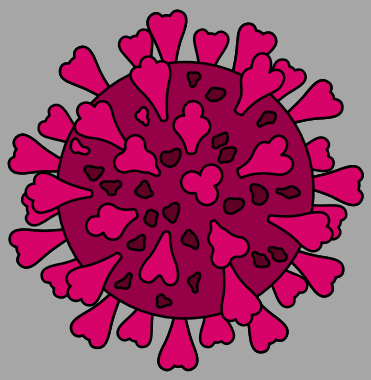
THE Physiologist MAGAZINE
SEPTEMBER 2020



TARGETING CORONAVIRUS

Physiologists halt their projects to put all their focus on prevention and treatment of COVID-19.

american physiological society®

Learn from Fellow Educators in Our New Monthly Series

The American Physiological Society is pleased to announce a live webinar series focused on our educator community. In these webinars, our Physiology Educators Community of Practice will explore best practices in education, synchronous and/or asynchronous teaching, establishing inclusive classrooms and publishing. We'll also host town halls as we strive to support and engage the educator community throughout the year. Check out all upcoming sessions and register at **physiology.org/PECOPWebinars**.

WRITING AND REVIEWING FOR *ADVANCES IN PHYSIOLOGY EDUCATION*

Speaker: Doug Everett, PhD, FAPS
September 17, 2020
12 p.m. EDT

Discussion on techniques and strategies for writing and reviewing papers related to physiology education. Educators who have adapted their teaching during the COVID-19 pandemic are encouraged to share their work.

A FRAMEWORK OF COLLEGE STUDENT BUY-IN TO EVIDENCE-BASED TEACHING PRACTICES IN STEM: THE ROLES OF TRUST AND GROWTH MINDSET

Speaker: Mark Graham, PhD
October 22, 2020
12 p.m. EDT

Building trust goes hand-in-hand with inclusion and diversity. Trust is essential for the different modalities of teaching that educators and students are experiencing.

EDUCATORS TOWN HALL

November 19, 2020
12 p.m. EST

A chance to review the fall semester and plan ahead for the coming year.

All webinars will be recorded and available on-demand.

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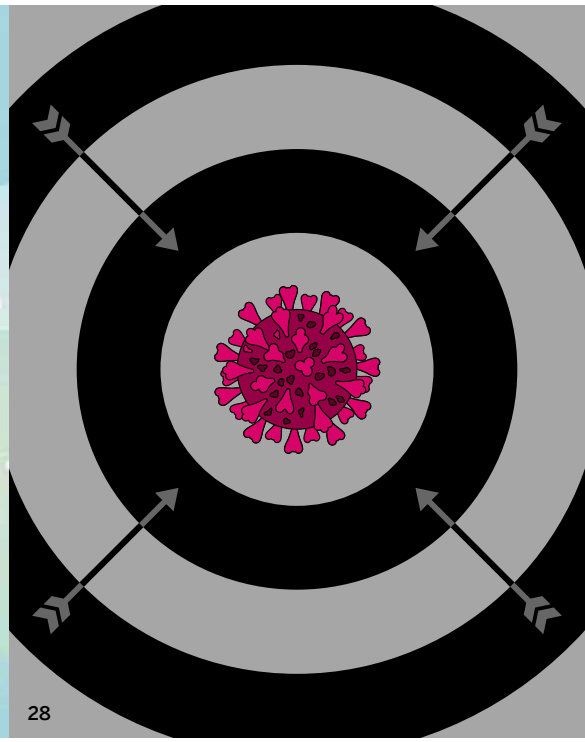
FEATURES



Cover illustration by Brad Latham

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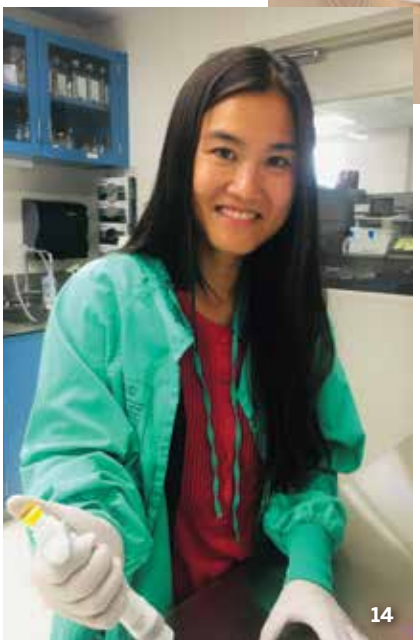
14


10


40

Read the comparative physiology blog

Life Lines

by

Dr. Dolittle

SPONSORED BY AMERICAN PHYSIOLOGICAL SOCIETY

Interested in contributing?
Email communications@physiology.org.

lifelinesblog.com

New Directions

BY SCOTT STEEN, CAE, FASAE

On July 16, the American Physiological Society (APS) Council approved a new strategic plan that will set a new course for the Society over the next three years and beyond. The plan is the result of a year and a half of work, with input from more than 1,000 APS members through surveys, focus groups, one-on-one interviews and planning sessions.

Some of the themes that emerged touch on long-standing issues for the Society and the discipline. Virtually every group that McKinley Advisors, our strategic plan consulting firm, interviewed expressed concern about the perception of physiology within the academic and scientific communities. Several also talked about the diminishment of physiology within medical schools and the consolidation of physiology as a subject with other biological sciences under different names, as well as the growth across the U.S. of physiology departments at the undergraduate level.

Other issues that came through strongly in the research were diversity, equity and inclusion; the rapidly changing publishing environment; the importance of spotlighting scientific achievement and advancing rigor and reproducibility; and the need to provide additional support and value for mid-career scientists, educators and international members.

The plan that resulted from this process will make us more diverse, dynamic, global, relevant, resonant and positioned for the future.

Goals for the plan include:

Scientific Excellence: *Advance and spotlight exceptional and high-impact physiological science, making excellence in science a key differentiator for the Society.*
The new strategic plan outlines explicit objectives to prioritize scientific excellence in the planning of the new annual meeting; ensure the success of our new apex research journal, *Function*; continue to strengthen our existing journal and conference portfolio; and develop a Society-wide content strategy that ensures high scientific standards and emphasizes rigor and reproducibility and cross-disciplinary science.

Elevating the Discipline: *Position physiology as a dynamic and essential field of study in advancing health and our understanding of life, focusing specifically within the academic, scientific and funding communities.*
This goal aims to explicitly address the brand perception of physiology, creating communications campaigns to reinforce the relevance and importance of the discipline and strengthening our advocacy program to enhance awareness of critical policy initiatives.

Membership & Member Value: *Define and expand the value we offer for key APS stakeholders, while significantly growing our regular membership category.*
In addition to aggressive plans to expand APS membership, this goal focuses on strengthening member value for all member demographics, with a particular emphasis on mid-career scientists, physiology educators and international members, developing new resources and experiences and strengthening existing offerings.

Diversity, Equity & Inclusion: *Champion diversity, equity and inclusion within the APS member community and the discipline, creating an environment in which all individuals are encouraged to join, thrive and lead.*
APS had committed to expanding diversity, equity and inclusion efforts before the burgeoning racial justice movement in the U.S. provided even greater urgency. This goal will spur concerted action to expand both representation within the Society and attract greater diversity to physiology.

International Engagement: *Deepen and expand APS' impact outside the U.S., growing international membership, submissions and engagement.*
APS is an international society. Approximately 25% of our members and half of our journal authors come from outside the U.S. This goal will enable us to enhance engagement and better serve our non-U.S. audience while simultaneously attracting new international members and authors.

We live in challenging times, but we still have big dreams for the future. Our new strategic plan is both exciting and ambitious, helping to position APS and physiology for a new era of success. Read the full plan at **www.physiology.org/strategicplan**.

GRADUATE PHYSIOLOGY & BIOMEDICAL SCIENCE CATALOG

The American Physiological Society (APS) is pleased to announce our new **Graduate Physiology and Biomedical Science Program Catalog**. The catalog is a resource for your students and mentees as they contemplate graduate school and the next step in their education and careers.

This online directory provides undergraduate biology and life science students and early-career physiologists with graduate program profiles that facilitate their search for the ideal institution. We encourage you to share this catalog with your undergraduate and postbaccalaureate students to help grow the next generation of physiologists.

Check out the catalog today at physiology.org/GraduatePhysiology.

Interested in listing your program?

Contact **Jacob White** for more information.

Jacob White
APS Development & Strategic Partnerships Manager
jwhite@physiology.org
301.634.7991

The Physiologist MAGAZINE

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WHAT is physiology?

WHERE is physiology?

WHY does it matter to you?

Join us as we follow the path from the lab all the way to the healthy lifestyle recommendations that you receive from your doctor.

Explore how the body works by reading the blog at **ISpyPhysiology.com**.

Interested in contributing?
Email communications@physiology.org.

#ISpyPhysiology

During the coronavirus pandemic, physiologists and other scientists are sharing on Twitter how they are teaching, learning and studying remotely.

How are you dealing with the coronavirus quarantine? Share your story with us and it may appear in the next issue of *The Physiologist Magazine*. Email your thoughts—and links to your tweets and posts—to tphysmag@physiology.org.

Lindsey A Ramirez
@_La_Ramirez

Shout out to the PIs who take your comfort level into consideration. @jensull56139602 and Paul O'Connor asked every lab member what would make the return to lab safe for them and crafted guidelines to make everyone feel safe. #phdlife #AcademicChatter

1:49 PM · Jul 1, 2020

Derek Daniels
@drderekd

Getting ready for the dissertation defense of my senior PhD student. Fifth time for my lab and it really doesn't get old. Without question, watching trainees succeed is my favorite part of my job. It more than makes up for all the rejected grants and papers. #AcademicChatter

12:28 PM · Jul 2, 2020

Karla Haack
@haack_kkv

I wonder how many of the folks on my Zoom meeting agreed with my 2 year old yelling at me to stop talking? 🤔🤔

12:59 PM · Jul 6, 2020

Dan Michele
@MicheleLabUM

Bittersweet when one of your graduate students defends their dissertation. Celebrating her accomplishment, but her contributions to the lab will soon be sorely missed. Congrats Dr. @Molly_Naylor1! An outstanding scientist, mentor to students, teacher, and colleague!

3:06 PM · Jun 25, 2020

Matt Bailey
@edinburgh_renal

This afternoon's delights are reviewing risk assessments & the next phase of return to research. ☕ poured 🎧 on. Let's go!

10:51 AM · Jul 15, 2020

Anne R Crecelius
@DaytonDrC

Is there a lot about the fall in education that is unknown? YES. Is there also a tremendous amount of energy around trying to figure it out and do best by our students? YES. Just on a 170+ person townhall (thx @HumanAandPSoc) of people talking about remote/online labs. 😍

5:01 PM · Jul 7, 2020

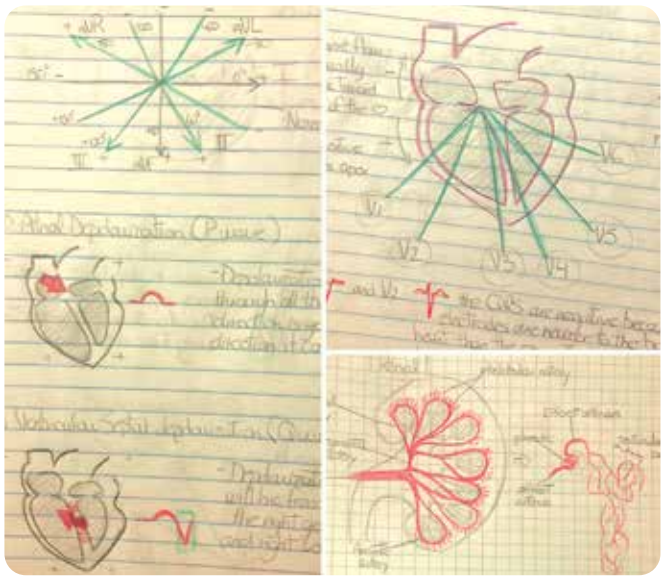
J. Brian Byrd, MD, MS
@thebyrdlab

I've now chaired my first virtual oral presentations and first virtual poster presentations! And it has some really neat aspects, the ability to rewind a presentation, lack of other people waiting to speak to the presenter. All in all, I loved it! #ISEV2020

5:14 PM · Jul 20, 2020

Spicy Fire
@Dai_Dayz

Don't normally post my study materials...but my physiology PhD qualification is soon. Protip: Drawing helps you study and memorize A LOT. #physiology #science



8:40 PM · Jul 21, 2020

Follow APS on Twitter: @APSPhysiology @SciPolAPS @APSPublications

LAB NOTES

STATS & FACTS

163

The number of SARS-CoV-2 vaccine candidates in clinical or preclinical trials being tracked by the World Health Organization as of July 15, 2020.

World Health Organization

RESEARCH FIZZ

Exogenous ketosis impacts neither performance nor muscle glycogen breakdown in prolonged endurance exercise

This study shows that taking ketone ester supplements during physical activity does not affect the breakdown of sugar and fats or high-intensity exercise performance.

***Journal of Applied Physiology*, June 2020**

https://doi.org/10.1152/japplphysiol.00092.2020

MENTORING Q&A | MAINTAINING COMMUNITY

Creative Communications

How to maintain a sense of community during the pandemic.

Each issue, we'll ask a trainee to pose their career questions to an established investigator and mentor. Here, APS Porter Fellow Jeanmarie Gonzalez, a fourth-year PhD student at the University of California, San Francisco, asks Ronaldo Ferraris, PhD, professor of pharmacology, physiology and neuroscience, New Jersey Medical School, Rutgers University, about how to build a community and keep communications open during the pandemic.

Q: How do you maintain a sense of community and creativity in your lab (and department) without small, organic, in-person interactions during the pandemic?

A: My lab was fortunate to quickly be able to use online communication to maintain a sense of community. Luckily, we were already collaborating with other laboratories off campus, relying on web-based video conferencing applications for online meetings to discuss experiments and data. Because we had

Illustration, above right, by Kagan McLeod; left: iStockphoto

to suddenly shut our doors down, we relied on online communications to coordinate visits to the lab to initiate procedures like stopping feeding experiments, reducing animal inventory and freezing cells. These online meetings then shifted to lab presentations and journal clubs—though the first few meetings began with informal chats about the pandemic and how it was affecting our personal lives. To enhance the relevance of our lab meetings, I encouraged my postdoctoral fellow and students to review SARS-CoV-2 papers related to our area of research for our journal clubs. In early April, a colleague also organized a virtual happy hour for the department every Friday late afternoon.

Q: What tips do you have for building solid communication in a socially distant lab environment?
A: This depends on the status or phase of closure/reopening. When the state of New Jersey was under strict lockdown and only critical on-campus lab research was allowed in the university, I had online meetings with individual laboratory members, discussing their research and what they could do remotely. When staggered visits and some research were allowed, I met individually with students when it was their turn to visit the lab. We did this in the laboratory where space was much larger, while maintaining social distance and wearing personal protective equipment. It felt bizarre at first, but eventually we all got used to the "new normal" and our masked appearances.

Q: How does your lab make space to discuss issues of diversity, equity and inclusion in science?
A: My laboratory has always been very diverse in terms of race and gender, and I have mentored, as well as helped, many master's students of underrepresented groups to eventual admission in medical and dental schools. We, however, have not been able to discuss, as a lab, important recent events relevant to the issues of diversity.

Q: With time (or resources) in the lab being limited, what advice do you have for trainees in deciding what to prioritize for their own projects?
A: In this unpredictable environment, trainees need to be imaginative and resourceful, while mentors need to be flexible so research can continue even under difficult conditions. I advise students to prioritize experiments that can be done with available resources. To adapt and remain productive, some students in my lab used archived samples to test a revised version of their original hypothesis while other trainees wrote reviews. While the pandemic created difficulties, it also provided new opportunities in terms of new requests for proposals (RFPs) related to COVID-19. Thus, we reviewed files that could be mined for data relevant to these RFPs and reanalyzed some archived samples to generate preliminary data whenever possible.

Q: What habits and low-time commitment experiences do you think trainees should engage in on a regular basis that would help them prepare for careers in academia?
A: By sheer necessity, the pandemic has popularized a new way of disseminating knowledge. Instead of occasional seminars by experts visiting the campus, numerous webinars are now available for trainees to choose from and attend remotely—and if recordings are available, even attend webinars at their convenience. Attending these webinars is a low-time commitment habit that trainees should engage in on a regular basis to learn new experimental approaches and information. And it would help trainees to remember that if they surmounted difficulties in their research during the COVID-19 pandemic, they may have prepared themselves for the challenges of a research career in academia!

iStockphoto

STATS & FACTS

80%

The portion of people in the U.S. who say they wear a mask frequently or always when they expect to be within six feet of other people.

The New York Times

RESEARCH FIZZ

Understanding the age divide in COVID-19: why are children overwhelmingly spared?

Differences in lung physiology and immune function may be why children are often spared from severe illness associated with SARS-CoV-2.

***American Journal of Physiology-Lung Cellular and Molecular Physiology*, July 2020**

https://doi.org/10.1152/ajplung.00183.2020

STATS & FACTS

36

The number of years Anthony S. Fauci, MD, has served as director of the National Institute of Allergy and Infectious Diseases.

National Institutes of Health

RESEARCH FIZZ

Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease

Recognizing the relationship between physical inactivity and increased heart disease risks is crucial in order to coordinate public health initiatives that can tackle both COVID-19 and inactivity due to pandemics.

American Journal of Physiology-Heart and Circulatory Physiology, June 2020

https://doi.org/10.1152/ajpheart.00268.2020

STATS & FACTS

28,000

The estimated number of deaths that could be prevented if 95% of people in the U.S. wore cloth masks between early July and October 1, according to a model out of the University of Washington.

National Public Radio

POLICY IQ | VIRTUAL ADVOCACY

APS Members Hold Virtual Meetings with Congressional Offices

In mid-June, the Society undertook its first remote advocacy campaign. Participants included members of the Science Policy and the Animal Care & Experimentation committees as well as the APS Early Career Advocacy Fellows. In previous years, these groups have gone to Capitol Hill in Washington, D.C., as part of their committee meetings. However, congressional offices closed to the public at the end of March due to the coronavirus pandemic, which led to the development of an alternative format. The APS Office of Science Policy developed interactive training sessions to explain how individuals can identify their senators and representatives and contact congressional offices to arrange meetings by phone or video conference.

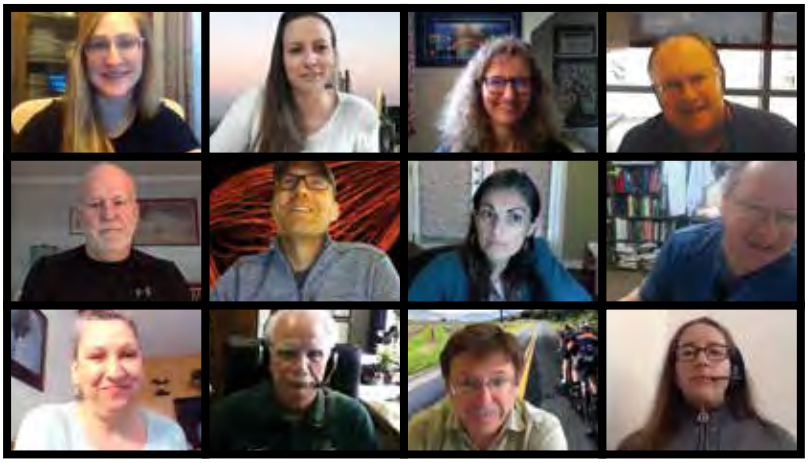
The mainstays of APS congressional advocacy are to seek sustained growth in federal biomedical research funding and to ensure that researchers have access to the appropriate animal models for their research. This year we also focused on two important new topics: urging Congress to address disruptions caused by the pandemic and to provide federal research agencies with the resources needed to promote greater diversity and equity in the scientific workforce.

COVID-19 DISRUPTIONS

Most research unrelated to the coronavirus was halted due to stay-at-home orders—and will continue to be hampered by the longer-term impacts of physical distancing requirements. As a result, many researchers will run out of time and/or funding before they can complete the work set forth in their grant proposals. Therefore, time extensions, as well as supplemental funding, will be needed to address disruptions caused by the pandemic. The same is true for training grants.

DIVERSITY AND EQUITY

Nationwide protests against racism have led to a watershed recognition of the importance of building an equitable and diverse scientific workforce. Federal agencies that fund research and training will need



APS Animal Care & Experimentation Committee members virtually prep for their Capitol Hill "visits."

additional funds to address these issues effectively.

RESEARCH FUNDING: Participants urged Congress to increase investment in biomedical research in fiscal year 2021 by providing these funding levels to federal agencies and programs:

- **National Institutes of Health (NIH):** At least $44.7 billion to support the next generation of researchers, fund new initiatives authorized under the 21st Century Cures Act and provide a 3% increase for every institute and center, enabling them to support high-priority research.
- **National Science Foundation (NSF):** At least $9.4 billion to support research training and enhance research efforts in a range of areas, including basic biological research to provide the foundation for addressing challenges to the health of people, animals and ecosystems.
- **VA Medical and Prosthetic Research:** $860 million to enable the VA to address health challenges facing veterans through basic and clinical studies.
- **NASA:** Congress should restore cuts to NASA's life sciences research programs into gravitational biology and biomedical research on the space environment and increase funding for the Human Research Program that addresses questions such as how to counteract the long-term effects of weightlessness.
- **Animal models in biomedical research:** Congress should refrain from placing arbitrary restrictions on the selection of animal models in biomedical research.

THE EXPERIENCE

Some committee members had done in-person congressional visits before, but remote advocacy was a new experience for everyone. Participants reported that this approach provided both opportunities and challenges.

Although new to the Science Policy Committee, Anna Stanhewicz, PhD, had previously met with congressional staff as an APS Early Career Advocacy Fellow. She characterizes her experiences as "overwhelmingly positive," noting, "it's never as intimidating as you think it will be."

It was challenging to gauge the staffers' responses in a phone call—something that others also observed—but Stanhewicz says she was surprised at how casual and personal the conversation was. "I got asked a lot more questions than I had [during in-person visits] and felt as though the staffers were more receptive than in previous years."

Several committee members found it helpful to recruit colleagues at their institution to participate in meetings with them. Animal Care & Experimentation Committee Chair Sonnet Jonker, PhD, says, "I don't think I would have enjoyed the experience nearly as much alone." She says remote advocacy opens up the opportunity for APS members to "get involved under the wing of a scientist with more advocacy experience."

Teaming up also has its challenges. Incoming Science Policy Committee Chair Katie Wilkinson, PhD, says she found it challenging in a joint conference call to know when to speak. "There are slight delays, and it is a little awkward, especially over conference call when you can't see people." She thinks the solution for group meetings is to "take a little time to strategize how the meeting should go, including suggesting certain people highlight certain talking points."

LOOKING TO THE FUTURE

Travel restrictions related to the pandemic mean that it could be some time before advocates return to Capitol Hill in person. Committee members who participated in remote advocacy have offered helpful insights to improve the experience going forward, including ways to make this important activity accessible to more APS members.

To learn more about APS advocacy efforts and find ways to get involved, visit **www.physiology.org/advocacy**.

STATS & FACTS

$1.5 billion

The amount of money appropriated by Congress for the National Institutes of Health's Rapid Acceleration of Diagnostics (RADx) program. RADx aims to substantially scale up methods of and access to SARS-CoV-2 testing.

National Institutes of Health

RESEARCH FIZZ

Consumer grade biosensor validation for examining stress in healthcare professionals

This study explores the effectiveness of a commercial biosensor to measure stress levels, energy expenditure and breathing rate in health care professionals.

***Physiological Reports*, June 2020**

https://doi.org/10.14814/phy2.14454

STATS & FACTS

2%

The target portion of U.S. population RADx aims to be able to test for SARS-CoV-2 daily by December 2020.

National Institutes of Health

UNDER THE MICROSCOPE

Rapid Fire Q&A

Dao H. Ho, PhD, talks about how the pandemic has changed her research, what she wishes she invented and that time she sat on the floor at Lowe's to work.

Ho's work environment, with the cityscape and mountains of Oahu, Hawaii, behind her.

Q: Ever had a "eureka" moment? Tell us about it.
A: I wanted to study the effects of egg yolk composition on the developing chicken embryo, but it was impossible to change the composition of the entire yolk in the egg. Instead, I removed the embryo from the original yolk and cultured it on yolks from different eggs, and it worked!

Q: What inspired you to become a scientist?
A: My inspiration to become a scientist stems from the wonderful biology teachers I had during middle school and high school. I was fortunate enough to have science teachers who encouraged and supported students and gave 100% effort to teaching us how to think and how to solve problems using the scientific method. They taught me how important scientific research and discovery is in everyday life.

Ho performs a bead-based assay to detect inflammatory cytokines produced by endothelial cells that were treated with an environmental toxicant.

Q: How has the coronavirus pandemic changed the way you work?
A: Coronavirus has caused a shift of my research focus to investigating the pathophysiology of COVID-19 and assessing strategies to mitigate the symptoms of COVID-19. I have been spending long days in the lab to keep up with the pace at which information is being generated about COVID-19.

Q: "Old school" technique you're most proud of mastering?
A: Using the Wösthoff gas mixing pump (circa 1960s) to make a 95% nitrogen gas mixture for experiments assessing hypoxia tolerance in zebrafish larvae.

Q: Items on your lab bench that you are most possessive of?
A: Sharpie permanent markers and digital timers.

Q: Favorite lab mishap story that you can share without incriminating the innocent?
A: This is a sad mishap story. One of the pipes busted overnight in a lab room and steam filled the room. Needless to say, by morning, most of the equipment in the room was not working, all paperwork and books were soaked, and experiments were ruined. This taught me the importance of keeping detailed notes of all experiments so that you can repeat experiments.

Q: Best "MacGyver" moment in the lab?
A: For one of my experiments during graduate school, I needed to build a closed-system swim tunnel respirometer for zebrafish. I went to Lowe's and sat down in the middle of the PVC pipe aisle with the Lowe's in-house plumber, and we worked out the configuration of the system right there, grabbing connectors, pipes and duct tape from the shelves. It was such a fun DIY experience. I recommend building your own tools and instruments as part of the graduate school experience!

Q: Title you'd use on your autobiography?
A: "Westward Ho! My Journey from East to West."

Q: If you could meet any scientist (living or dead) who would it be and why?
A: I would want to meet Albert Einstein because he seems like such a free-spirited and creative scientist.

Q: Briefly, what do you wish the general public understood about science or research?
A: Science and research are not mysterious or scary things that only belong to an elite group of people. The goal of scientific research is to allow for the understanding of how our own bodies work, as well as how the world around us works. The knowledge generated from scientific research is based on a logical and systematic approach that is designed to prevent personal biases from the results.

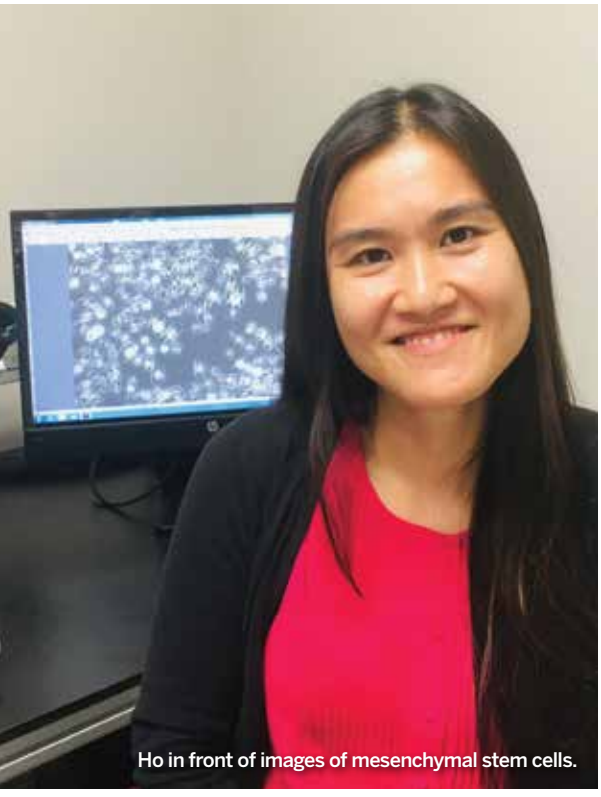
Q: Favorite book about science (fiction or non-fiction)?
A: "Why Zebras Don't Get Ulcers" by Robert M. Sapolsky.

Q: Favorite science-related TV show (fictional or factual)?
A: "MythBusters."

Q: The scientific discovery or invention (made by someone else) that you wish you had made?
A: I wish I had invented the internet. This has revolutionized the way we communicate and how we share information.

Q: Biggest misconception about physiology/physiologists is … in five words?
A: Physiology is a lost art.

Q: Favorite way to spend a free hour in quarantine?
A: Having a big cup of coffee on my lanai with my dog and watching the clouds roll over the mountains.


Ho in front of images of mesenchymal stem cells.

Q: Tell us a surprising fact about you.
A: My family and I escaped Vietnam on a tiny boat in 1979. I spent most of the first year of my life in a refugee camp on Macau.

Q: One thing every researcher/scientist should try at least once in their life?
A: Perform an experiment without using commercially made kits or buffers. Instead, make all assay components and buffers from scratch.

Q: Next book on your reading list?
A: "I Contain Multitudes" by Ed Yong.

Q: Go-to tech device?
A: A wireless camera so I can watch my dog throughout the day while I'm at work.

Q: Favorite musician/musical artist/band?
A: Neil Young.

Q: First place you plan to visit once pandemic-related travel restrictions are lifted?
A: Dallas, Texas, to see my parents!

Dao H. Ho, PhD, is a biomedical research physiologist at Tripler Army Medical Center in Honolulu. The views expressed in this article are those of the author and do not reflect the official policy or position of the U.S. Department of the Army, U.S. Department of Defense or the U.S. government.

PUBLISH WITH POLISH | JOURNAL MEASUREMENTS

How to Use Units of Measure in APS Journals

Some research—particularly altitude studies—concerns various pressure values, and these pressure values need to be distinguished clearly. APS journals use specific units of measure to differentiate the various types of pressure. Among these units of measure, the most generally used are atmospheres (atm), mmHg and Torr. The latter two are often used interchangeably in manuscripts, but APS journals use them to measure distinct parameters.

Atmospheres are solely used to measure atmospheric pressure. Although weather forecasters frequently refer to rising or dropping mercury levels, atm should be used in APS journals.

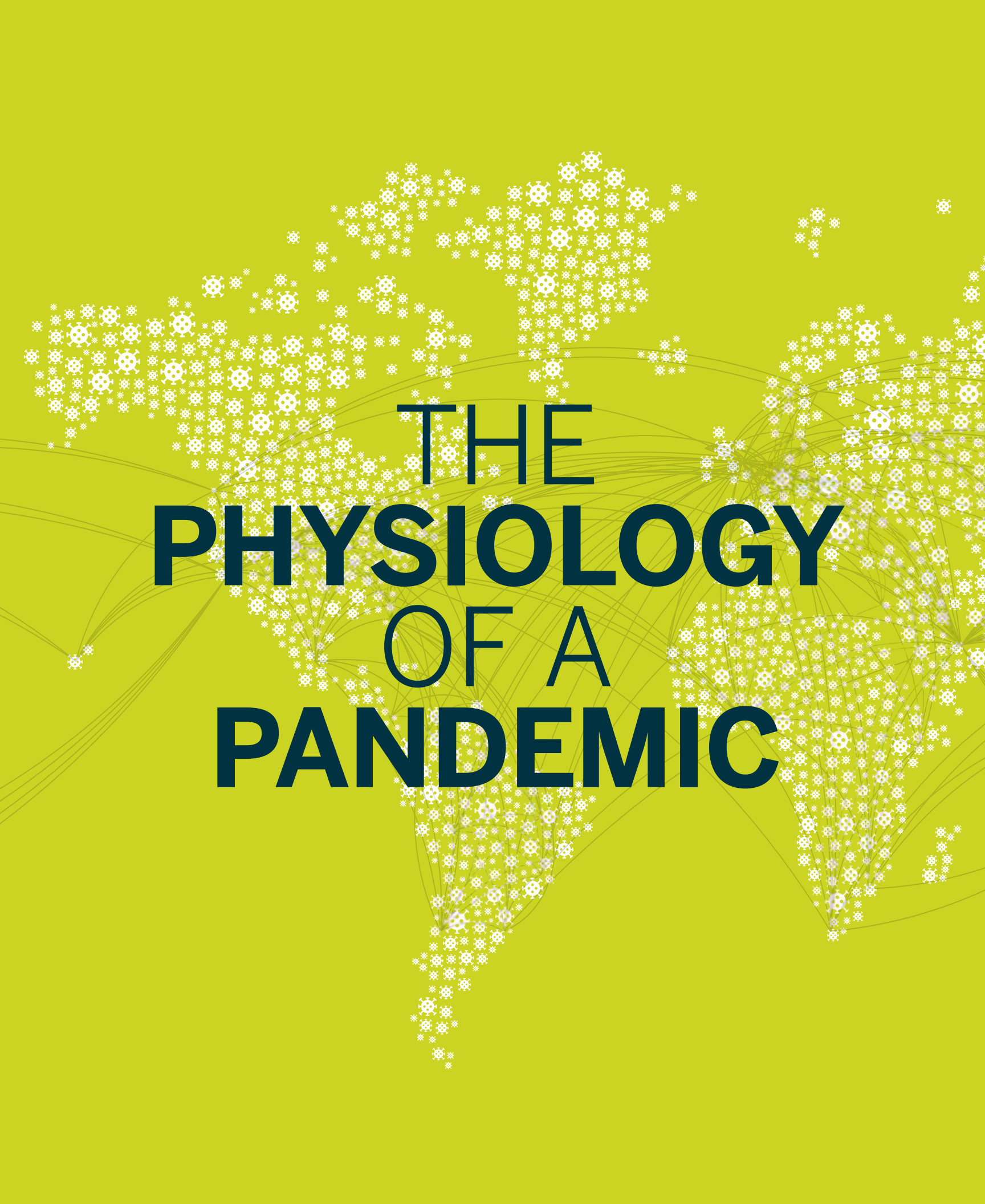
Regarding "mercury levels," use of mmHg in APS journals is restricted to measuring blood pressures. Diastolic and systolic blood pressures should always be measured in mmHg.

That said, gas pressures—including gas pressures in the blood and in the air—should be measured in Torr.

To illustrate, a study could be done at a specific atmospheric pressure (measured in atm) that measures the effects of a specific level of O2 in the blood (measured in Torr) as well as the blood pressure of a human (measured in mmHg).

By strictly adhering to the correct units of measure, readers should not have any problems identifying what pressures are being discussed.

APS' experienced publishing staff share their tips and know-how to help you improve the polish of your scientific manuscripts. Got a scientific publishing or style question that you want us to weigh in on? Email it to tphysmag@physiology.org.


THE
PHYSIOLOGY
OF A
PANDEMIC

As SARS-CoV-2 races across the globe, researchers explore what makes this virus more contagious—and deadlier—than most.

BY SARAH WATTS

For Clement Chow, PhD, the virus came on suddenly in mid-March. It started with a fever. Chills and aches quickly followed. A genetics researcher at the University of Utah, Chow had been following the news of a novel coronavirus called SARS-CoV-2 and knew that it was making its way rapidly across the globe. However, since there were only a few dozen confirmed cases in Utah at the time, Chow was hopeful he had only come down with the flu. Then the coughing began.

When Chow began to have trouble catching his breath, his wife rushed him to the emergency room at the University of Utah Hospital, where he was tested immediately for COVID-19. Although the test wouldn't come back positive for another two days, Chow said the ER staff treated him as a COVID-19 patient "as soon as I arrived."

Within an hour of being in the hospital, his condition declined rapidly. "I went downhill real fast," Chow recounted later on a Twitter thread about his experience with COVID-19. "I went from low oxygen supplementation to not being able to catch my breath on even the highest [oxygen] levels they could accommodate." He spent the next five days in the intensive care unit on high-flow oxygen, narrowly avoiding the need for intubation.

Despite respiratory failure, isolation from his family and the terror he would die alone—what Chow described as the worst part—Chow still considers himself one of the lucky ones. Months after his ordeal, Chow feels "mostly 100%," with no obvious lingering symptoms. It's a fate not everyone infected with COVID-19 is lucky enough to share.

A NEW VIRUS JUMPS TO HUMANS

SARS-CoV-2 was discovered in late 2019. The disease it causes, COVID-19, had killed more than 760,000 people worldwide by August 2020. In some cases, COVID-19 can cause minor symptoms such as fever and cough. But in other cases such as Chow's, the disease can cause a host of serious problems, such as sudden respiratory failure, neurological symptoms like stroke and even vascular complications such as blood clots.

Scientists are still trying to determine how the virus is transmitted. Some think it is only spread through close contact with an infected person or from touching contaminated surfaces, while others believe the virus is also airborne, able to travel through air currents and infect people even at remote distances. But what most can agree on is that the virus likely began as most other viruses do: originating in a wild animal, jumping across species to infect human beings and then quickly spreading west.

"Pandemics typically start with zoonotic transfer," says Robert Carter III, PhD, MPH, a professor of public health and health sciences at Los Angeles Pacific University. Other zoonotic diseases include Ebola, SARS and influenza A virus subtype H7N9. SARS-CoV-2 shares many genetic similarities with other coronaviruses, leaving scientists to speculate that it also originated in bats.

"The reason we tend to see transmission of disease from animals to humans is because humans tend to co-exist with wild animals, particularly in the East," Carter says. "In the East, consumption of exotic animals is still a cultural practice. We also tend to see more rodent infestations within cities, or you might find a wild pig or cow eating out of the trash. You get this unique milieu of various species that you don't see as much in the West."

Global deforestation also facilitates the spread of disease, Carter says, since it disrupts natural animal habitats and allows animals to encroach on human living spaces. Eastern countries have suffered the greatest rate of deforestation over the past 40 years.

Economic activity, as well as increased tourism and migration, means that infectious diseases are more likely to become global pandemics than at any other time in human history.

THE SPREAD ESCALATES

Once a disease crosses species, it tends to move quickly among humans. "With pandemics, we tend to see clusters of cases in port cities and major airline hubs for international travel, such as New York and Seattle," Carter says. "That's what we've seen with [SARS-CoV-2] as well." Economic activity, as well as increased tourism and migration, means that infectious diseases are more likely to become global pandemics than at any other time in human history.

But not all diseases spread as quickly—or infect as many people—as this coronavirus has. Ebola, for instance, which originated in Central Africa in the mid-1970s, is extremely deadly with a fatality rate of up to 90%. But Ebola is only infectious when a person is symptomatic, and the symptoms are often severe, making it unlikely for an infectious person to travel and unknowingly spread the disease. A person with SARS-CoV-2, on the other hand, can be asymptomatic for weeks, infecting other people without realizing they are a carrier.

The unique characteristics of SARS-CoV-2—like its long incubation period and possible airborne transmission—have informed the guidelines to curb its spread that have been put in place by public health organizations such as the World

Health Organization and the Centers for Disease Control and Prevention.

"When we started seeing cases of COVID-19 worldwide, we realized that they were rapidly increasing, our hospitals were overwhelmed and that some people were getting very sick and dying at a rate we'd never seen before," says Mighty Fine, MPH, director for the Center of Public Health Practice and Professional Development at the American Public Health Association.

"We recognized that the disease spread through respiratory droplets," similar to tuberculosis, he says. "One way to prevent transmission in that case is to wear a mask and stay at least six feet apart, since that's how far the droplets are capable of flying."

FOLLOWING PUBLIC HEALTH GUIDELINES

Even without a vaccine, Fine says, things such as physical distancing, masking, handwashing and closing down opportunities for people to congregate are tried-and-true ways to prevent the spread of respiratory illness. And some in medicine have long believed that masks can help lessen the severity of a virus because people who wear masks and become sick are exposed to fewer viral particles. New research backs up this idea: A study in the May 2020 issue of the journal *Clinical Infectious Diseases* showed that hamsters who were exposed to SARS-CoV-2 were more likely to experience a mild version of the disease if they were partitioned with a surgical mask.

Despite public health measures, the novel coronavirus continues to spread, particularly in the U.S., which accounts for a quarter of infections worldwide. "Part of the reason why the disease has spread is that early on there was a false sense of security with our health care system and our protections against disease," Fine says. "Ebola and SARS were very deadly diseases, but they didn't have a great impact on America. So initially, COVID-19 wasn't taken as seriously as it should have been. Our high cases are a clear indication of that."

And as the virus sweeps across the U.S., marginalized communities are the hardest hit. "If you look at America, we still live in [racially] segregated communities," Fine says. "Due to historical inequalities, Black communities can suffer from underlying health conditions that are linked to poverty, such as gaps in health care coverage or close proximity with neighbors. There's a concentrated disadvantage, and that can affect health and increase the risk for disease."

As the cases in the U.S. and elsewhere continue to surge, continuing to follow the public health guidelines is crucial if tourism and business are to safely resume, Fine says. "The practices we have in place are effective, although they'd be more effective containing the virus when we have a vaccine," he says. "At some point we have to take stock of what our moral currency is: What are we willing to do to ensure all of our communities are safe and protected? Those are the decisions we'll have to make."

"At some point we have to take stock of what our moral currency is: What are we willing to do to ensure all of our communities are safe and protected? Those are the decisions we'll have to make."

— Mighty Fine, MPH

The Physiology of COVID-19

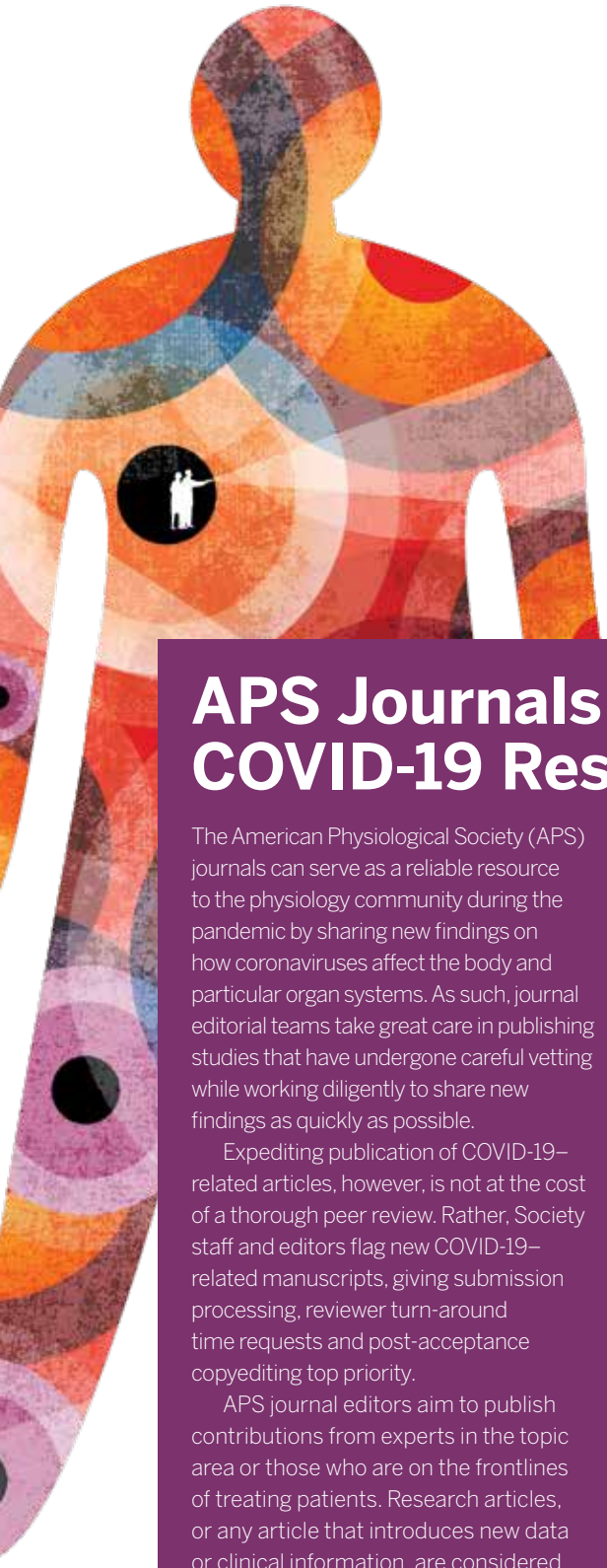
Physiologists are at the forefront of research that advances understanding of how COVID-19 attacks the body and the ways to prevent the damage it causes.

BY LAUREN ARCURI

The world has been in the grip of the novel coronavirus pandemic most of the year. The effects from the SARS-CoV-2 crisis on human health, health care systems and the global economy have been profound.

As U.S. states opened back up this summer, COVID-19 cases continued to rise, while researchers were working furiously to understand the virus better. Scientists need to learn more about the mechanisms of infection and the specific ways the disease exerts its deleterious effects on the physiology of the body, in hopes that they can thwart its damage and save more lives.

Illustration by Michael Austin



The major cause of mortality from COVID-19 is acute respiratory failure from acute respiratory distress syndrome (ARDS), but according to Mark Chappell, PhD, a number of patients with the disease are showing cardiovascular issues such as congestive heart failure, cardiac arrhythmias and vascular thrombosis, as well as brain dysfunction. Chappell is professor in the Cardiovascular Sciences Center at Wake Forest School of Medicine in Winston-Salem, North Carolina. He and his coauthors wrote on this subject in a May article in *American Journal of Physiology-Heart and Circulatory Physiology*. Research is mounting that the consequences of COVID-19 are more complex than they may have seemed at first blush, with wide-ranging effects on multiple physiological systems.

ENTER SARS-COV-2

Viruses must enter the cells of their hosts—which can be humans—in order to make copies of themselves. The copies are then released by the host cells and enter into circulation in the body, infecting still more cells. Then they travel into the world again via host emissions such as respiratory droplets, infecting new people. Researchers have learned that coronaviruses in the SARS family, including SARS-CoV-2, essentially "hijack" the protein angiotensin-converting enzyme-2 (ACE2) to allow them to gain entry into the cells in the lungs, heart, vasculature, brain and other tissues.

The viral coat of SARS-CoV-2 expresses a protein called SPIKE or S protein that contains a region that binds to the extracellular domain of ACE2. The virus uses this SPIKE protein to gain entry into the cell by binding to the ACE2 receptor. "That becomes really important," Chappell says, "because if you could somehow block or downregulate the ACE2 receptor completely, then SARS-CoV-2 would not be infectious anymore."

Several investigators have postulated that blocking ACE2 could be one way to prevent SARS-CoV-2 virus infection. However, the issue is that ACE2 is not merely a receptor for the SARS family of viruses, Chappell says. It's an important enzyme found in most tissues in the human body. ACE2 belongs to an endocrine system called the renin-angiotensin-aldosterone system, or RAAS. This system has been the focus of Chappell's research for 30 years.

Therapies used clinically to treat hypertension act directly on two components of the RAAS:

APS Journals Highlight COVID-19 Research

The American Physiological Society (APS) journals can serve as a reliable resource to the physiology community during the pandemic by sharing new findings on how coronaviruses affect the body and particular organ systems. As such, journal editorial teams take great care in publishing studies that have undergone careful vetting while working diligently to share new findings as quickly as possible.

Expediting publication of COVID-19–related articles, however, is not at the cost of a thorough peer review. Rather, Society staff and editors flag new COVID-19–related manuscripts, giving submission processing, reviewer turn-around time requests and post-acceptance copyediting top priority.

APS journal editors aim to publish contributions from experts in the topic area or those who are on the frontlines of treating patients. Research articles, or any article that introduces new data or clinical information, are considered by at least two independent experts in the topic area. Positively reviewed manuscripts will undergo revision until the work is deemed scientifically and ethically sound for publication.

Physiological Reviews, for example, has published several articles featuring COVID-19 research. "The only difference in the review process is that we asked the reviewers to provide us comments within two weeks. Ordinarily, it takes six weeks to arrive to a decision," said *Physiological Reviews* Editor-in-Chief Sadis Matalon, PhD.

There is much benefit in sharing what clinicians are seeing in the hospitals with physiologists who are experts in specific organ systems or disease states. The Society is pleased that its journals can facilitate such dialogue and help physicians and scientists work through how this new virus fits into and modifies their current thinking.

Read the latest physiological research on COVID-19 in the APS journals' Coronavirus-related Collection at **https://journals.physiology.org/covid19**.

angiotensin-converting enzyme (ACE), which generates angiotensin II (ANG II), and the angiotensin type 1 receptor (AT1 receptor). "The production of ANG II and the subsequent binding of ANG II to its receptor are thought to promote all the deleterious effects of the RAAS," Chappell says. Those include increases in blood pressure, inflammatory events and fibrosis. "So you can target the RAAS with an ACE inhibitor which prevents production of ANG II, or you can block the AT1 receptor with various antagonists which attenuates the actions of ANG II. Those are the two main clinical therapies we have to reduce blood pressure, although recently AT1 receptor antagonists are combined with other antihypertensive drugs."

When ACE2 was first discovered, researchers thought it would be similar to ACE and generate ANG II. They were surprised to discover that despite their similar structure, it has the opposite effect and metabolizes or destroys ANG II. "ACE2 is actually beneficial for our cardiovascular system," Chappell explains. It degrades ANG II so it can't activate the pathways associated with cardiovascular disease. What's more, in the process of degrading ANG II, it forms angiotensin 1–7, or Ang-(1–7), which is also beneficial for the cardiovascular system. Ang-(1–7) is antifibrotic, lowers blood pressure and is anti-inflammatory.

As the SARS-CoV-2 complex is internalized by our cells, this removes ACE2 from the outside of cells, allowing ANG II to build up and lowering the levels of Ang-(1–7). "If there's a high ratio of ANG II to Ang-(1–7) we think that's actually bad for the cardiovascular system and likely bad for pulmonary function, heart function, kidney function and particularly for COVID-19 patients," Chappell says. "The reduction of ACE2 may be contributing to the deleterious effects of viral infection."

The major cause of mortality from COVID-19 is acute respiratory failure from acute respiratory distress syndrome (ARDS), but a number of patients with the disease are showing cardiovascular issues such as congestive heart failure, cardiac arrhythmias and vascular thrombosis, as well as brain dysfunction.

On the flip side, if a therapy could be found that would create a higher ratio of Ang-(1–7) to ANG II, that could be beneficial, according to Chappell. "That has been shown to have beneficial actions in some pulmonary diseases like ARDS, which has affected many COVID-19 patients," he says. "And Ang-(1–7) has also been shown to have protective or beneficial actions in terms of the heart and the kidney, vascular system and brain."

But this means, he cautions, that blocking ACE2 to try to prevent SARS-CoV-2 infection runs the risk of increasing ANG II and lowering Ang-(1–7), which would have negative effects on the cardiovascular system.

Another problem that has been revealed with COVID-19 infection is that older people who have cardiovascular disease and hypertension appear to have greater incidence of mortality from COVID-19. Some physicians have raised concern that being on an ACE inhibitor or

> **"One of the features that seemed to be more characteristic of COVID-19 lung injury is that it is perhaps related more to pulmonary vascular injury."**
>
> **—Michael Matthay, MD, FAPS**

angiotensin receptor blocker (ARB) could make this population more susceptible to SARS-CoV-2 infection.

Chappell thinks that patients should stay on their medications. "It is important for COVID-19 patients to remain on these antihypertensive medications because it may actually reduce the extent of inflammation and cell damage in these patients in addition to, obviously, controlling their hypertension," he says. He also emphasizes that so far there is no clinical data showing that people on an ACE inhibitor or an ARB show a greater incidence of COVID-19 infection and there is some evidence that COVID-19 patients on ACE inhibitors or ARBs may exhibit less severe effects of the infection.

There is a lot that researchers still don't know, but they do know that ACE2 is widely expressed in the brain and that the blood-borne SARS-CoV-2 virus may target brain ACE2 receptors to cause central nervous system infections. Chappell says it could also travel along afferent nerves from peripheral sites in the body into the brain. As more clinicians are reporting neurological symptoms in patients with COVID-19, learning more about ACE2 and how SARS-CoV-2 affects the central nervous system is an emerging focus.

CLUES TO THERAPY

Many patients with severe COVID-19 complications are diagnosed with ARDS, a condition in which fluid collects in the distal air spaces (alveoli) of the lungs, depriving organs of oxygen. Viral pneumonia has been a well-recognized cause of ARDS, but the type of ARDS that COVID-19 causes has some features that seem to be unique.

Michael Matthay, MD, FAPS, is a pulmonologist and critical care physician at the University of California, San Francisco (UCSF), who studies acute respiratory failure from ARDS and from sepsis. He has turned his attention to ARDS in COVID-19. "There's a lot to learn about the mechanisms of injury that might be specific to SARS-CoV-2, but it should be emphasized first that many of the features of SARS-CoV-2 ARDS are really very similar to ARDS from other causes," he says. "The patients have severe hypoxemia, reduced lung compliance, elevated pulmonary dead space and associated non-pulmonary organ failure."

In May, a *New England Journal of Medicine* study compared postmortem, gross and microscopic pathology reports of deceased patients who had COVID-19 ARDS to similar histology and pathology reports from patients who had died from influenza-related pneumonia. It piqued Matthay's interest. "One of the features that seemed to be more characteristic of COVID-19 lung injury is that it is perhaps related more to pulmonary vascular injury" than lung injury from influenza or other viruses, he says. "And there is more evidence of alveolar capillary microthrombi as well as thrombi in other vessels."

This feature is reflected in the complications seen in other body systems with COVID-19—there appears to be a greater incidence of events related to blood clots

(prothrombotic), ranging from clotting of dialysis lines to venous thrombosis to strokes. "There seems to be a procoagulant feature of this illness that may be related to endothelial injury," Matthay says. "It certainly seems to be occurring more frequently in patients who have elevated plasma D-dimers," which are fragments produced when clots degrade.

Thus, one potential treatment strategy that has been of interest to researchers is the possibility of giving full-dose anticoagulants. Matthay says most patients are on a prophylactic dose. However, there is a concern that this could lead to an increase in bleeding events. "My view is that this may not be sufficient because it may not attack or manage adequately the primary mechanisms for vascular injury," he says. "We may need more novel therapies that actually work at the level of trying to attenuate the lung vascular injury."

In a March 2020 article in *Physiological Reviews*, Matthay and colleagues explored the elevated plasminogen and plasmin seen in COVID-19 patients that they think may be associated with the comorbidities that patients have, such as diabetes and possibly hypertension. Plasminogen is a precursor of plasmin, a critical enzyme found in the blood that degrades blood plasma proteins, including fibrin clots, in a process called fibrinolysis. "It's possible that this ties into the hyperfibrinolysis associated with plasmin levels that lead to elevated D-dimers," he says. "Theoretically, the plasminogen system could be a target for therapy." Plasmin may cleave the spike proteins of SARS-CoV-2, increasing its ability to hijack the ACE2 receptor and invade cells. This may be why patients with these comorbidities have worse outcomes with COVID-19.

Another target could be the mechanisms that are activated and cause endothelial injury, such as angiopoetin-2 (Angpt2). "One area of particular interest to us and other investigators is the angiopoetin-2 system," Matthay says. "It was reported by our research group in 2006 and in follow-up studies from us and others to be a very good plasma biomarker of poor prognosis in sepsis and ARDS and also a mediator of lung and systemic injury." Therapies that inhibit the effects of Angpt2 might then decrease the injury to the vascular epithelium.

Other approaches to mitigate ARDS-induced lung damage and help lungs heal from the ravages of COVID-19 are also being investigated. Matthay and colleagues are currently enrolling a Phase 2b clinical trial at UCSF and other locations around the U.S. to test whether intravenous doses of mesenchymal stromal cells (MSCs)—a type of cell from bone marrow, adipose tissue or umbilical cord—can help heal the lungs of COVID-19 patients suffering from ARDS. MSCs reduce injury to the lung and seem to enhance recovery time. Results from a phase 2b efficacy trial should be available in 12 to 18 months.

TARGETING THE PLASMIN(OGEN) SYSTEM

Matthay's article about plasmin enhancing the virulence of SARS-CoV-2 and increasing fibrinolysis inspired Brant Wagener, MD, PhD, an anesthesiologist and critical care physician at the University of Alabama at Birmingham (UAB), and coauthor Andrew Barker, MD, an anesthesiologist and intensivist at UAB, to brainstorm ideas for therapies that may target this system.

"A senior investigator in our department, Timothy Ness, came to me with an idea that we're working on together," Wagener says. "We use a drug in the operating room all the time to stop bleeding, called tranexamic acid, or TXA. It prevents the conversion of plasminogen to plasmin." Since it's thought that plasmin is one of the proteases that may cleave various sites of the virus—making it more likely to infect patient cells and become more virulent—theoretically, with less plasmin, the infectivity of the virus may be reduced. "That would give the patient's own immunity time to catch up and kill off the virus before it can get too far," Wagener says. The trial will use TXA in the early stages of COVID-19 and in patients who have comorbidities such as diabetes and hypertension that put them at higher risk of serious complications from the virus.

Currently, Wagener, Ness and Sonya Heath, MD, an infectious disease specialist also at UAB, are recruiting patients for a TXA clinical trial. They're specifically looking for patients shortly after diagnosis to administer five days of TXA and hopefully prevent hospitalization. Because TXA could potentially promote clotting, patients in the trial will concurrently have anticoagulation therapy. "We also use TXA in orthopedic surgeries, which are some of the highest-risk surgeries in terms of forming clots. When we use it in those patients, it doesn't increase the amount of clots we see, but because this is COVID-19, and there's a lot we still don't know about this infection, we're playing it safe," Wagener says.

As of July, the first cases had been enrolled. The trial is ongoing, with results expected later this year, according to Wagener.

SARS-COV-2 AND THE BLOOD-BRAIN BARRIER

The novel coronavirus can travel to the brain, too. More studies are being published that document neurological and neuropsychiatric

Research suggests that the interaction of the spike proteins from SARS-CoV-2 with the endothelial cells in the blood-brain barrier may be initiating an inflammatory response.

symptoms in COVID-19 patients. These include dizziness, loss of equilibrium, problems with motor function, delirium and confusion, as well as vascular issues such as strokes and autoimmune responses such as Guillain-Barré syndrome. Researchers are scrambling to determine exactly how SARS-CoV-2 gets to the brain and what happens once it is there.

Dao Ho, PhD, a biomedical research physiologist at Tripler Army Medical Center in Honolulu, studies how SARS-CoV-2 affects the blood-brain barrier, which helps protect the brain from harmful substances. She is modeling the blood-brain barrier using a technology called electric cell-substrate impedance sensing (ECIS), in which brain microvascular endothelial cells are cultured on a plate outfitted with electrodes. These endothelial cells form the barrier by linking together with junction proteins that function much like bridges, holding the cells tightly to each other. The ECIS system uses the plate containing electrodes to detect the resistance of an electrical current through the layer of cells. Lower resistance means a leakier barrier, while higher resistance means tighter junctions, or spaces, between cells and fewer leaks. Applying a toxicant, drug or the spike proteins from SARS-CoV-2, Ho can test how the substance affects the function of this barrier layer.

Her research is not yet published, but what she and her team are finding suggests that the interaction of the spike proteins from SARS-CoV-2 with the endothelial cells in the blood-brain barrier may be initiating an inflammatory response. Once the response is underway, cytokines and other inflammatory markers that are elevated in COVID-19, such as interleukins and tumor necrosis factor alpha (TNFα), may induce leakiness in the blood-brain barrier.

"It becomes a feedback loop because once the inflammatory response is initiated in these cells, the cytokines work to reduce the expression of the junction proteins," Ho says. Thus, a leaky blood-brain barrier becomes even leakier and inflammation continues to increase as proteins and other substances not meant to cross into the brain find their way there, damaging neurons in the brain. Damaged neurons could contribute further to the leakiness, as neurons play a role in keeping the blood-brain barrier functional.

LOOKING FORWARD

Research on SARS-CoV-2 and COVID-19 is moving rapidly, but there is still much that needs to be studied. Work continues on all fronts to understand how the virus affects so many systems and organs of the body and how to prevent and treat the damage it does.

"We know a little bit more about COVID-19 today than we did three months ago," Matthay says, "but there is a lot more to learn."

Open Access: What Researchers Need to Know Now

Researchers, including published authors and APS members, understand that rapid and widespread dissemination of physiological research can advance the field. Open access (OA) publishing is frequently mentioned as a path toward this future, but what does this mean for researchers? Listen to this APS webinar on-demand to learn more on this emerging publishing model.

Agenda

Intro to OA for Researchers

- **OA Typology**–Gold, green, bronze, hybrid and others.
- **OA Benefits for Authors**–Readership, copyright and reuse.

Who Covers the Cost of OA Publishing: Author? Funder? Institution?

- **Types of Publishing Costs**–Submission fees, color and page fees, publication fees, open access article processing charges.
- **What Are Transformative Agreements**–From "Read & Publish," "Publish & Read," "Subscribe to Open" and "Read, Publish & Join,": What are librarians talking about?

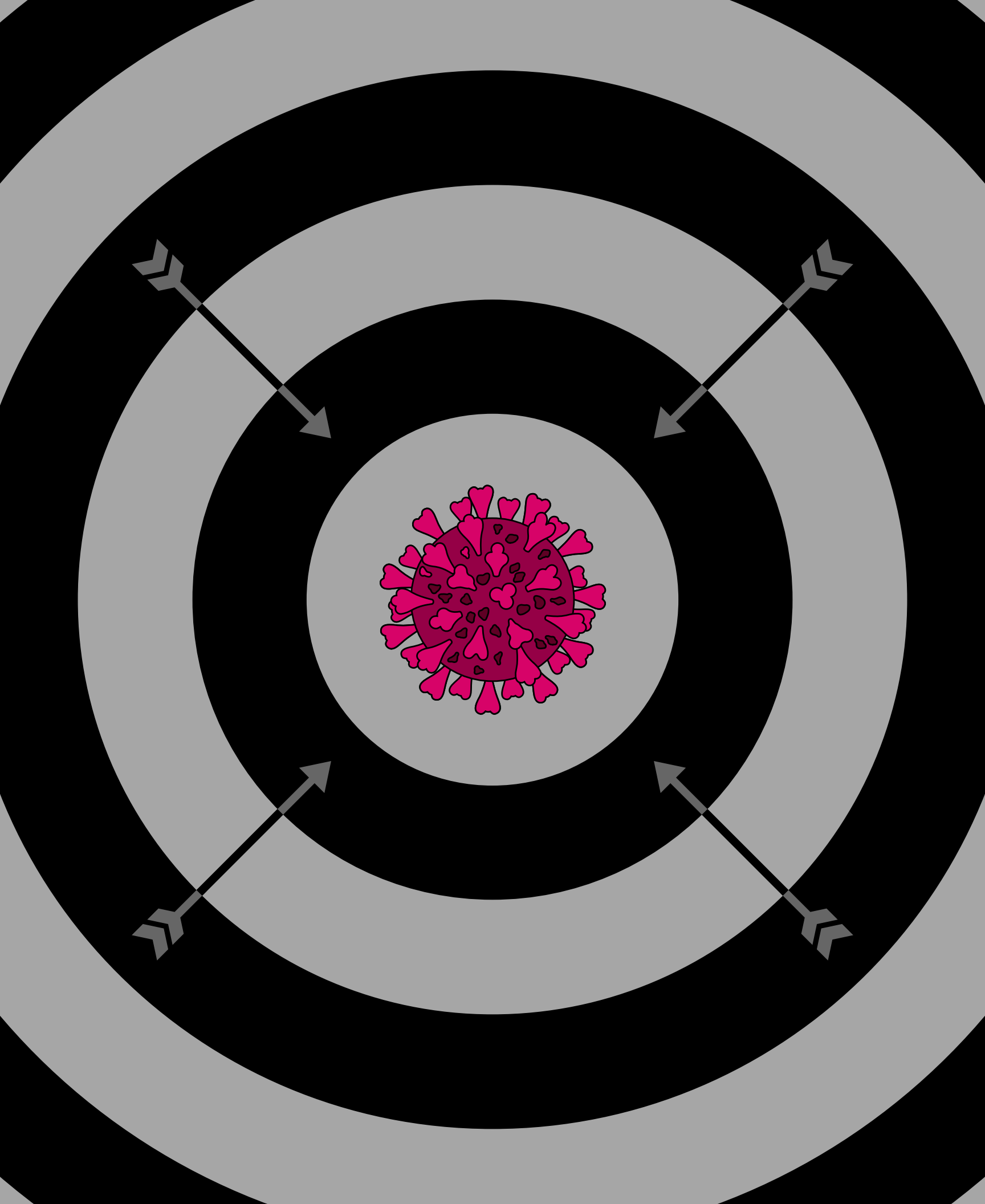
A Researcher Perspective: Paying for OA from Your Grant and Budget

- **Scenarios for Paying for OA**–Case examples from your colleagues about how they use their budgets and grants to pay for publishing research.

Speakers

Lisa Janicke Hinchliffe, MS
Professor for Information Literacy Services and Instruction, University of Illinois at Urbana-Champaign.

Dennis Brown, PhD, FAPS
APS Chief Science Officer, Professor of Medicine at Harvard Medical School in Boston, Director of the Massachusetts General Hospital (MGH) Program in Membrane Biology.



Targeting Coronavirus

Physiologists halt their projects to put all their focus on prevention and treatment of COVID-19.

BY MELANIE PADGETT POWERS

Much attention has been focused on the all-important creation and availability of a COVID-19 vaccine. But at the same time, with little to no fanfare, physiologists and other scientists have been working long hours to respond to other aspects of the pandemic. They overhauled their labs, pulled together new teams and halted their previous research, going all in to focus on COVID-19 tests and treatments.

Before the coronavirus pandemic hit the U.S., physiologist and clinical anesthesiologist Michael J. Joyner, MD, had been studying blood loss in combat, the role of hemoglobin in oxygen transport during hypoxia, sex and age differences on blood pressure, and human performance to try to understand how fast humans can go. Joyner is professor of anesthesiology in the Department of Anesthesiology and Perioperative Medicine at the Mayo Clinic in Rochester, Minnesota.

"Sometimes it's better to be a generalist than a specialist because we did not know all the limitations to what we were doing. We didn't really know why we couldn't do this, and we didn't know how things had been done in the past."

—Michael J. Joyner, MD

In February 2020, Joyner read a *Wall Street Journal* op-ed written by his researcher friend Arturo Casadevall, MD, PhD, of Johns Hopkins School of Medicine in Baltimore. Casadevall described how during a 1934 measles outbreak a physician used a recovered boy's blood to help his classmates. The physician, believing the boy's blood had protective antibodies, extracted it and injected it into 28 other students. None of them got sick. Casadevall explained that the same concept could be used for SARS-CoV-2, the novel coronavirus that causes COVID-19.

Michael J. Joyner, MD

Joyner was intrigued. "This was probably the first best biologically plausible shot at a therapeutic goal," he explains. He immediately emailed Casadevall, who was starting a prophylactic trial at Hopkins. Joyner proposed a therapeutic protocol at Mayo, and they were off and running.

Joyner is now the principal investigator of the U.S. Food and Drug Administration (FDA) Expanded Access Program for COVID-19 convalescent plasma. The first COVID-19 patients were enrolled in early April, and by the end of July, nearly 46,000 patients across the U.S. had been given convalescent plasma.

"This is by far the biggest thing I've ever been involved with," Joyner says. "My name is on the thousands of consent forms all over the country and also the INDs (investigational new drug applications) at the FDA."

The plasma collection from recovered COVID-19 patients is handled by the blood banking industry, under FDA regulations. More than 2,600 hospital sites in the U.S. have signed up. So far, about 1,800 sites have used convalescent plasma.

The latest safety update of 20,000 patients shows the treatment is safe. (It was not designed to study the efficacy of the convalescent plasma.) Patients who received the treatment between April 3 and June 11 had a seven-day mortality rate of 8.6%. Serious adverse events related to transfusion of the plasma were less than 1%. The diversity of the population studied has continued to improve, with almost 40% women, 20% Black, nearly 35% Hispanic and 5% Asian. (For more, visit **www.uscovidplasma.org**.)

FROM ZIKA TO COVID-19

At Meharry Medical College in Nashville, Tennessee, Donald Alcendor, PhD, has been focusing on developing an antiviral drug to treat COVID-19 patients. Alcendor, associate professor of microbiology and immunology, used his expertise from developing a Zika antiviral in 2016. His COVID-19 reagent aims to stop the coronavirus from replicating in cells. Ideally, it would be given intravenously to patients in early-stage disease, before they have severe symptoms.

"The idea is that the antiviral is used to circumvent replication and prevent the outcome of the replication—tissue damage, pathology and the inflammation that ensues after virus replication," he explains. "If you could stop the virus in its tracks, you'd be able to stop all the pathology that follows infection, and the main pathology would be tissue damage and inflammation.

"And if you're able to do those two things, you'd be well on your way to helping a patient to get better on their own, giving their immune system a chance to maybe clear the virus and allow them to recover."

Donald Alcendor, PhD

Evangeline Motley-Johnson, PhD

Alcendor's antiviral was ready for preclinical testing in mice in July to determine safe dosage levels. After that, his team will move to an infection model to test treatment efficacy. Then, Alcendor will file for an FDA compassionate use proposal for an early phase I study to test on seriously ill COVID-19 patients. If all goes well, he expects his antiviral to be ready for patients by spring 2021.

Alcendor's work is not only important scientifically; it goes hand in hand with the mission of Meharry, which is a historically Black institution.

"At Meharry, our mission is to serve the underserved, and the underserved population is at the greatest risk for disease in this epidemic," Alcendor says. "We want to do our part in this. We want to protect those underserved populations by developing an intervention that could be effective and safe against this virus."

Black Americans have the highest overall death rates from COVID-19. As of June, the death rate for Black Americans was about 2.3 times as high as for whites and Asians, about twice as high as the Latino and Pacific Islander rate, and 1.5 times as high as the Indigenous rate, according to APM Research Lab.

Alcendor's open access review article on COVID-19 disparities, "Racial Disparities-Associated COVID-19 Mortality among Minority Populations in the US," was published in the *Journal of Clinical Medicine* on July 30.

Early on in the pandemic, Meharry, working closely with the City of Nashville, offered free drive-through and walk-up testing in its predominantly Black neighborhood. Under the leadership of Meharry President and CEO James E.K. Hildreth, PhD, MD, the school eventually took over the city's other testing sites too. Hildreth, who is an infectious disease expert, has continued to educate Nashville residents about COVID-19 and preventive strategies.

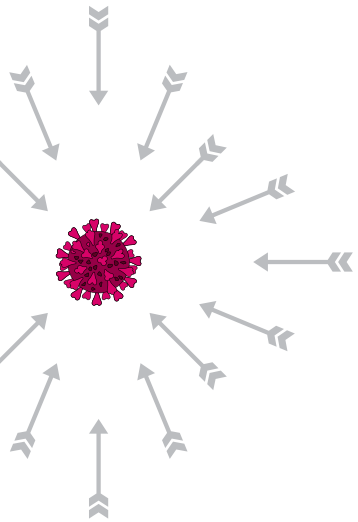
Hildreth has also proposed to Congress forming a consortium to address the Black health disparities among COVID-19 patients in partnership with the three other historically Black medical schools: Howard University in Washington, D.C.; Morehouse School of Medicine in Atlanta; and Charles R. Drew University in Los Angeles. No funding has been provided specifically for the consortium, but in June, Morehouse was awarded a $40 million grant to address the same issue.

Evangeline Motley-Johnson, PhD, says Hildreth has been an "important voice" for the city and the country. Motley-Johnson, professor of physiology and interim dean of Meharry's School of Graduate Studies and Research, was involved early on in the discussions about creating drive-through and walk-up testing sites. She now volunteers at the sites three days a week.

In the future, Motley-Johnson wants to be able to look back and say, "Meharry stepped up and was there to give a service to the community."

"At Meharry, our mission is to serve the underserved, and the underserved population is at the greatest risk for disease in this epidemic."

—Donald Alcendor, PhD



EMBRACING SCIENTIFIC CURIOSITY

The coronavirus has scientists in all fields brainstorming and hypothesizing what might help stop the disease. Lipids researcher Valerie O'Donnell, PhD, was lead author on a review in the APS journal *Function* about the potential of dental mouthwashes to destroy the lipid envelope of coronaviruses, thus reducing the spread of COVID-19. The paper calls for immediate clinical trials to test the effectiveness of the approach.

Valerie O'Donnell, PhD

O'Donnell, director of the Division of Infection and Immunity and co-director of Systems Immunity Research Institute at Cardiff University in Wales, became interested in the idea after she heard, early in the pandemic, the recommendation to use hand sanitizer with 60–70% alcohol to kill the coronavirus. That percentage seemed "harsh" and unnecessary to use against an enveloped lipid like SARS-CoV-2, she says.

"And it's very clear that common agents in mouthwashes or low concentrations of ethanol can work quite effectively. The question then is if you go from a test tube to somebody's mouth and somebody's throat, could it work there?"

—Valerie O'Donnell, PhD

O'Donnell discovered that that percentage was not created specifically for this coronavirus but based on more general information. Historically, it was discovered that microbicide agents would need at least 60% alcohol to kill a broad spectrum of viruses and bacteria. The alcohol levels needed to kill SARS-CoV-2 could be much lower, which led O'Donnell to start thinking about oral mouthwashes, which contain about 14–27% ethanol.

"When you look at the literature on enveloped viruses and how to inactivate them, there's a lot of literature in vitro on how to inactivate them in test tubes," O'Donnell says. "And it's very clear that common agents in mouthwashes or low concentrations of ethanol can work quite effectively. The question then is if you go from a test tube to somebody's mouth and somebody's throat, could it work there?"

As the virus replicates, cells continue to shed out through the throat, which leads to the question of how long a response from an oral mouth rinse would last. That's where clinical trials are needed, O'Donnell says. The findings could help lead to another way to prevent spread of the disease, as well as providing potential protection for dentists. In response to the pandemic, the American Dental Association issued some "common sense recommendations" that include having patients rinse with 1.5% hydrogen peroxide or commercially available rinses that contain 1.5% hydrogen peroxide before treatment.

Evidence shows high viral loads are found in sputum, and yet, O'Donnell says, preventing oral transmission is a neglected area. "Simple antiviral approaches to target the oral cavity is an area that just feels like it's not being addressed."

TESTING OHIO

After the pandemic reached the U.S., cardiovascular physiologist Loren E. Wold, PhD, became instrumental in the creation and distribution of COVID-19 test kits across his state of Ohio. Wold is professor of nursing and medicine, assistant dean for biological health research and director of the Biomedical Laboratory at The Ohio State University College of Nursing in Columbus.

After non-essential research was shut down on campus, Wold was restless working from home when the vice dean for research called him and asked if he would oversee the process of making test kits. "Initially, that was an opportunity for me to get to go into the office as an essential COVID-related researcher, so I jumped at the chance," he says. "Very quickly, my lab basically took over the entire process."

It was early April and the university was making about 1,000 test kits a day. That number needed to ramp up significantly, so Wold and his research team of about 15 people transformed his two lab spaces and took over six more in the building.

Loren E. Wold, PhD

Faculty and staff from across the university offered to help, from other physiologists to faculty from the colleges of medicine, nursing and engineering. Even a few coaches volunteered. In a few weeks, the team was making over 10,000 test kits a day. Eventually, they made nearly 300,000 kits. Demand slowed down after a couple of months, and by June 15, production was scaled back to 2,000 to 4,000 kits a day with newly hired staff. Researchers were given back their labs.

"Now it's wonderful because I've met people from all over campus I probably would have never met before. ... I had never worked with anything related to supply chain, having to order on these levels."

—Loren E. Wold, PhD

At the beginning, everything was on backorder: test media, sterile conical tubes and long nasal swabs. So, a colleague of Wold's created the university's own medium, which they dubbed Buckeye Media, after the university's mascot. They began making it in-house and were soon making 250 liters of media a week.

For tubes, the team gathered up a supply from the university labs' own stock until their order of 1 million tubes arrived. The next challenge was finding swabs. "We had set up the capabilities to do our own 3D printing of swabs, but … to be able to produce what we needed, it was going to take a ton of time with the manufacturing capabilities we had," Wold says. Luckily, he says, more manufacturers began making swabs and they were able to order what they needed.

Figuring out the production process was the biggest learning curve, he says. "Now it's wonderful because I've met people from all over campus I probably would have never met before. … I had never worked with anything related to supply chain, having to order on these levels. I had to get to know the people at such a huge university who were the ones that could make this happen—those in supply chain, those in leadership and those in the business operations who had to sign off on all these things."

THE WORK CONTINUES

As fall arrives, physiologists and other scientists across the U.S. continue to brainstorm on ways they can contribute to the study, prevention and treatment of COVID-19. At Mayo, Joyner says being a physiologist helped him pivot from his research to leading the convalescent plasma program.

"Sometimes it's better to be a generalist than a specialist because we did not know all the limitations to what we were doing," he says. "We didn't really know why we couldn't do this, and we didn't know how things had been done in the past."

Case Receives Distinguished Graduate Student Mentor Award

Adam Case, PhD, an assistant professor at the University of Nebraska Medical Center (UNMC), is the 2020 recipient of UNMC's Graduate Student Association's Distinguished Graduate Student Mentor Award. The award recognizes outstanding mentorship in the areas of research, critical thinking, communication skills and career preparation. An active APS member since 2012, Case is on the *American Journal of Physiology-Heart and Circulatory Physiology* editorial board and was recently named to the Cardiovascular Section's Nominating Committee.

Kohan Receives American Heart Association Award

Donald Kohan, MD, PhD, FAPS, is the 2020 recipient of the American Heart Association (AHA) Council on the Kidney in Cardiovascular Disease Distinguished Achievement Award. The award is presented every three years to those who have made major contributions to an AHA scientific council, to new knowledge in the field or to teaching or clinical care in the field. Kohan, an APS member since 1991, is the DRF Endowed Chair in Nephrology and Professor of Medicine at the University of Utah and a past chair of the APS Renal Section. His research focuses on using renal cell-specific gene targeting to examine tubule-derived autocrine and paracrine factor regulation of kidney function and blood pressure.

Kregel Begins New FASEB Position

Kevin C. Kregel, PhD, FAPS, executive vice provost and senior associate provost for faculty at the University of Iowa, began his term as the Federation for American Societies for Experimental Biology (FASEB) vice president for science policy on July 1. A member of APS since 1988, Kregel is a past chair of the Animal Care & Experimentation and Science Policy committees and was the APS representative to the FASEB Board from 2018 to 2020.

Labrecque Receives Canadian Institutes of Health Research Award

Lawrence Labrecque, a PhD student in kinesiology at Université Laval in Québec, Canada, is a 2020 recipient of the Frederick Banting and Charles Best Canada Graduate Scholarships Doctoral Award. The award is sponsored by the Canadian Institutes of Health Research and recognizes continued excellence in Canadian research. Labrecque's doctoral studies focus on cerebral blood flow regulation during high-intensity interval training in patients with peripheral artery disease.

Wandinger-Ness Receives Presidential Award for Excellence in STEM Mentoring

Angela Wandinger-Ness, PhD, of the University of New Mexico (UNM), is a recipient of the 2020 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM). PAESMEM honors the important role mentors play in guiding the academic and professional development of future STEM professionals. Wandinger-Ness is associate director for education, training and mentoring at the UNM Comprehensive Cancer Center and an endowed professor in the UNM School of Medicine's Pathology Department. She has been an APS member since 2002.

APS Welcomes Class of 2020 Fellows

The following members have recently been awarded the prestigious status of Fellow of the American Physiological Society (FAPS). FAPS honors distinguished leaders who have made significant contributions to physiological sciences and related disciplines and have served the Society for at least 15 consecutive years. Congratulations to the Class of 2020!

David J. Adams, PhD
Victor A. Convertino, PhD
Robert S. Fitzgerald, PhD
Joseph C. LaManna, PhD
David L. Mattson, PhD
Derek M. McKay, PhD
Vladimir Parpura, MD, PhD
Noreen F. Rossi, MD
Ivo P. Torres Filho, MD, PhD

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physiology.org/jobs

DATES & DEADLINES

AWARDS

A. Clifford Barger Underrepresented Minority Mentorship Award (Deadline: September 15)

Bodil Schmidt-Nielsen Distinguished Mentor and Scientist Award (Deadline: September 15)

Environmental & Exercise Physiology Section CANTROL Environmental Systems New Investigator Research Award (Deadline: November 14)

Environmental & Exercise Section Gatorade Sport Science Institute Postdoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Gatorade Sport Science Institute Predoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section New Investigator Award (Deadline: November 14)

Environmental & Exercise Section Nike Loren G. Myhre Postdoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Nike Loren G. Myhre Predoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Partnership for Clean Competition Anti-doping Postdoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Partnership for Clean Competition Anti-doping Predoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Postdoctoral Research Award (Deadline: November 14)

Environmental & Exercise Section Predoctoral Research Award (Deadline: November 14)

Neural Control & Autonomic Regulation Section Data Sciences Outstanding Graduate Student Award (Deadline: November 14)

Neural Control & Autonomic Regulation Section Experimental Biology Trainee Award (Deadline: November 14)

Neural Control & Autonomic Regulation Section Michael J. Brody Young Investigator Award (Deadline: November 14)

Neural Control & Autonomic Regulation Section New Investigator Award (Deadline: November 14)

Neural Control & Autonomic Regulation Section Research Recognition Awards (Deadline: November 14)

Neural Control & Autonomic Regulation Section The NCARnation Trainee Presentation (Deadline: November 14)

Respiration Section New Investigator Award (Deadline: November 14)

Respiration Section Outstanding Trainee Award (Deadline: November 14)

Respiration Section Research Recognition Award (Deadline: November 14)

Respiration Section Trainee Poster Presentation Awards (Deadline: November 14)

Respiration Section The Usha Awards sponsored by Y.S. Prakash, MD, PhD (Deadline: November 14)

Respiration Section Giles F. Filley Memorial Award for Excellence in Respiratory Physiology and Medicine (Deadline: November 15)

Cardiovascular Section Clinical Science Young Investigator Award (Deadline: November 19)

Cardiovascular Section New Investigator Award (Deadline: November 19)

Cardiovascular Section Outstanding Postdoctoral Trainee Award (Deadline: November 19)

Cardiovascular Section Outstanding Graduate Student Trainee Award (Deadline: November 19)

Cardiovascular Section Research Recognition Award (Deadline: November 19)

Renal Section Predoctoral Excellence in Renal Research Awards (Deadline: November 21)

Renal Section Postdoctoral Excellence in Research Awards (Deadline: November 21)

Renal Section Research Recognition Awards (Deadline: November 21)

Renal Section New Investigator Award (Deadline: November 21)

Endocrinology & Metabolism Section New Investigator Award (Deadline: November 22)

Endocrinology & Metabolism Section Research Recognition Award (Deadline: November 22)

Endocrinology & Metabolism Section Virendra B. Mahesh Award of Excellence in Endocrinology (Deadline: November 22)

Central Nervous System Section New Investigator Award (Deadline: November 25)

Central Nervous System Section Research Recognition Award (Deadline: November 25)

Central Nervous System Section Van Harreveld Memorial Award (Deadline: November 25)

Juan Carlos Romero and Water & Electrolyte Homeostasis Section Postdoctoral Research Recognition Award (Deadline: November 27)

Teaching of Physiology Section New Investigator (Deadline: November 27)

Teaching of Physiology Section Research Recognition (Deadline: November 27)
Teaching of Physiology Section William Galey Professional Skills Training Scholarship Award (Deadline: November 27)
Water & Electrolyte Homeostasis Section New Investigator Award supported by Data Sciences International (Deadline: November 27)
Water & Electrolyte Homeostasis Section Portland Press Predoctoral Research Recognition Award (Deadline: November 27)
Local Undergraduate Research Awards in Physiology (Applications accepted on an ongoing, year-round basis)

More details: www.physiology.org/awards
These deadlines are subject to change. Please check the APS website for updates on award deadlines and applicant eligibility.

CALLS FOR PAPERS

Journal of Applied Physiology (September 1, 2020)
- Highlighted Topic: Physiology of Thermal Therapy

American Journal of Physiology-Gastrointestinal and Liver Physiology (No deadline)
- Adaptations of Physiologic Systems to Promote Cancers
- The Chronification and Treatment of Visceral Pain
- Coronavirus Disease (COVID-19) and Digestive System
- Gastrointestinal Issues in Neurological Diseases
- Microbiome-based Therapeutics and Their Physiological Effects
- The Physiology of Cellular Organelles

More details: www.journals.physiology.org/calls

MEETINGS & EVENTS

OBESITY WEBINARS

Cravings and weightlifting squats: technologies that explore new metabolic and behavioral research
September 2, 2020
- Speakers: Zhen Yan, PhD; Diego Bohorquez, PhD

Mitochondrial membrane lipids and respiratory efficiency
September 16, 2020
- Speaker: Katsu Funai, PhD

Animal model selection, study design and current trends in preclinical obesity research
September 30, 2020
- Speaker: Fred Beasley, PhD

More details: www.physiology.org/obesity

FUNCTION-SPONSORED WEBINAR

The brain as a whole: executive neurons and sustaining homeostatic glia
September 29, 2020
- Speakers: Carl Petersen, PhD; Alexei Verkhratsky, MD, PhD, DSc

More details: www.physiology.org/webinars

PHYSIOLOGY EDUCATORS COMMUNITY OF PRACTICE (PECOP) WEBINARS

Writing and reviewing for *Advances in Physiology Education*
September 17, 2020
- Speaker: Doug Everett, PhD, FAPS; Moderator: Alice Villalobos, PhD

A framework of college student buy-in to evidence-based teaching practices in STEM: the roles of trust and growth mindset
October 22, 2020
- Speaker: Mark Graham, PhD

More details: www.physiology.org/meetings

APS CONFERENCE

Integrative Physiology of Exercise
Virtual Conference
November 9–13, 2020
- Abstract Submission Deadline: October 1
- Abstract Award Deadline: October 1

ACCOLADES

APS Racks Up Multiple Coveted Association Awards

APS was honored with eight top awards recently in recognition of marketing and communications excellence in the association community. Four of these awards were the highest possible recognition. APS beat out stiff competition in the association community for the highly coveted honors given by three different organizations. The awards were:

Association Media & Publishing EXCEL Awards

The EXCEL Awards recognize excellence and leadership in association media, publishing, marketing and communications.

- Gold Award – www.physiology.org (Website General Excellence)
- Gold Award – I Spy Physiology Blog (Blog Site – Overall)
- Bronze Award – APS Rebranding (Rebranding)
- Bronze Award – APS at Experimental Biology (EB) Campaign (Direct Mail Campaign for Event/Convention)
- Bronze Award – APS at EB Campaign (Integrated Media Campaign for an Event/Convention)

Communications Concepts' APEX Awards

APEX Awards are based on excellence in graphic design, editorial content and the ability to achieve overall communications excellence. APEX Grand Awards honor the outstanding works in each main category, while APEX Awards of Excellence recognize exceptional entries in each of the individual categories.

- Grand Award – I Spy Physiology Blog (Social Media)
- Award of Excellence – *The Physiologist Magazine* (Magazines, Journals & Tabloids, Print – +32 pages)

Association Trends' TRENDY Awards

The TRENDY Awards seek to honor the best in association and nonprofit marketing and communications.

- Gold Award – APS Promotional Giveaways (Promotional Items)

"These awards are very competitive, with many top-notch associations submitting their work," said APS Executive Director Scott Steen, CAE, FASAE. "APS is undergoing significant change right now, and this recognition is a wonderful validation of some of the work we are doing to increase recognition of both APS and the discipline of physiology. I'm very proud of the work of our marketing and communications teams, along with the many other APS staffers from across the organization who contributed to these efforts."

The Society recognized its industry partners whose collaboration has been integral to its success:

- Results Direct (www.physiology.org)
- Grafik (APS rebranding, promotional item development)
- Chuck Fazio (APS on-site photographer)
- Brad Latham, Latham Creative (*The Physiologist Magazine*)
- Melanie Padgett Powers, MelEdits (*The Physiologist Magazine*, I Spy Physiology Blog)

SECTION AND CHAPTER NEWS

APS Chapters Host Annual Meetings

The **Kentucky Chapter of the American Physiological Society** successfully conducted a virtual Summer Research Conference on June 19, 2020, hosted by Kentucky State University. The Chapter's Board of Directors organized the half-day event, which included 49 attendees. The conference included several oral presentations in student and trainee categories. Presentations were judged, and awards were presented totaling $750.

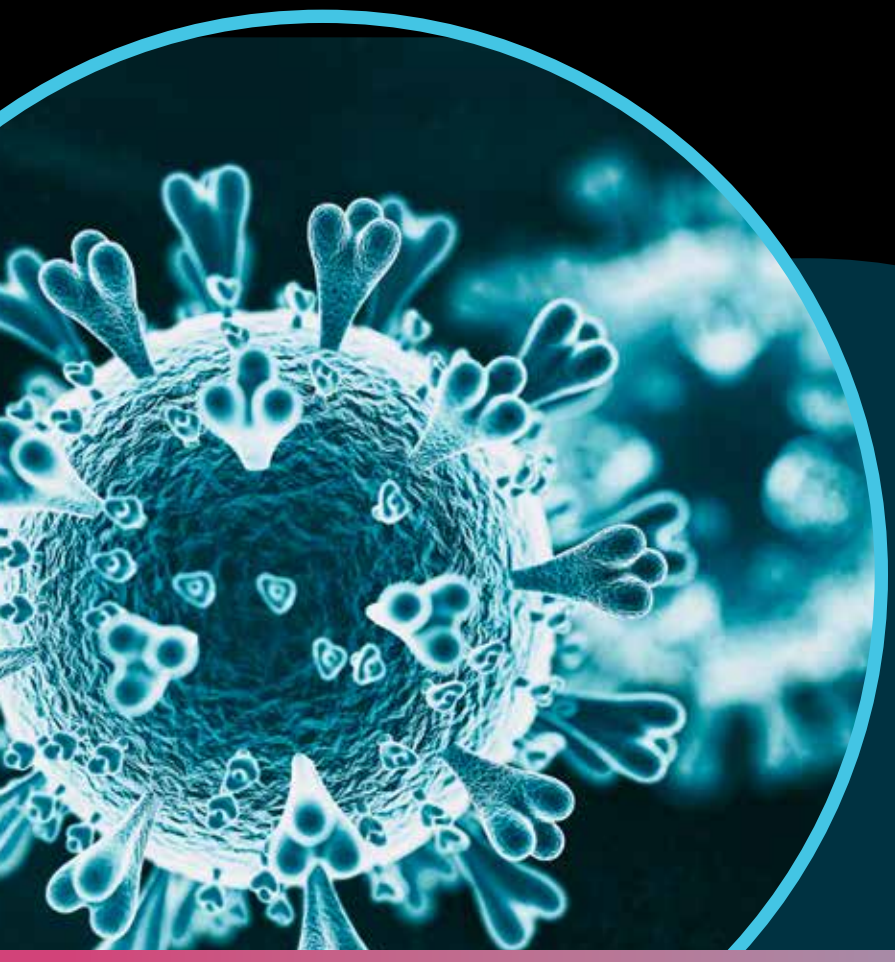
The **Michigan Physiological Society** held its 8th Annual Conference virtually on June 26, 2020. Twenty abstracts were chosen for presentation, which included a five-minute rapid poster presentation followed by a short Q&A. The meeting featured four sessions with five presenters and was attended by approximately 130 attendees. Submitted abstracts and the list of trainees that received recognition can be found at **www.apsmichigan.org**.

The annual meeting of the **Oklahoma Society of Physiologists** (OSP) in conjunction with the Tulsa Society for Neuroscience and Tulsa Area Bioscience Education and Research Consortium was held on July 23, 2020. This remote Zoom conference included three major symposia: Outreach—presentations on recent scientific activities with high school teachers and middle school girls; Education—presentations and a panel discussion on online distance learning; and Research—a virtual poster session organized in Zoom breakout rooms. OSP is happy to report a successful remote conference.

CALL FOR PAPERS

The Pathophysiology of COVID-19 and SARS-CoV-2 Infection

Learn more and submit: https://tinyurl.com/ajplung-covid19



SUBMISSION DEADLINE: DECEMBER 31, 2020

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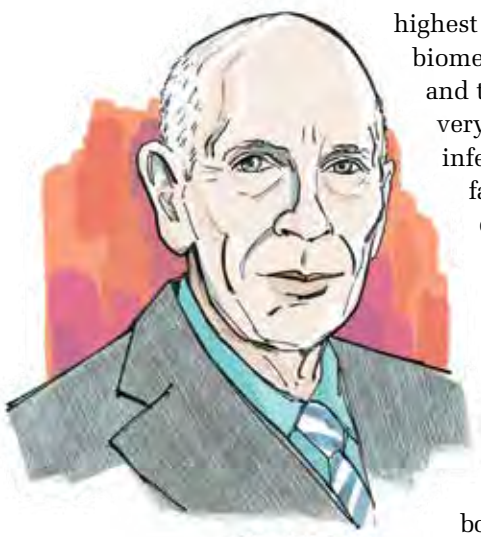
Common Sense and Evidence

BY OLE H. PETERSEN, MD, CBE, FRS

Nobody has escaped the impact of COVID-19, and therefore everyone has thoughts about the current situation, what has, should have been and will be done. My own perspective is influenced by my training as a medical doctor and by my current jobs as one of the managers of Science Advice for Policy by European Academies (SAPEA)—a key element of the European Commission's Scientific Advice Mechanism—and as editor of APS' new open access journal *Function*.

As I write this at the end of July 2020, we have a paradoxical situation. The two countries in the world with perhaps the highest reputation for advanced biomedical research—the U.K. and the U.S.—have done very badly, with COVID-19 infection and death rates far in excess of many countries with more modest research records. This should inspire appropriate humility and a desire to understand where things went wrong.



Clearly, an important part of the problem in both countries is political. However, I have also noticed that national scientific advisers, often too closely associated with their governments, as well as the World Health Organization (WHO), sometimes disregarded simple common sense and failed to give sensible advice at a time when it could have had maximal impact.

The issue of face masks is illustrative. For a long time, the official advice was not to recommend their use. Two principal arguments were advanced: a lack of hard scientific evidence showing that masks were effective and the suggestion that wearing masks could give a false sense of security, encouraging irresponsible behavior.

There were, indeed, no gold-plated clinical trials showing that masks prevent transmission of the virus. However, the precautionary principle was largely ignored. Given that COVID-19 is spread by SARS-CoV-2 airborne transmission, it was highly plausible that masks would reduce transmission and, very importantly, would not pose any health risks. The other argument about creating a false sense of security seems, to me, simply ridiculous. If we were to apply such arguments, seat belts—to name just one example—should never be worn! It would now appear that countries that introduced wearing of masks early in the crisis had much better outcomes than those that delayed the decision.

SAPEA does not deal with short-term advice in crisis situations, but it is engaged in providing advice about issues affecting long-term policy decisions. In one of our recent projects (**https://bit.ly/SAPEAMASOS**), we noted that issues of importance for policymakers mostly involve much uncertainty, due to both inadequate data and inherent complexity. Nevertheless, policy decisions have to be made. And while it is certainly the duty of scientific advisers to point out uncertainties in the evidence base and what is simply unknown, independent science-informed advice is still much better than uninformed advice.

We need more knowledge about the pathophysiology of COVID-19. Therefore, *Function* (**https://bit.ly/FunctionJournal**) has already published several articles pointing to new directions of research relevant to the current situation.

As physiological research continues to elucidate our understanding of the disease, I hope our politicians will use our science—along with common sense—to steer us toward a COVID-19–free future.

Ole Petersen, MD, CBE, FRS, is professor at Cardiff University's School of Biosciences in Wales and director of Academia Europaea Cardiff University Knowledge Hub. He is also founding editor-in-chief of APS' new open access journal *Function*.

Illustration by Brett Affrunti

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COVID-19 Resources

APS has collected journal articles, resources, news articles and other information to keep you informed and help you work smarter and more efficiently from home. Check out our compilation of government agency resources, advice on how to stay healthy and ways to get involved around your community.

Find out how your fellow physiologists are faring through the pandemic. See the results of the COVID-19 survey at **physiology.org/covid19survey**.

physiology.org/covid-19