national media. Petco even received a shout-out during a White House news conference.

"What I'm probably most proud of is that the Petco site served as a model for other similar mass vaccination centers in the state, and around the country." Maysent said.

Staff and volunteers were treated to donated meals and treats, visits from Padres alumni, high fives from the Padres mascot, an impromptu concert from an opera singer during her post-vaccination observation period and thank-you cards from kids grateful that their grandparents had been vaccinated.

The Petco site operated for 68 days, administering more than 225,000 vaccine doses. It permanently closed on March 20, 2021, with the advent of the Major League Baseball season.

As the county began to open up vaccine eligibility to additional occupations and age groups, UC San Diego opened a second super site at the Recreation, Intramural and Athletic Complex (RIMAC) on the La Jolla campus. The site served UC San Diego employees, students and patients, as well as members of the community. In the almost four months that it operated, more than 195,000 doses were administered at the RIMAC site.

"One of the things I'll never forget is how grateful people were to get their vaccines, how they thanked us for saving their lives, even if they'd been waiting in traffic for hours to get there," Ikeda said. "It was a privilege to be able to help our community this way, and we, in turn, were buoyed by them. It was exactly what we needed after months of being 'COVID-weary."



## Vaccines by the Numbers\*

**2** Vaccination super sites

3 Vaccines administered 550,818 Total doses administered 287,872 Total individuals vaccinated

\*as of November 15, 2021

Reaching the underserved while the super sites were exceptional

at vaccinating huge numbers of people, they often weren't accessible to those who needed them most. In March 2021, with support from philanthropists John and Sally Hood, UC San Diego Health, led by Abeles, Ikeda and others, began collaborating with trusted community-based organizations to expand outreach and support widespread deployment of vaccines to San Diego County communities affected by the greatest number of COVID-19 cases and the highest rates of hospitalizations and deaths. These mobile vaccine clinics were designed to reach more patients more effectively, and help ease barriers such as lack of transportation to vaccine appointment sites and distrust in health care providers outside of local communities.

One of the first stops was a complex of warehouses and trucking services in Otay Mesa, where a team vaccinated approximately 1,200 people who deliver food and goods throughout San Diego County and the nation. In the following weeks and months, the team administered vaccines in churches, high schools and work places.

"No virus, especially one as infectious as COVID-19, recognizes borders," said Abeles, dubbed the "vaccine czar" in a February 2021 *Science* article. "As a leading advocate and provider for health care across our region, UC San Diego Health quickly recognized the public health benefit in joining our binational community in expanding outreach and supporting the widespread deployment of COVID-19 vaccines to help end this pandemic."

In May, UC San Diego Health set up a mobile clinic at the Mexican border in San Ysidro, where a team vaccinated 10,000 maquiladora workers employed by United States subsidiary companies over seven days. The clinic was made possible through the efforts of the Consulate General of Mexico and the County of San Diego.

"Our ability to vaccinate a quarter of San Diegans, and save so many lives; it was historic," Ikeda said. "We'll be telling these stories to our grandkids the way our grandparents talk about the polio vaccine." ●





HIDDEN FIGURES: From setting up surge tents and testing sites to launching vaccination super stations to establishing that fire and life safety protocols were in place in clinical spaces, the facilities and engineering team helped make it possible for staff to provide the highest level of care for patients during and after the pandemic. "If our clinical staff can come in to work every day and are able to do their job of taking care of patients in their greatest time of need, then we're doing our job and it's an honor," said **Tim Rielly**, director of facilities engineering at UC San Diego Health. "We're always here, working behind the scenes, and our goal is to keep everyone safe." *Pictured above: Ahmed Wiggins, emergency management planner (left), and Robert Pruett of Facilities Engineering.* 



FOR MOST PATIENTS who succumbed

to COVID-19, the ultimate cause of

death was pneumonia, a condition

buildup make it difficult to breathe.

Severe pneumonia often requires

lengthy hospital stays in intensive

care units and assisted breathing

To quickly detect pneumonia

- sometimes before a COVID-19

diagnosis – UC San Diego Health

clinicians used artificial intelligence

to augment lung-imaging analysis,

part of a clinical research study.

"Pneumonia can be subtle,

especially if it's not your average

bacterial pneumonia. If we could

you could even detect it with a

stethoscope, we might be better

identify those patients early, before

from mechanical ventilators.

in which inflammation and fluid

Technically revealing: (Left) Chest X-ray when the AI algorithm detects pneumonia. (Right) Chest X-ray from a patient without AI detection.



"If we could identify those patients early... we might be better positioned to treat those at highest risk of severe disease and death."

-ALBERT HSIAO, MD, PHD

## LENDING A HELPING MACHINE

AI algorithm helps clinicians detect pneumonia early

BY HEATHER BUSCHMAN, PHD

positioned to treat those at highest risk of severe disease and death," said **Albert Hsiao, MD, PhD**, associate professor of radiology at UC San Diego School of Medicine and a radiologist at UC San Diego Health.

Hsaio's team developed a machinelearning algorithm that made earlier detection possible.

The images show chest X-rays from a patient with COVID-19 pneumonia. On the right, above, is the original X-ray and on the left, above, is what a clinician sees when the AI algorithm detects pneumonia. This particular patient also happened to have a pacemaker device and an enlarged heart, indicators that, while a subject may have significant underlying health issues, the algorithm was still able to do its job. ●

## A NURSE'S COVID-19 PLAYLIST

*Telemedicine nurse uses music to build patient relationships* 

**BY JEANNA VAZQUEZ** 

DURING THE PANDEMIC, JOE Bautista, a registered nurse at the UC San Diego Health COVID-19 Telemedicine Clinic, collected songs from his patients as part of a satirical "Nurse's Fee," in which Bautista would ask each patient to tell him which song best described 2020 for them. As the pandemic spread and deep-

As the pandemic spread and deepened in San Diego, **Michele Ritter, MD**, and other infectious disease specialists launched the COVID-19 Telemedicine Clinic, which was open to anyone in the community with a recent COVID-19 diagnosis. Through video visits and phone calls, nurses and physicians consulted with people who had mild to moderate symptoms.



Every week, Bautista called and checked in on his patients to ensure they were on their way to recovery at home. These song requests helped Bautista build relationships with his patients, which in turn furthered the healing process by providing a personal connection.

"Music brings us together and is something that everyone can relate to. We all speak the language of music," said Bautista.

Now, Bautista's COVID-19 playlist has more than 500 songs. Popular titles include "I'm a Survivor" by Destiny's Child; "House Arrest" by Sofi Tukker; and "You Can't Always Get What You Want" by the Rolling Stones. ●

## **EVERY INFECTIOUS DISEASE THAT CAME BEFORE COVID-19 PREPARED US**

A Q&A with Francesca Torriani, MD, medical director of Infection Prevention and Clinical *Epidemiology at UC San Diego Health, on the* early days of the pandemic

**BY JACKIE CARR** 

### When did you first become aware of COVID-19 outside of the United States?

I happened to be in Switzerland at the time, and was with friends with whom I had graduated from medical school. We were reading in the news what was happening in China and discussing whether the illness was a global threat, whether this could be the next SARS or the next epidemic.

### Were you afraid in the early days?

No. As a health care epidemiologist, you're always thinking about what could be. Always in the back of your mind, you think, "What should I be worrying or thinking proactively about? Could this virus come to the U.S.? How should we prepare?" As epidemiologists, we are engineered to think ahead. It's really a question of how you detect or how you prevent infection. For example, what PPE (personal protective equipment) should you use? What necessary diagnostic tests are needed? Ventilation systems? Etcetera.

### When did you start to realize that a global threat was emerging?

Toward mid-January 2020, we started hearing about something unusual going on in Italy. Within weeks, it was clear that the situation was remarkable and dangerous. Illnesses started appearing in the region of Bergamo, in northern Italy. That was when my attention became very narrowly focused, and I started thinking about San Diego and the need for a headquarters of local operations. Then, in late-January, we got the phone call that planes would be arriving from Wuhan. That was our unified call to action at UC San Diego.

### What prepared you for the patients' arrival from China?

Every infectious disease that came before COVID-19 prepared us. In 2014, we prepared for Ebola, and even designed and built an infectious disease unit to care for potential patients. Before that, there was SARS, H1N1 and avian flus. All of the lessons learned came into play. While there was no test for COVID-19 early on, we already had intense safety protocols to prevent disease transmission, plus the CDC team was on-site for consultation. We knew that this was a respiratory virus, so if we had good protection, and we knew how to doff (or remove) our PPE without contaminating ourselves, we would have appropriate layers of defense.

### What did you see in the patients' faces when you entered their rooms?

For me, one thing that struck me about the patients from China was the fear. The fear of being targeted because of the perception of bringing a new disease into a country. The racism, the inherent fear of being targeted and the abrupt separation from their families all became factors. All of the patients had a connection to the U.S., and so, were allowed to get on that plane, but their fear was real. When I saw them, I observed how isolated they were. I felt the pure humanity of it all. Very few of the patients actually tested positive. One happened to be a grandmother and nurse, bringing her grandson to the U.S. She had to be separated from him to be hospitalized, and how heart-wrenching that was to see. In the grandmother, and in all the patients, was this fear of rejection, and this feeling of guilt. Survivor's guilt. But, at the same time, there was a lot of gratitude toward us, who were willing to take care of them, and welcome them.

### What was the game changer in altering the course of the pandemic?

The one change in practice that was really a game changer was when we recognized the need for masks outside of health care. The primary purpose of universal masking is source control, right? It's not letting the aerosol particles of coughs or sneezes move through the air. With masks, we can halt the fitness and survival of a virus. Had we masked in public earlier, not just inside hospitals, the course of the pandemic could have changed dramatically. It's inevitable there will be another pandemic. Hopefully, this lesson learned stays with us and is implemented quickly in the future.

"It's inevitable there will be another pandemic. Hopefully, this lesson learned stays with us and is implemented quickly in the future."

-FRANCESCA TORRIANI, MD

### What traits of UC San Diego Health helped us survive the pandemic?

One of the things I greatly appreciated was a leadership team deeply grounded in reality. They were very keen on learning from a wide variety of experts and polling them on a regular basis to guide the health system forward. They made hard decisions to protect the integrity and the survival of the health care ecosystem, especially our CEO. It was gutsy to stop all surgeries because we wanted a safe environment for all employees and patients, knowing that there would be economic consequences. Our C-suite was among the heroes in this community. We took in the first patients, launched the first clinical trials and vaccinated the first community members. None of this would have been possible with leaders who were not nimble and present every single day.





Francesca Torriani, MD, joined UC San Diego Health in 1995. She has long cared for patients with infectious diseases, including those with HIV/AIDS and tuberculosis.

## **BUILDING AN ANTI-RACISM FRAMEWORK**

In medicine, the patient's health isn't always the only issue to address

### **BY JEANNA VAZQUEZ**

"YOU DON'T LOOK LIKE THE DOCTOR," the patient's husband says. "I bet I wouldn't catch you running around in the street, would I."

The resident stops short, but isn't surprised. As a Black man, he has confronted such comments many times. This particular comment is prompted, in part, by the recent death of Ahmaud Arbery, a 25-year-old Black man pursued and fatally shot by white community members while he was jogging through his South Georgia neighborhood on February 23, 2020. At the time, no arrests were made.

The resident feels powerless. He turns to leave the room, believing that no matter how he responds, any reply might jeopardize his career and wouldn't change anything.

Three months after the death of Ahmaud Arbery, George Floyd dies after a Minneapolis police officer kneels on his neck for nine minutes and 29 seconds. This time, more than 30 medical students and residents in the School of Medicine speak up, penning a pair of letters to school leadership demanding change.

"We had been meeting with medical students from underrepresented communities in the field of medicine for some time in order to address the need for equity, diversity and inclusion in medicine," said Steven Garfin, MD, interim dean, UC San Diego School of Medicine. "But we realized in this situation with our resident, and after receiving the two letters, a more urgent response was necessary to ensure policies and procedures, as well as education and training, were put in place for medical professionals - and patients."

And so the Anti-Racism Framework for UC San Diego Health Sciences was established, along with multiple work streams tasked with addressing specific issues and demands raised in the letters.

The five main categories of work are organized by Education; Organizational Training and Enrichment; Recruitment, Retention and Representation; Health Care Policies; and Health Disparities. Each group seeks to improve equity, diversity and inclusion efforts where we all learn, work, teach and receive care.

Invitations to join a work group were sent to all faculty, staff, students and residents; nearly 400 individuals expressed their interest in helping.

In fall 2020, the work groups began meeting regularly to address issues affecting not just residents, nurses and medical professionals but hospital support staff, such as environmental services and food and nutrition as well.

"First and foremost, we listened, and it was very painful to hear the stories," said Garfin. "We thought we understood and empathized, but we can't do this right unless we're put in the shoes of others. We opened our eyes to what had to be done because we can't continue to relive centuries of this systemic racism."

Immediate actions included leadership recruitment, and new positions, such as a Chief Administrative Officer for Health Equity, Diversity and Inclusion at UC San Diego Health and an Assistant Vice Chancellor for Health Equity, Diversity and Inclusion for UC San Diego Health Sciences.

New clinical policies were created to protect staff and set expectations for patients on what is acceptable

behavior while receiving care. "We needed to be clear that we will not tolerate racist behavior at UC San Diego Health. These policies are critical because they affect everyone," said Thomas Savides, MD, chief experience officer at UC San Diego Health and chair of the Health Care Policies work group.

"Specifically, we've created two policies on anti-racism that would promote an inclusive work environment for our staff and also help mitigate racist encounters with patients."

For team members, the policies provide guidance on how to manage racist events involving patients. Each event will be managed by a team to evaluate the situation. escalate for additional action, review the event and track patterns.

For patients, certain expectations, rights and responsibilities are expressly outlined, explaining that racism exhibited by patients, family members or anyone visiting the health system will not be tolerated. The updated policy will be provided to patients upon admission.

"It's been a coordinated effort instead of a lot of people working in silos," said Savides. "It's gratifying to know that we're making changes now that will be in place for decades to come."

Systemic racism has been a public health crisis for centuries. Numerous high-profile deaths, often involving police, fueled an explosion of outrage and grief in 2020, which soon spread to not only include disproportionate violence, but also heightened health disparities and the impact of COVID-19 on communities of color.

"Our CEO Patty Maysent sent out a call to action for physicians and nurse leaders: Stand up and contribute to ensure patients have more equitable health outcomes," said Amy Sitapati, MD, chief medical information officer of Population Health at UC San Diego Health and chair of the Health Disparities work group. "We were tasked with finding a way to become a cohesive unit of change and the most important thing



### Well-being on both sides of the stethoscope: Systemic racism and health disparities confront both health care providers and patients alike.

"We needed to be clear that we will not tolerate racist behavior at UC San Diego Health. These policies are critical because they affect everyone."

### -THOMAS SAVIDES, MD

we needed to do first was allow for open and transparent conversations." Sitapati's work group focused initial efforts on listening to staff who were personally affected by health care inequities, experienced racism in the workplace, and who had witnessed inequities in patients they cared for. Collectively, they were moved by how the pandemic dramatically

impacted Latinx in San Diego. "During the surge, half of my inpatients with COVID-19 only spoke Spanish. We also noticed our Spanish speaking Latinx population were developing severe cases," said Sitapati. "Our goal as a work group was to be strategic and personal to ensure we were more inclusive to all patients and staff." The work consisted of adapting communications for frontline staff including nonclinical departments such as food and nutrition and environmental services – to be more linguistically inclusive and at an appropriate literacy level. Translations for staff town halls were provided to ensure staff received leadership updates in the language they best understood. For patients, the team understood the underlying importance that structural barriers and social determinants were impacting patients at risk for severe COVID-19. "We were able to load in the social deprivation index for every person, based on their census block provided by the California Healthy Places Index

(HPI)," said Sitapati. "Just by knowing where a patient lived, we could determine their HPI and prioritize care for patients with the highest risk."

Not only did this apply in the clinical setting, but it also assisted the work group in determining where to focus COVID-19 vaccination efforts as UC San Diego Health ramped up its mobile vaccine clinic, which delivers vaccines directly to communities in the greatest need.

Since the Anti-Racism Framework was established, Sitapati has noticed a culture shift at UC San Diego Health that she believes is a result of the collective efforts of all involved.

"The timing of these two extremely emergent events – COVID-19 and the social injustice experienced by persons of color - truly highlighted the severity of health disparities among certain communities and really emphasized the critical need for change," said Garfin. "Which is why it's so important for those in medicine to understand how racist sentiments and biases affect a person's overall health. As educators, this training will become the norm as we mentor the next generation of doctors and work with our current doctors actively providing health care." •

### DISCOVERIES

## Research Clinical Education

## **Teaching and Learning Re-Envisioned**

IN MARCH 2020, our response to pandemic SARS-CoV-2 and the disease it causes. COVID-19, demanded dramatic changes to teaching and learning.

It quickly became apparent that the community public health efforts necessary to mitigate the rapid spread of the virus, hospitalizations and deaths would require students from the schools of pharmacy, public health and medicine to transition to remote teaching and learning for the remainder of the spring quarter.

Evolving science and the availability of protective tools would improve clinical care, reduce deaths and ease the burden on health care and public health systems. But we would also learn a lot about living with the virus. Under extraordinary circumstances, UC San Diego became a trailblazer in its efforts to provide a place of refuge for students facing unforeseen challenges, from food and housing insecurity to physical and emotional abuse. The campus became a refuge and respite, albeit one filled with the promises and perils of being a pioneer.

In May 2020, Return to Learn debuted, a bold initiative to return students to campus and learning during the pandemic. It was designed to be adaptive and responsive to changes in the local epidemiology of COVID-19. It focused on risk mitigation, viral detection and public health intervention. Every sector of the campus was engaged in preparations for mass testing, delivery of student health services, housing, dining, isolation and quarantine resources, symptoms monitoring, wastewater surveillance and reporting our daily status on a public dashboard. These efforts transcended everyone's routine job assignments. It was service to an educational mission bigger than oneself.

DISCOVERIES UCSD EDU

By fall 2020, students were pre-The new Herbert Wertheim School For much of the fall and winter UC San Diego's educational pro-Across the campus, we emphasized

sented with the option to return to campus or continue to learn remotely. We welcomed back almost 10,000 students, roughly two-thirds of whom lived on campus. Inside and outside of the classroom, our students, staff and academics demonstrated extraordinary resilience, creativity and commitment. of Public Health and Human Longevity Science (founded in 2019) partnered with the San Diego County Department of Public Health for contact tracing among those aged 18 to 24 years. A great deal of the success of any public health program relies on human behavior that considers the needs of others. Our students' behaviors were exemplary. seasons, the highest prevalence of COVID-19 in San Diego (and across the region and country) was in persons 18 to 24 years old, yet there were very few outbreaks on campus - and none traced to our classrooms. Our students adhered to rigorous testing, isolation, quarantine and monitoring protocols, and their dedication showed. grams attract students from all over the world. Meeting these diverse needs requires flexibility. During the pandemic, some classes were in-person, in rooms modified to maintain physical distance; some were in specially prepared outdoor settings; some classes used a hybrid format with a number of students in-person and others joining lectures remotely. Yet others were fully online. proper hygiene, sanitation, face coverings and the use of other, appropriate personal protective equipment. The Teaching+Learning Commons tool assisted the development of strategies for impactful remote instruction. Our faculty and staff swiftly rose to

meet the challenges they faced. Professors and instructors who. prior to the pandemic, could not have envisioned teaching students online, or in hybrid formats, reinvented their courses and themselves. They designed lessons that were adaptable to a range of student needs and teaching formats. They ensured high quality interactions using virtual whiteboards, chat features and breakout rooms to stimulate conversation and creative engagement.

Our response to the pandemic has perhaps permanently changed the way students will learn and faculty will teach at UC San Diego. In a stressful time without precedent, we became even more adaptive, more considerate of student needs and more conscious of our impact as educators - regardless of setting.

I hope we continue the educational practices learned over the pandemic. They will help us reduce inequities in student access and increase the reach and impact of UC San Diego's pharmacy, public health and medical school educational programs.

Sincerely,

CHERYL A.M. ANDERSON, PHD. MPH Dean, Herbert Wertheim School of Public Health and Human Longevity Science, UC San Diego



## COLLABORATION, COMMUNITY AND FOLLOWING THE SCIENCE

The formula for UC San Diego's Return to Learn success

### **BY CHERYL ROBINSON**

UC SAN DIEGO ENTERED 2020 in growth mode, well-positioned to advance progress toward the goals outlined in its long-term Strategic Plan to drive the physical, intellectual and cultural transformation of the university.

But the emerging public health crisis in Wuhan, China led renowned infectious disease expert Robert "Chip" Schooley, MD, professor of medicine and chief of the Division of Infectious Diseases at UC San Diego Health to ask UC San Diego Chancellor Pradeep K. Khosla what the university would do if forced to shut down for a prolonged period of time in response to the crisis.

While some universities took a wait-and-see approach, Khosla recognized the seriousness of the situation and knew that thoughtful and immediate action was necessary. He considered the university's vast human, research and infrastructure resources, and knew UC San Diego was uniquely suited to address this challenge head on.

### Early action was key

KHOSLA EMBRACED the university's deeply ingrained, interdisciplinary ethos to assemble experts from UC San Diego's faculty, administration and staff to form a task force that could evaluate the rapidly changing situation, regionally and globally.

"We assembled our emergency operations centers (EOC) for our campus and for our hospitals. The

EOCs explored options and models for impacted operations," said Khosla. "So, when the state mandated the shutdown in March 2020, we were already a step ahead."

Students, faculty and staff were sent home. Mechanisms and platforms were quickly stood up and communicated to ensure everyone was supported through the transition. Remote operations were stabilized. A newly-formed Campus Operations Group rolled up its collective sleeves. And the necessary work of understanding detection, intervention and mitigation of the COVID-19 virus began with a singular goal: to return to in-person learning, research and service to the community in the safest way possible.

### **Return to Learn**

ON MAY 5, 2020, UC San Diego became the first university to announce a commitment to incrementally bring back a portion of its campus population in fall 2020 through a flexible, multilayered and data-driven approach called Return to Learn or RTL.

RTL was built upon three key pillars: risk mitigation, viral detection and intervention. Khosla often referred to the approach as a "Swiss cheese" model. "Every layer has its holes," Khosla told The New York Times in December 2020. "But put together, it's a solid block." Hundreds of employees and students successfully built and tested new systems and protocols on campus with a limited number of students, researchers, faculty and staff in advance of the fall quarter to ensure the feasibility and scalability of the plan.

### A campus reimagined

FACULTY RECONFIGURED instruction for remote and hybrid learning, ensuring that the academic rigor of the university was upheld. Staff reimagined nearly every service to ensure access to important resources. UC San Diego's Facilities Management team, with help from the university's engineering experts, reconfigured the campus environment, including traffic flow.

Academic buildings, residence halls and retail and dining facilities were adapted to provide one-way traffic into and out of spaces. Experts like Kimberly A. Prather, PhD, UC San Diego Distinguished Professor and Distinguished Chair in Atmospheric Chemistry, served as a resource to guide updates and adaptations to airflow in campus buildings, helping promote circulation of fresh air flow and reduce disease transmission risks. More than 200 critical custo-

dial staff were devoted to enhanced cleaning and sanitization protocols. disinfecting light switches, elevator buttons, desktops and other surfaces twice daily. And 1,500 hand-sanitizing stations were installed across campus.

→ **Test kit vending machines:** Testing compliance became easier and more efficient with the addition of COVID self-test kit vending machines at the beginning of winter quarter 2021. The vending machines could distribute more than 2,000 test kits per day and were placed in high traffic areas, such as the Price Center and near residence halls across campus.

→ Wastewater monitoring: Led by Rob Knight, PhD, professor and director of the Center for Microbiome Innovation at UC San Diego, teams collaborated to develop an innovative way to test wastewater for SARS-CoV-2. The highly sensitive monitoring stations were able to detect the virus in wastewater three to five days before individual testing would show a positive result. The campus started monitoring six buildings, but by spring 2021, more than 125 samplers were monitoring 340 residential and non-residential buildings daily. This work resulted in early notification and identification of potentially exposed individuals.

 $\rightarrow$  **CA Notify:** UC San Diego Health, in partnership with Google and Apple, launched the first of two UC system pilot initiatives to test use of this mobile COVID notification technology early in the fall quarter. More than 50 percent of students, faculty and staff signed up for the app within the first week of its announcement.

→ **Outdoor classrooms:** When public health guidelines significantly reduced in-person instruction capacity, the university took advantage of San Diego's climate and quickly erected Americans with Disabilities Act-compliant outdoor classrooms equipped with a full suite of teaching tools, including audio/visual, Zoom capability, Wi-Fi and more, so that instructors could simultaneously teach both in person and remotely. In addition to the outdoor classrooms - which ultimately totaled six structures by the end of winter quarter - six smaller, outdoor study and meeting areas were erected to facilitate tutoring and study groups.

### **Collaboration with UC San Diego** Health also guided campus efforts to keep positive case rates low. These efforts included:

 $\rightarrow$  **Screening and testing:** To prioritize health and safety, UC San Diego provided asymptomatic testing for students, faculty and staff. Two labs, UC San Diego Health's clinical diagnostics lab (CALM) and a new one on the School of Medicine campus (EXCITE), provided capacity to test students bi-weekly, then weekly as cases declined. Everyone coming onto campus completed mandatory daily online symptom screenings. Positive case rates remained low, and there was no evidence of transmission in classroom or research settings, suggesting that physical and operational changes to campus were successful in helping to mitigate risk.

→ Return to Learn website and dashboard: University Communications launched a dedicated Return to Learn website in June 2020 to serve as a centralized resource for all pandemic-related information. Comprehensive dashboards showing current positive case rates and wastewater testing results on campus were added to the site and updated daily to ensure ongoing transparency in the university's approach. The website receives more than 75,000 visits per week, reinforcing the importance of communication throughout the pandemic.

### **Readv to return**

WITH CONFIDENCE built through practice, UC San Diego put its plan into action and successfully welcomed 5,730 undergraduate students back to a transformed campus for the fall 2020 quarter. Returning students were introduced to new safety protocols, including mandatory testing during move-in. The Student Code of Conduct was updated to establish clear expectations for student behavior and to remind students of the health consequences of risky behaviors.

On-campus residence housing was limited to 50 percent capacity, with all students residing in single-occupancy rooms. More than 600 beds on campus were reallocated to serve as isolation and quarantine housing for students who received a positive COVID-19 test result. These students would receive special support and access to care.

Bright banners, flags and digital signage were placed on light posts, public transportation, buildings and elsewhere throughout campus to encourage students and keep safety awareness high. Ground markings signaling physical distance were located where students tended to congregate.

### **Case rates remain low**

UC SAN DIEGO defied the odds and demonstrated that a successful return to campus was possible. The 14-day COVID-19 positivity rate for UC San Diego students on and off campus averaged between 0.12 percent and 0.87 percent throughout fall 2020. During that time, the positivity rate in San Diego County averaged between 2.7 and 8.7 percent.

A surge was anticipated when students returned from winter break, but the university was willing to increase campus density because the data was clear: The approach was working, and new innovations, such as the vending machines, were making it easier for students to comply with testing requirements and adhere to safety protocols.

### Nurturing community

THERE WAS A FOURTH and critical element to the success of RTL: students. The weakest link in any plan is human behavior. The nation saw this play out as other universities struggled to contain the virus after reopening their campuses in the fall of 2020. But UC San Diego's commitment to

inclusion and innovation meant that students were involved in RTL from its inception. They were empowered to own the issue, plan and implement approaches in ways that worked.

By making meaningful contributions, the student community was invested in creating and sustaining a safe and fulfilling on-campus experience for everyone. Student leaders and Student Affairs came up with novel ways to engage students, including the creation of Triton Health Ambassadors.

More than 400 trained peer ambassadors/educators, easily recognizable by their bright yellow shirts, positioned themselves across campus to personally engage with students and provide important support by "catching" and recognizing positive behaviors and serving as resources for students seeking information.

"Our students behaved in an exemplary manner. I mean it was unbelievable," Khosla said in an April 2021 interview with KPBS-TV. "We were expecting it, and they beat our expectations and then some. To me, they were the reason we were so successful." •



## AN INFODEMIC OF MISINFORMATION

As the virus spread, so too did rumors, fake news and fraud

### **BY SCOTT LAFEE**

**ONE ADVERSE SIDE EFFECT** of pandemics is the corresponding outbreak of misinformation and scams, the latter both medical and financial. They are as inevitable as, well, the pandemics themselves.

The spread of misinformation, intentional or not, has been rampant during the COVID-19 pandemic. A Brookings Institution study in late-2020, using monthly data from the Franklin Templeton-Gallup Economics of Recovery Study, found significant variation in understanding of COVID-19 facts which, in turn, distorted public policies and behaviors.

Not all of the misinformation, particularly on social media, was promulgated by human beings, however. At least not directly. For example, in a research letter published June 7, 2021, in JAMA Internal Medicine, a diverse team that included UC San Diego scientists found that significant misinformation about face masks and COVID-19 was spread by "bots," autonomous software programs that allow individuals to generate content and share it broadly via numerous automated accounts, amplifying messaging. Specifically, first author

John W. Ayers, PhD, associate professor in the Division of Infectious Diseases and Global Public Health at UC San Diego School of Medicine, and colleagues measured how quickly links were shared in a sample of 300,000 posts to Facebook groups that shared 251,655 links. They found that links shared by Facebook groups most influenced by bots averaged 4.28 seconds between shares, compared to 4.35 hours for Facebook groups least influenced by bots.

One in five of the posts made to Facebook groups most influenced by bots claimed masks harmed the wearer, contrary to scientific evidence. The World Health Organization has called the phenomenon an "infodemic of misinformation." While the purpose of misinformation is to give it freely and often, the COVID-19 pandemic also provoked an abundance of efforts to essentially take. mostly money in the form of bogus COVID-19 products and therapies. Writing in the August 25, 2020 issue of the Journal of Medical Internet Research Public Health and Surveillance, UC San Diego School of Medicine researchers found thousands



### **3 tips for identifying fraudulent posts or scams:**

1. If it's too good to be true, it probably is. Look out for mentions of bulk or rapid sales, cheap pricing and questionable claims such as FDA approval or specific certifications another country. Such when products have yet purchases should be to be approved or are not readily available.

of social media posts on two popular platforms – Twitter and Instagram - tied to financial scams and possible counterfeit goods specific to COVID-19 products and unapproved treatments.

Lead author Timothy Mackey, PhD, associate professor in the Department of Anesthesiology, and colleagues surveyed the internet between March and May 2020 using a combination of Natural Language Processing and machine learning to identify nearly 2,000 fraudulent postings "likely tied to fake COVID-19 health products, financial scams, and other consumer risk."

Mackey's research team continues to do research on fake COVID-19 products, including vaccines and vaccination cards, through a sponsored project with Google.

"We're in a post-digital era and, as this boom of digital adoption continues," said Mackey, "we will see more of these fraudulent postings targeting consumers as criminals seek to take advantage of those in need during times of a crisis." •



2. Importing products from another country. If you're a United States consumer, it is likely illegal to import products such as COVID-19 tests from considered risky.

3. Illegitimate contact methods. If the seller is conducting business or a transaction through social media direct messages or another non-traditional communications application, including Skype or WhatsApp, it probably isn't legitimate.

## A MEDICAL STUDENT'S FIGHT AGAINST INEQUITY

For Betial Asmerom, medicine is in sore need

### **BY YADIRA GALINDO**

down on one knee in pristine white coats, UC San Diego School of Medicine students rallied against a public health emergency – systemic racism – that had been catapulted into the public eye by the death of five African Americans in five separate incidents over a five-month period in 2020.

Ahmaud Arbery was gunned down while jogging. Breonna Taylor was shot and killed during a botched police raid on her apartment. Daniel Prude and George Floyd both died while under police restraint: Prude while suffering from a mental health episode, Floyd for suspicion of using a counterfeit \$20 bill. Rayshard Brooks was fatally shot by police responding to a call of a man asleep in his car at a fast-food restaurant.

Betial Asmerom, a fourth-year medical student and one of the organizers of the student protest, said that for years Black, Latino and Indigenous medical students had been organizing to call attention to racism and disparities in medical education and health care.

They felt unheard.

"I don't know if the nation was ready to have these conversations about race before. I've been raising the flag on these issues since I was in high school. People in power have to be receptive to have these conversations if we want to make any change," said Asmerom. Enough was enough.

The deaths of Arbery, Taylor, Prude, Floyd and Brooks resulted in wide-scale demonstrations protesting police abuse and racial injustice in the United States. Students like Asmerom choose

medical education as a way to learn how to heal. In a country roiling with anger, racial tensions and despair, they felt the call to heal even stronger. But it would not be an easy task, and the concurrent COVID-19 pandemic, which was disproportionately impacting communities of color, would only make things harder.

"My family are immigrants from Eritrea. I chose medicine because I want to serve my community and all communities impacted by inequity," said Asmerom, who is enrolled in a dual-degree program called the UC San Diego School of Medicine Program in Medical Education - Health Equity. She has already earned her master's degree in public health, with her medical degree soon to follow.

The collision of the anti-racism movement and glaring health care inequities sharpened by the pandemic prompted Asmerom to speak out louder and more boldly.

"When we first started hearing about the pandemic and all the data coming out, one of the first things I said was 'I can't wait until data on the pandemic is published by race. I already know what it's going to say," said Asmerom.

"These events really lit me up to keep my focus on equity and advocacy work because we've seen, in the pandemic, how people of color have been disproportionately impacted, and yet not prioritized in the solutions to mitigate the impact of the pandemic."

Black medical students at UC San Diego did not mince their words. In a publicly published letter, they wrote that they were

"I don't know if the nation was ready to have these conversations about race before. I've been raising the flag on these issues since I was in high school. People in power have to be receptive to have these conversations if we want to make any change."

-BETIAL ASMEROM



racism as a public health emergency.

"tired of asking our institutions to be better for us and for society."

They called for a commitment from both the university and the health system to become anti-racist institutions.

Leadership heard the concerns, fears and worries of not just students, but the echoing words of faculty and staff. They identified four immediate actions to foster an environment supportive of Black and underrepresented minorities in medicine.

Among the steps was mandating an anti-racism training program; implementing a new policy to address racism and discrimination from patients and visitors at UC San Diego Health hospitals and clinics; hiring leaders in equity, diversity and inclusion for UC San Diego Health Sciences and the health system; and the creation of an Anti-Racism Task Force.

Because of her leadership roles in regional and national student organizations and her commitment to equity, UC San Diego Health CEO Patty Maysent hired Asmerom as a project consultant on anti-racism initiatives for the health system. Among Asmerom's proudest achievements as a consultant is her role on the COVID-19 vaccine committee. UC San Diego Health collaborated with community-based organizations to deploy mobile vaccine clinics into the San Diego communities most impacted by COVID-19 in order to reach more patients more effectively, and help ease barriers, such as access, lack of transportation to vaccine appointment sites and distrust in health care providers outside of local communities. "Being able to help with equitable vaccine distribution, and doing it in a

Coming together: Medical students, faculty, staff and leadership gather in support of the Black Lives Matter movement and to call attention to systemic

way that intentionally centers on the needs of minoritized communities, represents the kind of care I want to provide as a physician, and I get to do it while still in medical school. I see the impact on communities that look like me. I see the gratitude on their faces. I get to use these platforms to ensure that my community is taken care of in a meaningful way," said Asmerom.

"I hope that this momentum is not lost, that we continue to center equity and talk about racism in a really honest and authentic way so that we continue to make strides toward making UC San Diego, the medical school, the health system and the country a more equitable place for Black, Indigenous, Latinx and other minoritized groups. We cannot fall back into a pattern of ignoring the people who are the most marginalized and hurt by inequitable systems." •

## THE PANDEMIC TEMPORARILY CLOSED CAMPUS, BUT OPENED **OPPORTUNITIES AND MINDS**

A Q&A with James C. Nieh, PhD, professor of biological sciences, and graduate student Sumedha Ravishankar

### **BY SCOTT LAFEE**

### How did your roles as teacher and student change during the pandemic?

NIEH: Moving to fully remote education was challenging, especially during spring quarter 2020, when everyone was embarking on this experiment, and there were many aspects that we were unsure about. For many years, I have created video podcasts for my Animal Behavior course (BIEB 166). All notes, lectures slides, lecture readings and exercises were also available online. Thus, my biggest change was to only interact with students via Zoom and to give online exams.

RAVISHANKAR: As PhD students, our lives revolve around our lab experiments. When the world went remote, I lost a core component of my livelihood. Unlike many of my friends, I couldn't work from home in the same way they could. I couldn't bring my bacteria or zebrafish home (that's a MAJOR safety violation!). When we got the news that California was going into lockdown, I remember going into the lab for the last time to clean up and throw away bacterial cultures, effectively halting months of research. My role as a graduate student went from a full-time laboratory researcher to a work-fromhome scientist.

At first, I didn't even really know what a work-from-home scientist looked like. I went from doing hours of infection research and imaging per day to zero. I used my time at home to read, write and do further analyses

on my existing data. I was able to take a deep dive into the literature to get a better understanding of the state of the field, and how my work could further it. I was also able to write my thesis proposal and focus on developing a plan for the next four (or five, or six) years of my PhD program. Instead of working on developing my research skills, I was able to hone my writing, public speaking and experimental design skills. Around June 2020, we were able to re-enter the lab and resume research part-time. Now, I try to ensure I make enough time for both in-person research and at-home reading and writing, as both are essential to being a successful scientist.

### What were your biggest concerns at the beginning of the pandemic when the campus closed and education went remote?

NIEH: I was not sure how the systems would handle the internet load of essentially all students in the United States going remote at the same time. There were concerns about our Canvas software crashing, and about the local networks at UC San Diego. I tried to prepare for this with multiple backups, mirroring all course materials and lectures onto separate cloud servers approved by the campus. However, this was only needed for a few days, and everything else went quite smoothly, a remarkable achievement for the campus and its hardworking staff.

My second concern revolved around how the instructional assistants (IA)

and I could provide equitable access for students in multiple, different time zones. How could we ensure that everyone could attend office hours and sections? We were fortunate to have several IAs and came up with a system to accommodate students who were at home across the globe.

RAVISHANKAR: The severity of the pandemic became abundantly clear the day UC San Diego shut down. Thousands of students. myself included, were left uncertain about how they would graduate or continue with school, or when they'd next see their friends. My main concern was for my safety, and the safety of my peers. I was terrified to be around other people and out in public. But my anxiety over graduate school was constantly nagging at me. Would I still be on track to finish graduate school? What would happen to my research that was already in progress? So much of my scientific development comes from discussing science with others and learning from my colleagues. I work in an open lab space with five other labs, where collaboration occurs daily. This synergistic environment was gone, and I felt isolated. In terms of my education, I was primarily concerned with falling behind, losing the precious time I had to make discoveries in the lab, and missing out on working with my fellow graduate students. Remote learning can only go so far, especially when the majority of what I needed to do had to be in person.

"At the end of spring quarter 2020, we saw a huge increase in student stress as they grappled with the important issues brought up by the racial justice movements around the country."

### -JAMES C. NIEH, PHD

How did your expectations of teaching and student performance change? Was the school year better. worse or about the same? NIEH: At the end of spring quarter 2020, we saw a huge increase in student stress as they grappled with the important issues brought up by the racial justice movements around the country. Because of the pandemic, my expectations had already shifted to focus more upon what students were able to achieve and learn, given the pandemic. I think the concept of advancement within opportunity, evaluating what individuals are able to achieve and thinking more broadly about what constitutes achievement, was very helpful. Essentially, having honest conversations with students about learning and grading is necessary. For example, like many other instructors, I adopted a "no fault" final exam policy in which students could raise their grades via the final, without penalizing them.

I think that it will take time to better understand the impact on learning, but I hope that shifting the focus away from grades toward learning through opportunities gave students the breathing space they needed during this difficult time.

RAVISHANKAR: UC San Diego shut down in March of 2020. I started my PhD program in September 2018, so I was just wrapping up my second year and my first year in my thesis lab. I was just getting ready to begin conducting

research in earnest, after having found my bearings in the lab. I had pretty high expectations for the year, and was hoping to make significant progress in mv research.

However, after the school shut down, I was forced to take a step back from lab work. I had no idea what the timetable for our return to the lab would be, and watching the cases exponentially increase, it seemed like we were in the pandemic for the long haul. Around this time, there was a resurgence of civil rights advocacy and awareness, galvanized by the brutal murder of George Floyd. Re-energized, I shifted my focus to science outreach



Changing courses: James Nieh, PhD, is a professor of biological sciences and associate dean in the Department of Biological Sciences.

and co-founded an organization that is geared toward increasing underrepresented minority retention in STEM (Science, Technology, Engineering and Math) and creating a safe community for our minority students.

Along with my fellow graduate student, Tara Spencer, and biological sciences faculty member Dr. Sonya Neal, we co-founded the Biology Undergraduate and Master's Mentorship Program (BUMMP). Our primary aim is to ensure that our undergraduate and master's students at UC San Diego, who are underrepresented in science, are reminded that they belong in STEM by providing them



**Life lessons: Sumedha Ravhishankar** is a fourth-year PhD student studying bacterial infections that affect the nervous system.

with a scientific mentor and funding to do research. I am so thankful for the amazing work we've been able to accomplish with BUMMP. We have raised more than \$150,000 to award scholarships for our undergraduate and master's students. This year ended up being far more successful than I had anticipated when the pandemic began.

### What would you do differently if you had to do 2020 all over again?

NIEH: I think I would have taken a more relaxed approach. I wanted everything to work out and so we spent a lot of time and energy creating backups and worrying about online exams and how to ensure that students could learn and perform in the same way as they did in person. In retrospect, this was not a realistic expectation. Given the pandemic and the racial reckoning, it now seems that I should have relaxed a bit and dedicated that extra time and energy to conversations with students, including how events outside of the classroom were affecting their lives. The mantra "keep calm and carry on" perhaps should have shifted to "keep calm and carry on, but recognize that that this is a very difficult time and the same expectations cannot apply."

### Was there any particular moment/ conversation/event from the pandemic that you think will stick in your mind forever?

NIEH: For me, there was no striking moment. But I will always remember the first few weeks of class when everyone was still adjusting to this new Zoom world. There were a lot of blank screens in the beginning and reluctance to talk. Students mainly texted questions. But in the third to fourth week, this began to break down and students actually showed their videos and asked questions in person a wonderful small step forward!

RAVISHANKAR: The week before we went into lockdown, my lab mate and I were talking about all the news articles that were circulating about a flu-like infection that was taking over China. There was so much information that we really didn't know what to believe. We were in our lunchroom, eating and chatting, talking about how we thought people were overreacting and that it was just like the flu — no big deal. The next night, we were with a few friends for our weekly *The Bachelor* (the TV show) viewing night. We suddenly got a notification that the NBA was stopping its season. That's when we realized that we were about to live through a historic event. The following Monday, UC San Diego went into lockdown and our labs shut down. I will never forget the pure confusion, fear and hopelessness that I felt. A little over a year later, we've made it through, but that moment still feels fresh.

### What changes do you hope will continue beyond the pandemic?

NIEH: Multiple aspects of remote learning are here to stay. I think that many more instructors will now feel more comfortable about video podcasting, putting their lecture materials online and generally increasing access. There are small but significant changes that will help students. For example, several students have told me that automatic, closed captioning of video-recorded lectures was very helpful. I hope that most instructors will adopt this for the future. Open-book exams and writing tests that evaluate knowledge, not only memorization, are also important legacies of the pandemic.

RAVISHANKAR: This year was tough for so many, with countless lives lost and a lack of much-needed human interaction. Despite that, there were positives to come out of the pandemic that I hope we continue to see in the future. There was an emphasis on mental health for graduate students this year, and I hope we continue to prioritize our well-being above our daily grind. Additionally, having meetings on Zoom allowed me to attend more seminars than I would have before the pandemic. Scientists from all over the world were able to give talks that anyone could join. I hope we continue to use Zoom as a platform for various meetings and conferences to encourage greater attendance. Finally, I hope we all continue to wash our hands and practice clean habits! I haven't gotten sick in over a year, so I hope we maintain this level of mindfulness.



**PROOF IS IN THE POOPING:** When early evidence emerged that people with COVID-19 – whether or not they have symptoms – shed the virus in their stool, UC San Diego researchers quickly got to work, screening wastewater from campus buildings for signs of the virus, thinking the information could act as an early alert to help prevent outbreaks. Now they have data to back it up: The team showed they can detect even a single infected, asymptomatic person living or working in a building of more than 500 people. Notification to occupants of each building with positive wastewater increases COVID-19 testing rates by as much as 13-fold. Once an occupant tests positive, isolation and contact tracing helps prevent further spread of the virus. The approach, part of the university's Return to Learn COVID safety plan, has enabled early detection of 85 percent of COVID-19 cases on the campus, researchers reported August 10, 2021 in *mSystems*. The team now monitors 350 buildings daily. *Pictured above: Wastewater screening leaders* **Smruthi Karthikeyan, PhD**, postdoctoral researcher (left), and **Rob Knight, PhD**, professor and director of the Center for Microbiome Innovation at UC San Diego, pick up a sample from a campus collection point on Thanksgiving Day 2020.

## MAKING HOUSE CALLS **DURING A PANDEMIC**

Public health has never been more important

**BY YADIRA GALINDO** 

WHEN COVID-19 VACCINES first became publicly available, demand overwhelmed supply, prompting urgent, even desperate, online searches for scarce appointments, followed by long lines and hours of waiting at super stations and clinics.

But after the initial, eager throngs had bared their deltoid muscles to needles inoculating them against the SARS-CoV-2 virus, crowds thinned and in time super stations - temporary facilities erected to vaccinate large numbers of persons quickly and safely - were closed.

Hundreds of millions of Americans have received at least one dose of vaccine. Roughly half of the nation's population has been fully vaccinated. But early data also exposes a stark truth: Underrepresented groups in the United States are bearing a disproportionate number of COVID-19 cases and deaths and are accessing vaccines at much lower rates.

"There is no genetic predisposition to COVID-19. People of color are severely impacted because of social determinants of health and disparities that have not been addressed," said Argentina Servin, MD, MPH, assistant professor in the Division of Infectious Diseases and Global Public Health at UC San Diego School of Medicine. "In a high-income country, like the U.S., we should not see these disparities and gaps."

After watching friends and family suffer, and nearly losing her 80-yearold grandfather, Servin applied for and received a \$3 million grant from the National Institute on Minority Health and Health Disparities, part

of the National Institutes of Health, to design a program to increase outreach, access and use of COVID-19 vaccines among Latino and Black communities in six of San Diego's most heavily affected neighborhoods.

Dubbed "Project 2VIDA!," Servin and colleagues formed an intervention working group comprised of representatives from community and academic organizations to address challenges in the communities of San Ysidro, Chula Vista, National City, Logan Heights, Lincoln Park and Valencia Park.

The approach was based on community-based participatory research. Rather than sit behind computers, the team donned their most comfortable walking shoes and canvassed homes and greeted patrons at cafés, grocery stores and other local businesses, engaging residents with questions related to vaccine hesitancy, addressing widespread misinformation and encouraging them to be vaccinated at one of the Project 2VIDA! mobile vaccine units or with its collaborator San Ysidro Health.

But public confidence in vaccination is fragile, especially among communities long suspicious about historical or institutional motivations. Servin said Project 2VIDA! is fighting an uphill battle against myths. Individuals say they do not want to be immunized for fear that the vaccines carry microchips that track their movements. They fear vaccine-induced infertility or safety due to a "rushed" launch. These misconceptions are all false, yet unfortunately common, experts say.

"We have to remind community members that vaccines have helped save millions of lives. Just a few generations ago, people lived under the constant threat of deadly infectious diseases, like smallpox, polio, hepatitis and the flu," said Adriana Bearse, promotion manager in the San Ysidro Health Research and Health Promotion Department. Because the COVID-19 vaccine is an important part of stopping the pandemic, Servin said Project 2VIDA! seeks to implement and assess a COVID-19 vaccination protocol and establish a model for the rapid vaccination of Latino and Black adults that can be implemented in other impacted communities.

**Beyond community borders** 

SINCE NO VIRUS recognizes borders, the binational region comprised of San Diego and Baja California, Mexico is significantly impacted by the pandemic.

Linda Hill, MD, MPH, professor and interim assistant dean for Community Border Health Partnerships in The Herbert Wertheim School of Public Health and Human Longevity Science at UC San Diego, has spent most of her career addressing the public health needs of migrant workers, immigrants and refugees.

In late-2018, Hill began supporting government agencies with health screenings for asylum seekers entering the U.S., using a congregate sheltering model. At the time, she and a team of community and UC San Diego Health doctors were treating infectious diseases, such as scabies, chicken pox and influenza, but nothing as severe as COVID-19.

Since starting the asylum program in 2021, qualifying persons are now housed in hotel rooms to reduce the risk of contracting and spreading COVID-19.

Hill and her team of community health workers and medical providers screen for COVID-19 and conduct house calls for approximately 250 guests per day, checking on pregnant women, providing hypertension



Reaching out: The goal wasn't just to boost vaccination rates, but to understand why those rates were low

medicine and other medications, and caring for acute illnesses. The team has been working seven

days a week since March 1, 2021. It's a labor of love made up of a community of students from UC San Diego, San Diego State University and University of San Diego; community health workers; medical residents from UC San Diego Health, Kaiser Health and Scripps Health; and clinicians from UC San Diego Health

"With 200 arrivals a day, and the challenges of travelers in a pandemic, in no time at all you have 600 people under your care," said Hill.

and the community.

But Hill said the long hours are worth it, with the added bonus of having trainee participation.

"We are building future public health professionals who will understand and care for displaced populations, who will be committed to providing culturally competent care and who will

address diversity and equity," she said. Hill has also been involved in projects managing the impact of COVID-19 on vulnerable populations in Mexico. Early in the pandemic, the Mexican border town of Tijuana was devastated by severe cases of COVID-19 and local hospitals experienced shortages of personal protective equipment for health care providers treating critically ill patients. UC San Diego Health formed Aliados *por Salud*, a volunteer team of critical care doctors, nurses and respiratory therapists who collaborated daily with counterparts at Tijuana General Hospital to combine their knowledge and experience on how best to treat patients diagnosed with COVID-19. For six months, the two hospital systems worked and learned together to manage severe cases and to secure donations of masks, face shields, goggles, pulse oximetry units and other supplies for Tijuana General Hospital.

In 2021, Hill and other UC San Diego colleagues, including Timothy Rodwell, MD, PhD, MPH; Richard Garfein, PhD, MPH; and Steffanie Strathdee, PhD, joined the Consulate General of Mexico in San Diego and various health agencies and universities in Baja California to conduct a survey of the prevalence of COVID-19 in the Mexican cities of Tijuana, Mexicali and Ensenada.

"This project is an example of binational cooperation and collaboration – government, academia and non-governmental organizations coming together to design public policies for the prevention, management and eventual eradication of COVID-19," said Hill.

"Working directly in the communities most affected by disease or illness allows us to find innovative solutions that address unique challenges and have the greatest impact where it is needed most." •

## TALES IN and OUT of SCHOOL

During the pandemic, innovation and adaptability became virtual realities

**BY YADIRA GALINDO** 

IN MARCH 2020, rumors and uncertainty plagued Betial Asmeron, then a third-yearstudent at UC San Diego School of Medicine who was, by nature, optimistic and assured. With three classmates, Asmeron now crowded anxiously around a computer monitor to watch a virtual town hall in which school leadership would reveal how their education would be impacted by COVID-19 and the growing pandemic.

Prior to the pandemic, Asmerom's routine was the same, day in and out: Wearing hospital scrubs and coffee in hand, she would arrive at 5 a.m. for a rotation at UC San Diego Health to check on the welfare of patients under her watch.

"As medical students, we have the gift of time in the hospital. We get to know our patients on a deeper level, which allows us to better help with their medical and emotional needs," said Asmerom.

With consent from patients and under the supervision of resident and attending physicians, third-year medical students interview and examine patients, write notes in their electronic medical records, present findings to their team for review and are part of hands-on care, such as surgery or labor and delivery.

After a full day in the hospital, Asmerom would return home by 7 p.m. for a late night of studying for shelf exams — national standardized exams that evaluate competency over each core rotation or clerkship — before repeating the routine the next day.





Pursuing both medical and doctoral degrees, **Betial Asmerom** also found time to play key roles in multiple community health outreach efforts.

## UCSan Diego Health

### **Time Stands Still**

ASMEROM WAS BEGINNING a six-week rotation in obstetrics and gynecology (OBGYN) when the pandemic struck with full force. The world shuddered, and then shuttered. Everything and everybody seemed to shut down and withdraw behind closed doors, except where she worked.

As a provider of essential services, UC San Diego Health opened its doors wider.

One of the first hospitals in the United States to care for patients sickened by SARS-CoV-2, UC San Diego Health's infectious disease experts recognized the expanding pandemic that would require all available hands to care for the millions of people who would eventually become infected and the millions more who would die. close to home or far away.

"We pursued medicine because we wanted to help people, and even though we knew

that there was some risk to our own health by being in the wards, we really wanted to be there," said Asmerom.

She and her classmates eagerly offered to become contact tracers, to serve as symptom checkers or help patients sign up for the MyUCSDChart electronic patient portal that would allow access to telehealth visits. They wanted to do anything and everything to help during the crisis and to continue their education.

But there were immediate challenges: A worldwide shortage of personal protective equipment (PPE), such as mask-respirators, gloves, gowns and face shields, meant that some hospital workers would necessarily be shifted to telework, where PPE was not needed.

School of Medicine leaders were forced to make a difficult decision: Are medical students essential on site or should they be learning safely from home?

### Wuhan to WELCOME (above):

UC San Diego Medical Center in Hillcrest was among the first hospitals in the nation to provide care to patients with COVID-19, notably evacuees from China.

### Pictured right:

Steven Garfin, MD, interim dean of UC San Diego School of Medicine. Below, Stephanie Jed, PhD, professor of literature, works at a community farm. During the pandemic, farm visits became virtual.

### "For the safety of our faculty and students, and to ensure our students had a way forward through this difficult time, we made tremendous changes over a very short period of time in a highly collaborative way."

- CARLOS JENSEN, PHD

Standing before the computer monitor, a "A hurricane is devastating. The residual And just like that, Asmerom's cherished

practice that would soon become very familiar, Asmerom and her classmates heard their fate echoing over the speakers. Rotations or clerkships were indefinitely suspended. is terrible, but it sweeps through and it is over. There is a finite period when things turn around with enough resources, but with this pandemic, we had no clue when it was going to let up. If it would let up," said Steven Garfin, MD, interim dean of UC San Diego School of Medicine. time and connectedness with patients vanished, like a leaf in a hurricane.

### Virtual Classrooms

ALL LEVELS OF EDUCATION - from elementary schools to universities – found themselves grappling with unprecedented challenges posed by a highly contagious virus that did not discriminate by age, gender, ethnicity or even health status.

Once lively campuses emptied as schools UC San Diego faculty, program directors, "For the safety of our faculty and students,

and districts took early or extended spring breaks to plan for online instruction and to implement safety protocols to bring staff and students back, when it was safe to come back. course directors and information services scoured online resources to build and shift to virtual learning on a campus-wide scale. and to ensure our students had a way forward through this difficult time, we made tremendous changes over a very short period of time in a highly collaborative way," said Associate Vice Chancellor for Educational Innovation

Carlos Jensen, PhD.

"The way that administration, faculty and senate came together, because it was the right thing to do, is a tremendous testament to the kind of community that we are. We've shown that we can really change education if we want to."

For example, the Division of Arts and Humanities quickly flipped its campusbased, 12-week transfer student Summer Academy to online only. The Preparing Accomplished Transfers to the Humanities partnership with the San Diego Community College District provides hands-on resources for students to succeed at the university, as well as two full academic courses.

For the class "Politics of Food: Justice, Diversity, Community," led by Stephanie Jed, PhD, a professor in the Department of Literature, students would normally visit multiple community farms together. For the virtual class, students instead received a produce delivery from a San Diego-based Community Supported Agriculture (CSA) program, and seeds, soil and a planter box to grow their own vegetables at home. The program staff organized an online discussion about community gardens and food deserts and cook nights to help create bonds among the students.

Bioengineering students at UC San Diego Jacobs School of Engineering completed senior design projects. They used many strategies, including creative use of Zoom for collaborative brainstorming and design; a focus on regular, precise communication with project sponsors and clients; off-campus, socially distanced outdoor work meetings; and limited use of labs following safety protocols. And, in a nod to the old days, they mailed parts and prototypes to each other.

Faculty members tapped into a wealth of resources available through the Teaching + Learning Commons. It became an important source of support for faculty, instructors, graduate instructional assistants and students. The Commons created an integrated approach that ensured educators had the tools they needed to keep teaching through partnerships with Educational Technology Services, the Library, Academic Integrity Office, Campus Privacy Office and others.

### **Unique Challenges**

"DEALING WITH A NEW ORGANISM is the greatest challenge," said Maria Savoia, MD, an infectious disease expert and dean of medical education at UC San Diego.

Savoia could have been talking about the novel coronavirus, which was previously unknown, but her words applied as well to teaching medical students during a pandemic.

"We did not know exactly how people would react. There were challenges and worry over access to personal protective equipment in the clinical arena. No one knew where we would end up, and what we saw happening in Italy was worrisome. People were afraid for their patients, afraid for themselves. And everything was changing almost every single day," said Savoia.

Medical school is a minimum of four highly structured years of classes, myriad exams and countless hours of clinical experience that must be completed in a specific sequence and time.

During the first two years, students spend most of their time in classrooms. The third and fourth years are devoted to applying in a clinical setting what they previously learned. Going virtual meant trying to train medical students without access to clinics.

"We pivoted from in-person learning, where we work together in teams and take care of patients in the clinic, to deciding what could be virtual for effective student instruction. We had to implement the strategy as best we could on virtual platforms over the course of a couple of days," said Savoia.

Julia Cormano, MD, assistant professor in the Department of Obstetrics, Gynecology and Reproductive Sciences and director of the Third Year Medical Student Clerkship, said medical school scheduling can be unforgiving, especially in the third year.

Third-year medical school students are required to learn in-person rotations in seven specialties - internal medicine, family medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry and neurology - before progressing to their final year and earning their medical degree.

"It was also a big pivot for physicians. We were trying to figure out very quickly how to do remote clinical visits ourselves. We realized there were a number of different ways we could include students in this sudden increase in telehealth, including pre-interviewing the patient and observing," said Cormano.

Case in point: A hospitalist stepped back from the clinical setting and spent his days rounding virtually with students in the OBGYN rotation. Students were able to review patient charts, interpret fetal heart-tracing data and speak with the hospitalist in real time.

"It was essentially transferring what we would do on the wards to our house, with the added luxury of having an uninterrupted hour of the physician's time. Something like that never happens in the hospital. I probablv learned more pathophysiology doing this at-home rotation," said Asmerom.

"Still, it's not the same as being in the hospital and being with patients and I think that was the part we really yearned for. We wanted to be able to see our patients, interact with them, and really just feel like we were making some sort of impact or difference in their lives and in their care."

In addition to the unique challenges of medical school, faculty and students across the entire campus were faced with a lack of at-home workspace or proper equipment. Some found that having multiple people working or studying from home affected their bandwidth and therefore their productivity.

"We tried hard to mitigate that by giving people resources as much as we could. I think the university was very good about trying to help and we opened up spaces for students to be able to find a quiet space to learn and to study," said Savoia. "Everyone came together faculty, staff and students - to make the most of a very difficult situation."

House rules: To reduce exposure risk, on-campus housing density was reduced, frequent testing required and buildings' wastewa ter screened for indicators of positive cases.



"We wanted to be able to see our patients, interact with them, and really just feel like we were making some sort of impact or difference in their lives and in their care."

- BETIAL ASMEROM



### Return to Learn

CAMPUS-WIDE VIRTUAL INSTRUCTION was never intended to be long-term or permanent at UC San Diego. From day one, a multidisciplinary team of leaders began formulating a plan to safely welcome back students, faculty and staff.

Through its transformative, adaptive and multilayered Return to Learn plan, which launched in May 2020, the university was able to bring students back to campus in a safe and strategic manner.

Among the first to return were medical students.

"None of the national requirements or dates changed so we could not select 10 students to come back. The whole class had to follow a pattern to get into the next year's program. There is just no way to catch up in medical school without losing potentially a whole year," said Garfin.

Guided by risk mitigation, virus detection and intervention, Return to Learn kept positive case rates low compared to regional and national case rates. UC San Diego maintained a median campus-wide infection positivity rate of 0.28 percent throughout the fall 2020 quarter, while San Diego County's median was 8.1 percent.

Return to Learn subsequently served as a model of best practices for other institutions and K-12 school systems regionally and nationally. The plan received the 2021 American Council of Education/Fidelity Investments Award for Institutional Transformation.

"We see students as being integral parts of medical teams. So we wanted to introduce them back into the clinic as soon as we could, and we did that safely," said Savoia.

"In addition, we did a lot of hands-on training in the Simulation Training Center. We broke classes into much smaller groups and had students mask and take COVID-19 tests. Many of our anatomy professors and the people in the simulation lab thought that the educational experience was better in smaller groups because it was more one-on-one."

The number of students returning to campus increased with each subsequent quarter. With access to COVID-19 vaccines for faculty, staff and students, as well as continued mitigation and virus detection

efforts, the plan is to return to full, oncampus operations for fall 2021.

Teaching is primarily delivered through in-person instruction in campus classrooms. Appropriate remote learning options are available for students who are unable to arrive from abroad due to visa delays or travel restrictions.

### A School Tested

shelter-in-place ordinances began in March 2020. It took approximately six weeks for medical students to return to clinics and hospitals and yet seniors still needed to complete rotations in order to graduate in May.

While medical students were ready, patients were not.

It took a while for hospitals to have the resources to return to regular operations, but it took patients even longer to feel comfortable resuming routine screenings and active health care, affecting some clerkships and residency programs.

"We worked to find the right spots for students who still had requirements that needed to be met so that they could meet their graduation requirements. This necessitated adaptability and a lot of individual work with students. For example, surgeons who could not be in the operating room instead helped in the intensive care units putting in central lines to help their overworked colleagues," said Savoia.

In the end, all students passed their tests and met the requirements to move on to the next stage in their medical education or career.

"Given the situation and how many unknowns there were, I think we adequately prepared students to be able to have the clinical information that they needed to move forward to their fourth year and to their future careers. Their test scores reflected that readiness," said Cormano.

Charley Coffey, MD, associate professor in the Department of Surgery, who published three papers on student perspectives of remote learning during the pandemic, said that although first- and second-year students spend minimal time in clinics, they too felt the loss of clinical interactions.

"For many students, working with patients is one of the most gratifying things that they do. It is one of the things that keeps them motivated through sitting in lecture halls for hours and years on end," said Coffey, co-director of the Third Year Surgery Clerkship.

"There were very creative and innovative things done to involve students in telemedicine and to rounding remotely on the surgical floor and labor and delivery floor. Those were things that students responded well to, ways to reconnect with those aspects of patient care that were so easily lost when we shifted to remote learning modalities."

Students did appreciate the flexibility of learning at their own pace and working virtually in smaller groups, said Coffey. However, digital fatigue set in after one hour.

"It is nearly as easy for a professor to stand up in front of a lecture hall of students as it is to stand in front of a computer and similarly for students to be able to just sit in front of their computer. On the other hand, when it came to anatomic dissections, it is impossible to do that without being in person. It is nearly impossible to replicate during an overnight transition to remote learning and it is among the things that preclinical students missed most," said Coffey.

Fellows are physicians who have already completed their residency and are now in specialty training. Because fellowships are entirely dependent on caring for patients, fellows were dramatically impacted during the pandemic. Thankfully, by this point in their training most fellows had met the required number of surgeries.

"The concern that many trainees had at that time was how they would transition into the working world. A lot of the hiring, or the interviewing process, or both, were put on hold due to the pandemic," said Coffey.

### Lessons Learned

PRIOR TO THE PANDEMIC, Some lectures were available virtually. COVID-19 forced the entire campus, from dance instruction to chemistry labs, to find alternative instruction options.

"We have learned a lot about how diverse our student population is, and their diverse needs, and how some of the small changes that we make in the classroom have a tremendous impact on student well-being,





Challenges met: Maria Savoia, MD, dean of medical education, said everything about teaching during the pandemic was new.

Charley Coffey, MD, published three papers on student perspectives about remote learning





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success and retention. We have learned to become comfortable with remote and hybrid teaching in a way that we were not before and it has made us think differently about classes." said Jensen.

"This post-pandemic period is going to be an exciting time when we start thinking about what are the right pedagogical tools. It forced faculty to challenge their assumptions and learn new skills. I wish we could have learned these skills under better circumstances, but I think we need to take the good that has come out of this and take that forward. They are valuable skills." For the School of Medicine, small groups for hands-on learning has been one of the most touted changes by students and faculty alike. Cormano recognizes that less time in the labor and delivery ward may actually be a more productive and immersive experience if it allows for individualized teaching. "I think one of the real take-homes for educators is to be critical in determining the modalities and the resources that are going to be most useful to students. How do we make those accessible, digestible and useful for student learning without just throwing a lot of information at them? Part of that

Asmerom is in her fourth year of medical school after taking a year to pursue a master's degree in public health.

comes with experience and listening to what students said worked and what did not."

For Asmerom, who will start her fourth year of medical school in the fall after taking a year to pursue a master's degree in public health as part of the UC San Diego School of Medicine Program in Medical Education - Health Equity program, remote learning was an effective experience. Still, she is not advocating to make medical school virtual.

"Remote learning is not how you learn to be a doctor. It's really like an apprenticeship model where you have to go there in person, work with patients, residents and attendings, review labs, and develop your differentials. You have to do it over and over again in order to cultivate your clinical decision-making skills. You can't do that very well from home," said Asmerom.

"And I really missed seeing and interacting with patients, meeting their families and being able to bear witness to some of their hardest moments or laugh with them. Relationships are the heart of medicine and I really craved and missed that when we switched to remote learning. And, of course, I missed morning burritos from the Hillcrest cafeteria." •





## WHAT ----WE SAID

Selected excerpts from commentaries, perspectives, op-eds and Q&As by UC San Diego leaders, faculty and students





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learning opportunities. Highly infectious viruses in a connected the onset."

DAVID PRIDE, MD, PhD, associate director of microbiology, UC San Diego School of Medicine The Conversation | March 16, 2020





Commentary: Amid the coronavirus outbreak, San Diego medical professor explains why staying home is essential

"You and your children are not immune to coronavirus. I still see too many cavalier friends and acquaintances who think this is hysteria and pandemonium, and are not doing what is right for humanity. The novel coronavirus (SARS-CoV-2), which causes a disease called COVID-19, is 'novel' because it has never existed in people before. Since people have never been infected by this virus before, nobody is immune and we don't yet have a vaccine. Thus, everyone can be infected, everyone can get sick and everyone can spread

ROBERT A.J. SIGNER, PhD, assistant professor of medicine, UC San Diego School of Medicine The San Diego Union-Tribune | March 16, 2020

### On the front lines of developing a test

"There's a lot of negatives to find in the response to the coronavirus outbreak, but the flaws in the response represent world won't stay contained for long. Our assumption should have been that it would make it to the U.S. from



### **Commentary: How UCSD Health is** rising to the coronavirus challenge

"No hospital is immune from the coronavirus outbreak that is starting to stress the nation's health care system, and all are taking every possible measure to address the urgent needs and concerns of patients and communities. But in very important ways, UC San Diego Health is different than most health care providers. Underlying the phrase 'academic medical center' are three essential and enduring missions: Outstanding patient care through commitment to the community, groundbreaking research and inspired teaching of new generations of physicians and health care providers." PATRICIA MAYSENT, CEO, UC San Diego Health The San Diego Union-Tribune | March 26, 2020

### **Opinion: Pandemics come and go, but** the mental harms tend to linger

"Past pandemics of this magnitude produced significant evidence of lingering neuropsychiatric harm, but they were also decades or centuries ago and the epidemiological tools required to accurately measure and assess their effects were not strong, or even existent. Our tools are better

today; and our concerns larger. This pandemic will end, but critical work in the global biomedical community is just beginning. We need to launch longitudinal monitoring of neuropsychiatric symptoms and neuroimmune status in persons exposed to SARS-CoV-2, not just in the immediate aftermath but across the course of life. including *in utero*. throughout childhood development, adulthood and advanced age." SUZI HONG, PhD, associate professor, Herbert Wertheim School of Public Health and Human Longevity Times of San Diego | April 28, 2020

### **Return to Learn**

"Our strategic approach to masking, physical distancing, daily screening, regular asymptomatic testing, wastewater testing, contact notification, and isolation and care for positive cases has been successful. We envision a "Swiss Cheese Model," where each slice of cheese represents a layer of protection. While one slice may contain small holes, taken together with other slices, the result is a solid block of cheese, or in this case a block of protection against the virus." PRADEEP K. KHOSLA, Chancellor, UC San Diego The San Diego Union-Tribune | August 11, 2021

### Commentary: At UCSD, feedback on remote learning is mixed. Here's how we'll address that.

"At UC San Diego, our faculty swiftly moved all classes to remote settings. We adapted our research and work activities so that the vast majority of faculty and staff could work from home. Our doctors and clinicians adopted telehealth technologies to continue providing health care remotely to our patients. The public health crisis forced us to innovate nearly all aspects of our enterprise. The questions we face now: How do these innovations affect us moving forward? How much of what we have learned will become part of a 'new normal'? How will we decide what to keep and what to reject?" PRADEEP K. KHOSLA. Chancellor, UC San Diego The San Diego Union-Tribune | June 17, 2020



### Reducing transmission of SARS-CoV-2

"Aerosol transmission of viruses must be acknowledged as a key factor leading to the spread of infectious respiratory diseases. Evidence suggests that SARS-CoV-2 is silently spreading in aerosols exhaled by highly contagious infected individuals with no symptoms." KIMBERLY A. PRATHER, PhD, Scripps Institution of Oceanography; CHIA C. WANG, PhD, National Sun Yat-sen University (Taiwan); and ROBERT SCHOOLEY, MD, UC San Diego School of Medicine Science | June 26, 2020

Commentary: Italy has turned the corner on COVID-19. The U.S. can still learn from it.

"The only universal constant has been universal inconstancy. Without a singular source of information and guidance founded upon sound science and prevailing public health practices, Americans are buffeted by mixed messages, misinformation and confusion." NANCY BINKIN, PhD, Professor of epidemiology, Herbert Wertheim School of Public Health and Longevity Science The San Diego Union-Tribune | Aug. 27, 2020

*"People get allergic* reactions to influenza vaccines and other vaccines. So it's not beyond the realm of possibility as a rare event. When drugs and vaccines are approved, the approval process isn't that there will never be a side effect. The process is around whether or not the net benefit justifies those risks." -ROBERT SCHOOLEY, MD

### Commentary: I'm a doctor who had COVID-19. A vaccine will help you eventually. A mask will help you now.

"We know the mantra by heart: Wear a mask. Keep social distance. Wash your hands. Repeat. I am a pulmonary and critical care doctor at a busy intensive care unit (ICU) of an academic medical center. The mantra pervades my life, inside the hospital and out. Here is why I never stop listening: I've had COVID-19." ALEXANDRA ROSE, MD, UC San Diego Health The San Diego Union-Tribune | Nov. 25, 2020

### Q&A: An FDA panel endorsed Moderna's COVID vaccine. One UCSD panelist explains why

"People get allergic reactions to influenza vaccines and other vaccines. So it's not beyond the realm of possibility as a rare event. When drugs and vaccines are approved, the approval process isn't that there will never be a side effect. The process is around whether or not the net benefit justifies those risks." ROBERT SCHOOLEY, MD, professor of

medicine, UC San Diego School of Medicine The San Diego Union-Tribune | Dec. 18, 2020



"Efforts must shift to prioritizing the rapid identification of cases among those who have symptoms or have known exposures, so they can be isolated and treated if positive. The focus needs to be on making sure that those who have positive tests are quickly informed and appropriate actions taken to prevent further spread of the disease, with contact tracing performed only for cases with a high risk of spread to multiple individuals. Finally, but no less importantly, we must reimagine the public health messages about facial coverings and distancing so that they resonate in a time when we are grappling with frustration and fatigue." CHERYL A.M. ANDERSON, PHD, MPH dean of the Herbert Wertheim School of Public Health and Human Longevity at UC San Diego and HALA MADANAT, PhD, Interim Vice President for Research and Innovation at San Diego State University The San Diego Union-Tribune | Jan. 7, 2021



### Commentary: Health experts and other San Diego leaders must unite to better coordinate pandemic response

### Commentary: I've seen so much as an ER nurse. Getting the COVID-19 vaccine brought me to tears

"When I was asked to be first to get the vaccine at UC San Diego Health, I jumped at the chance. The idea of getting vaccinated was exciting and brings the start to the end of this nightmare. The moment I was vaccinated made me very emotional. The feelings and struggles that have brought us to this point became overwhelming and brought me to tears. It was a sense of relief, and it felt like I could finally take a breath, while taking the first steps toward ending this disaster."

BRIANNA SALAS, RN, UC San Diego Health The San Diego Union-Tribune | Jan. 7, 2021



### EDUCATION

"I don't think we're at the end. but we're at a place where we can see where this is going. *I'm optimistic that, through* vaccines, we can manage this virus in the coming years... *I think we'll be living* alongside it, but in a manageable way that will allow us to reopen society and resume some amount of normal activity." -NATASHA MARTIN, DPHIL

### **Opinion: As COVID-19 vaccines are** given, these are the concerns medical professionals grapple with

"Our fundamental goal is straightforward: Vaccinate as many people as possible as quickly as possible. It is an aspiration predicated upon a plentiful supply of effective vaccine and the infrastructure to deliver it. Neither currently exist in abundance." SHIRA ABELES, MD, and MARLENE MILLEN, MD, UC San Diego Health The San Diego Union-Tribune | Jan. 28, 2021

### **O&A:** The pandemic's next few months could be the hardest. A UCSD researcher explains why

"I don't think we're at the end, but we're at a place where we can see where this is going. I'm optimistic that, through vaccines, we can manage this virus in the coming years. Now, does that mean that it's all going to go away? No. I think we'll be living alongside it, but in a manageable way that will allow us to reopen society and resume some amount of normal activity. NATASHA MARTIN, DPhil, infectious disease modeler, UC San Diego School of Medicine The San Diego Union-Tribune | Jan. 31, 2021



### **Opinion: With new coronavirus** variants and high case rates, it's too soon to reopen San Diego schools

"The constant closures and quarantines in schools we have already seen in many districts that have returned to campus does not represent stability for our youth, who are already living in uncertain, confusing times. In-person learning is ideal, but it is not safe at this time, and we have alternatives that protect families at home and communities at large." LISA DELANO-WOOD, PhD, associate professor of psychiatry, UC San Diego School of Medicine; Andrea D. Lehman, health economist, UC Santa Barbara: and Elizabeth A. Shulok, data scientist The San Diego Union-Tribune | Feb. 11, 2021

### **Opinion: If San Diego wants an** equitable vaccine distribution, racism should be addressed head-on

"If we truly desire equitable vaccine distribution, we should be addressing racism head-on. However, policymakers are uncomfortable with using race as a factor for vaccine allocation. ZIP code serves as a proxy for race, and incorporating this into vaccine distribution planning is

consistent with California's goal of directing resources to most impacted communities. Not only do vaccines need to be preferentially distributed to ZIP codes with the highest burden of disease, but their distribution must be led by community leaders and trusted messengers. Without this vital component, vaccination sites in hardhit ZIP codes will be accessed by those who do not live there." LEONARDINO A. DIGMA AND BETIAL A. ASMERON, students at UC San Diego School of Medicine, and MARIA ROSARIO G. ARANETA, MD, PHD, MPH, assistant dean of diversity and community partnerships at UC San Diego School of Medicine The San Diego Union-Tribune | March 3, 2021

**Opinion: San Diego's sexual health** programs need better resources to be sustainable, now and post-pandemic

"We're more than a year into the pandemic and COVID-19 has impacted nearly every facet of San Diegans' lives. As our communities combat SARS-CoV-2 transmission across the city, we are simultaneously, and quite literally, in the fight of our lives against sexually transmitted diseases and HIV in the region." SUSAN LITTLE, MD, associate professor of medicine, UC San Diego School of Medicine The San Diego Union-Tribune | April 7, 2021

### Opinion: I'm a chaplain who provides support when needed. Here's how we've been helping COVID-19 patients

"Many COVID-19 'long haulers' are experiencing immense spiritual struggle. The daily statistics about infections and deaths from COVID-19 do not tell the story of the thousands of individuals and families who are working hard to heal. And while scientists and medical providers are beginning to understand more about long and post-acute COVID-19, they are also seeing the limits of their interventions for some people who are struggling to return to work, reconnect with expectations of family and friends, or just feel like themselves. Spiritual struggle takes the form of isolation, loss of selfworth, estrangement and loss of direction or purpose." ALLISON KESTENBAUM, supervisor of spiritual care and clinical pastoral education at UC San Diego Health The San Diego Union-Tribune | June 14, 2021

### Why We Volunteered in COVID Vaccine Trials — A father and son's perspectives

"Early on, it became clear that vaccines would be the only pathway to protect the vulnerable, approach herd immunity, and regain a secure foothold toward normalcy. However, we'd never had a coronavirus vaccine-would this deadly infectious agent prove as elusive as a cure for the common cold, for which more benign coronaviruses are the frequent culprit?" VICTOR NIZET, MD, Distinguished Professor at UC San Diego School of Medicine and Skaggs School of Pharmacy and **Pharmaceutical Sciences** MedPage Today | June 16, 2021

"When my dad participated in the COVID-19 vaccine trial last summer, I paid close attention and asked a lot of questions. Three things convinced me that I should participate in the kids' trials. First, a teen's antibody

chain of transmission." OLIVER NIZET, age 15 MedPage Today | June 16, 2021

### **Moral Injury**

"Describing the total emotional cost to frontline health care workers is difficult. My own capacity to process human suffering ultimately ruptured under the weight of what I saw daily. Distraught family members pressing their faces against dirty hospital

response to vaccines is every bit as good as an adult's. Second, any serious side effects to vaccines always appear in the first few days or weeks after the shot, and millions of adults had already been immunized to COVID-19 without such problems. Finally, even if my risk of severe disease is pretty low, I can protect more vulnerable people by taking myself out of the potential

windows for a glimpse of dying loved ones. The voice of a mother of three children, begging me to save her life. The words of a grandfather who said, 'I trust you, doc,' before quickly deteriorating on my watch. The hours seemed endless and cruel, filled day after day with dying patients and desperate and angry families constantly demanding why. My thoughts turned to images of war-weary soldiers adapting through depersonalization and numbing. I could not shrug off the gnawing dread while driving to the hospital, devolving into utter helplessness as I walked through the ICU, knowing that most of my patients would die, no matter how intense my efforts." VENKTESH R. RAMNATH, MD, pulmonologist and associate professor of medicine, Division of Pulmonary, Critical Care and Sleep Medicine, UC San Diego Health, Annals of Internal Medicine | June 29, 2021





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IN MEMORIAM This issue is dedicated to all health workers and caregivers who have served so selflessly, often at great cost, during the pandemic and in remembrance of family, friends and strangers who are no longer with us.

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