

SPRING 2022

UNIVERSITY OF COLORADO SCHOOL OF MEDICINE

# CUMEDICINE

*Today*

## *Getting the Message*

Olivia Rissland, Sujatha Jagannathan,  
and CU's RNA Bioscience Initiative 6

CU's Paralympian 20

Eye Cancer Care 22

Discovery in Italy 28

VOLUME 35 | ISSUE 1





## On the Cover

Olivia Rissland, DPhil, and Sujatha Jagannathan, PhD, were recruited to the CU School of Medicine to be part of the RNA Bioscience Initiative, a \$20 million investment that has strengthened basic scientific research and fostered collaborations on the CU Anschutz Medical Campus.

*Photos by Keith Singer*

### 1 Letter from the Dean

### 2 In the News

### 4 Q&A

Screen time for teenagers in the time of COVID

### 6 Research

Investment in RNA research yields major results for CU

### 10 Faculty Profile

Olivia Rissland and the endless possibilities of RNA

### 12 Faculty Profile

Sujatha Jagannathan studies RNA's path in cells

### 14 Clinical Care

Team of CU physicians save pregnant mom and baby

### 20 Faculty Profile

Paralympian Pam Wilson competes in wheelchair curling

### 22 Clinical Care

CU physicians team up for uveal melanoma patient

### 24 Alumni Corner

### 26 Peaks

### 28 Research

Mesolithic burial site offers link to teaching anatomy



*Saving Kabrini, page 14*



*Brigitte Douglass, page 22*



*Caley Orr, PhD, page 28*

## CU MEDICINE TODAY

is published twice a year by the University of Colorado School of Medicine. Views and opinions expressed in this publication are not necessarily those of the University of Colorado, the School of Medicine or the Medical Alumni Association. Contributions to support this effort are welcome and appreciated.



**School of Medicine**

UNIVERSITY OF COLORADO  
ANSCHUTZ MEDICAL CAMPUS

## OFFICE OF ALUMNI RELATIONS

13001 E. 17<sup>th</sup> Pl., Mailstop A080  
Aurora, CO 80045

E-mail: [healthalumni@ucdenver.edu](mailto:healthalumni@ucdenver.edu)  
303-724-2518/877-HSC-ALUM  
[www.ucdenver.edu/healthalumni](http://www.ucdenver.edu/healthalumni)

## SCHOOL OF MEDICINE

John J. Reilly, Jr., MD  
Dean; Vice Chancellor for Health Affairs,  
University of Colorado

## EDITOR

Mark Couch  
Chief of Staff  
Director of Communications

## PHOTOGRAPHY

Cyrus McCrimmon  
Keith Singer

## WEB CONTENT

Tonia Twichell

## PRODUCTION

CU Design & Print  
Services

## WRITERS

Mark Couch  
Greg Glasgow  
Katie Kerwin McCrimmon  
Rachel Sauer  
Rachel Wittel

# INVESTING IN OUR FUTURE

Even as the latest spike of COVID-19 cases recedes, reckoning with the pandemic's impact continues.

The University of Colorado School of Medicine and our clinical partners have been a bulwark during these past two years, protecting as many people as possible with strategies to prevent illness, to mitigate the spread of infection, and to care for those who get sick.

All that work – even when we've spent our careers training and preparing for such circumstances – takes a toll. As a result, we are meeting the need for renewal and recommitment with reinvestment in what matters most: people.

We have created a new senior leadership position in the School of Medicine – Senior Associate Dean for Faculty and Chief Well-being Officer – to lead our efforts to address workload and burnout. For that new role, we have hired an expert who helped write the book on the subject: Lotte Dyrbye, MD, MHPE.



Lotte is co-author of the National Academy of Medicine's consensus study, "Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being." The book was named the 2021 winner of the James A. Hamilton Award, which is given annually to the authors of a management or health care book judged outstanding by the American College of Healthcare Executives.

Lotte is joining us this spring from the Mayo Clinic, where she has worked since 2001 and where she is a professor of medicine and medical education and co-director of the Mayo Clinic Department of Medicine Physician Well-Being Program.

While it is crucial to have ways to care for our colleagues when they are challenged by the consequences of our demanding work, it is important to heed advice we would give to others. We often advise patients on ways they can prevent unhealthy outcomes. It is no different for ourselves and our colleagues.

We must look at the mounting pressures in our professional lives and address the factors that cause emotional exhaustion, detachment, and a low sense of personal accomplishment. Those factors can include long work hours, technologies and documentation requirements that detract from patient care, insufficient job resources, unsupportive organizational cultures, and ineffective team structures.

To identify and correct these matters, we must measure them and take action. This investment requires consistent attention and rigorous effort to implement. This approach is consistent with our academic medical campus's mission to ask challenging questions, develop experiments to understand experience, collect the data, test the results, and design interventions that will make a difference.

To that end, the School of Medicine is energizing its overall commitment to data science by establishing a new Department of Biomedical Informatics. Computation drives many facets of biomedical discovery and innovation, from the most basic molecular biology through each step of clinical translation. If our goal is to deliver the most advanced health care, we must be adept with the best practices of measuring, collecting, and applying data.

During the past two years, we have recruited faculty to coordinate and lead this effort. Notably, Casey Greene, PhD, joined us in November 2020 as the director of the newly created Center for Health Artificial Intelligence, and Melissa Haendel, PhD, in April 2021 was named the campus's first Chief Research Informatics Officer. Casey joined us from the University of Pennsylvania School of Medicine, and Melissa came from Oregon Health & Science University.

In the Department of Biomedical Informatics, we will be uniting talented faculty housed in multiple departments into an academic home that continues to serve all. The members of the new department will raise the level of training in the field and will spur additional robust collaborations between data scientists and laboratory researchers. The department will also offer an opportunity to continue our efforts to recruit biomedical informatics leaders, faculty, fellows, and students.

Such investments are key to our future and necessary if we are to thrive.

With warm regards,

A handwritten signature in black ink that reads "John J. Reilly, Jr."

John J. Reilly, Jr., MD  
Richard D. Krugman Endowed Chair  
Dean, School of Medicine  
Vice Chancellor for Health Affairs  
University of Colorado

## Reporters locally and nationally turn to the School of Medicine for expertise and research news. Here are some examples from near and far.

**Lalit Bajaj, MD, MPH**, professor of pediatrics, told the Denver Post in November that the Pfizer COVID-19 vaccine is safe for children ages 5 to 11. “The scrutiny these vaccines are under from our regulatory agency is pretty intense,” he said. “We wouldn’t put it out there if we didn’t think it was safe and the benefit didn’t outweigh the risk.”

**Carey Candrian, PhD**, associate professor of medicine, was quoted in a November article in USA Today about a U.S. Army veteran rejected from multiple elder care homes because she is transgender. Candrian said older LGBTQ adults often face discrimination. “Especially for the older LGBT community, who grew up when being gay was dangerous, or even illegal, to stay safe they had to develop this silence about who they are,” Candrian said. “That stays with them, despite growing acceptance and new laws. They’re fearful to disclose their identity.”

**Vik Bebart, MD**, professor of emergency medicine, was quoted by the Colorado Springs Gazette in February after a meeting with its editorial board to discuss drug overdoses. “We’re seeing a major increase in fentanyl-related doses, overdoses and deaths specifically, which is by far the majority of all the deaths around drug overdoses in Colorado and across the country.”

**Irina Petrache, MD**, chief of the division of pulmonary, critical care, and sleep medicine at National Jewish Health and professor of medicine, described lingering effects of COVID in some patients in a February report in Everyday Health. “Most patients who suffer from long COVID were previously healthy and are extremely frustrated and exasperated by this condition,” she said. “Lots of folks are expecting answers more quickly than the speed with which we can provide them because of how new this is and how unexpected this new syndrome has been.”

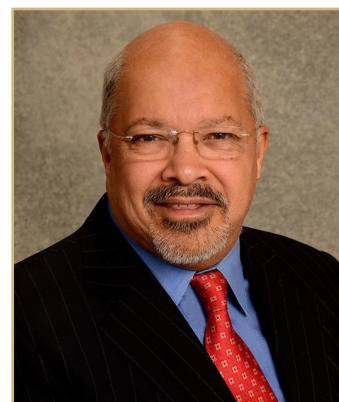


Brandi Freeman, MD

**Brandi Freeman, MD**, assistant professor of pediatrics, described an interaction with a 12-year-old patient who wanted the COVID-19 vaccination. “He researched it on his own and brought it to his mom,” she said in December on the NBC affiliate in Denver. “They came here together to talk about it, talked about the COVID-19 vaccine and routine immunizations. Kids recognize the world is different for them right now. And they’re listening to the science, too, that the vaccine can help us and keep us safe so they can keep doing what they want to do, which is to be healthy kids.”

**Lilia Cervantes, MD**, associate professor of medicine, was quoted in a December report on Colorado Public Radio about efforts to vaccinate Colorado’s Latino population. “For this community, family comes first and self-care comes second and if there are concerns, such as religious, side-effects, or simply due to competing social challenges, they may not get the vaccine,” she said.

**Sean O’Leary, MD, MPH**, professor of pediatrics, was quoted in a February report by the PBS NewsHour discussing the rise in pediatric COVID-19 infections. “What we’re seeing right now is still a lot of hospitalizations and unfortunately some deaths in this age group,” he said, adding that if the FDA clears vaccinations for children under 5, “that’s going to be really important because all of those hospitalizations and deaths essentially are preventable.”



Eric Simoes, MD

**Eric Simoes, MD**, clinical professor of pediatrics, described the results of a clinical trial of Pfizer’s COVID-19 vaccine in children ages 5 to 11 at Children’s Hospital Colorado in a November news report on the Denver ABC affiliate. “As principal investigator of this site, and one of the largest sites in the world, I believe in the science and integrity of the trial and this vaccine,” he said.

**Paula Riggs, MD**, professor of psychiatry, discussed shortcomings in care provided to teenagers treated for drug overdoses in a CNN report in January. “Less than 10% of kids go to treatment with the standard screening, brief intervention, referral to treatment model that we’re using,” she said. “They do a great job screening, but the referral to treatment part is not working. It’s broken.”

**Nanette Santoro, MD**, professor and chair of obstetrics and gynecology, told the Denver CBS affiliate in January that a new study funded by the National Institutes of Health should reassure pregnant women to get the COVID-19 vaccine. “There’s quite a bit of vaccine hesitancy in women who want to get pregnant,” she said. “A lot feel their body is a temple, and they don’t want to do anything. Only 31% of women who are pregnant are vaccinated nationally. This should make them feel better about protecting themselves and their baby. This sample size is one of the largest we’ve seen.”





*Joshua Barocas, MD*

**Joshua Barocas, MD**, visiting associate professor of medicine, was interviewed by the Washington Post for a November article about rock star Eric Clapton's vocal opposition to measures that would reduce the spread of COVID-19. "He could be helping us in finishing off this pandemic, especially with a vulnerable population," he said. "We're looking at millions and millions of people worldwide. He could be a global ambassador, and instead he's chosen the pro-covid, anti-public-health route."

**Matthew Wynia, MD, MPH**, professor of medicine and director of the CU Center for Bioethics and Humanities, told the Denver Gazette in March that Colorado needs to do a better job vaccinating underserved populations. "It's a deadly embarrassment that Colorado is still doing so poorly at vaccinating our Latino/Hispanic residents," he said. "While other states have narrowed the gap, or even eliminated it, we have not. We need to do more outreach and make it super easy for folks in this community to get vaccinated. With only about 40% of Colorado's Latinx population vaccinated, we remain a set-up for future waves of infections in that community."

**Linda Zittleman, MSPH**, senior instructor of family medicine, described the Implementing Technology and Medication-Assisted Team Training program in a February report by Healio. The program engaged 42 primary care practices in efforts to improve care for those with opioid-use disorder. "The on-site team training truly aims to give practices a resource that utilizes the entire team," she said. "Everyone — front desk staff, medical assistants, nurses, billing — can play a role, reduce stigma around opioid use disorder and medication-assisted treatment and help clinicians provide this treatment."



*Megan Adams, MD*

**Megan Adams, MD**, assistant professor of surgery, was quoted by the Denver ABC affiliate in a February report about an 11-year-old who received a liver transplant from a living donor. "A living donor is a great option to transplant patients sooner," she said. "The outcomes are much better with a living donor because you don't have to be so sick to obtain the organ."

**Pei-Ni Jone, MD**, professor of pediatrics, explained in a January report in Healthline, that the risk of viral heart disease is higher for those who contract COVID-19 than for those who get vaccinated. "There is a 1-in-3,000 risk for myocarditis in patients with COVID-19," she said. "This risk is much higher than 1-in-50,000 to 1-in-100,000 in myocarditis associated with the vaccine."

**Eric G. Campbell, PhD**, professor of medicine and director of research for the CU Center for Bioethics and Humanities, discussed the nomination of Robert Califf, MD, to serve as commissioner of the U.S. Food and Drug Administration in a November article in the Washington Post. Campbell said Califf's past consulting work with pharmaceutical companies should not disqualify him. "To my knowledge those relationships have been fully discussed and widely debated in the academic and political arena," Campbell said.

**Samuel Dominguez, MD, PhD**, professor of pediatrics, told the Colorado Sun in November that vaccinating 5- to 11-year-olds against COVID-19 would be beneficial to the children and to the community. "You're either a stop in the chain of transmission or you're a propagator in the chain of transmission," he said, "And the more stops we have, the better off we are as a community, as a state, as a nation, and as a world."



*Michael Puente, Jr., MD*

**Michael Puente, Jr., MD**, assistant professor of ophthalmology, discussed with the NBC affiliate in Denver his efforts to update a 27-year-old federal policy prohibiting gay men from donating their corneas. "This is just nonsense that this is still the law," he said in a November news report. "I've been working the last couple of years to research this policy and raise awareness about it and how to convince the Food and Drug Administration (FDA) that it's time to change it."

**Rosemary Rochford, PhD**, professor of immunology and microbiology, was quoted in the Smithsonian magazine in November in an article about waning immunity to COVID-19 among the vaccinated. "We're seeing a lot of breakthrough cases," she said. "But we don't see as much breakthrough disease."

**Emmy Betz, MD, MPH**, professor of emergency medicine and director of the Firearm Injury Prevention Initiative with the Colorado School of Public Health, in February described the Firearm Life Plan on the ABC affiliate in Colorado Springs. "It's something that we developed for firearm owners and their families to help think through what they would want to happen in the future, either if they develop impairments that make them less safe at handling firearms, or ultimately in their death."

**Matthew Greenhawt, MD, MSc**, professor of pediatrics, told HealthDay in February that an allergic reaction to a second shot of the COVID-19 vaccine is low for those who had a reaction to the first shot. "Persons who have had an immediate allergic reaction to the first dose of an mRNA COVID-19 vaccine can be safely revaccinated and receive a second dose under allergist supervision, allowing persons to be able to receive a full vaccination series," he said. "This has the potential to change current practice and further prevent COVID-19 transmission and severe COVID-19 outcomes."

# SOCIAL MEDIA IN THE TIME OF COVID

Psychologist Jenna Glover on the pandemic's impact on teenagers and technology

Interviewed by Greg Glasgow



Jenna Glover, PhD

Responding to concerns over increased screen time for teenagers during the pandemic and the potential negative effects of social media use, CU School of Medicine psychiatry faculty members Jenna Glover, PhD, Sandra Fritsch, MD, and Merlin Ariefdjohan, PhD, reviewed recent studies on children and digital technology, synthesizing their findings in a paper published in January 2022 in the journal *Child and Adolescent Psychiatric Clinics of North America*.

Glover, a psychologist and director of psychology training at Children's Hospital Colorado, discusses the study and the team's findings.

**Q: What were some of your primary findings when it comes to the ways children are using social media during the pandemic?**

**A:** Both in the United States and in other countries, children's rates of anxiety and depression doubled — and in some places tripled — during the pandemic. So we knew the pandemic was having a big impact on mental health. What was interesting to me is that initially social media was an important source of connection and information-finding for children. Because this was so new, and it was rapidly evolving, it was a great place for people to connect, share information and frustrations, and get support.

I know a lot of parents were very worried about, "Oh, my gosh, my kid has so much screen time now," but what the research was finding is that children being online a lot was not the important thing. It was the way that they were engaging with being online. For example, we know that active use can be helpful for a child's mental health, and it certainly was during the pandemic. If you are creating content, like

creating YouTube videos, or if you're gaming with a friend, and talking with them while you're doing it, you're doing something active. That's super helpful. If you're passively scrolling TikTok or passively viewing YouTube videos for three or four hours, that's toxic for your mental health.

The important takeaway was that the pandemic made it so that we're on screens a lot more, but it's not the amount of time that you're on it; it's how you're using it that really is a difference-maker. There was a huge benefit, during the pandemic, to still being able to interact with peers, see family members, and still have those relationships and build those relationships. There were certainly major benefits of social media that were really helpful for a child's resiliency.



**Q: What accounts for that difference? What is so toxic about scrolling through TikTok videos for hours?**

**A:** One of the nice things about social media and technology use is that it helps children explore their identity and express their identity, which is a developmental task. Social support is an important aspect of their growth as well, and that active use allows children to meet those two developmental tasks. In contrast, with the passive use, you're not interacting with somebody; you're not exploring aspects of your identity. One of the things we compared it to is calories. Not all calories are created equal. There's good nutrition and there's bad nutrition, and technology is the same way. That passive use tends to be more like junk food. It fills children up, but there's nothing that's helpful or substantive for their growth in it.





**Q: Were there any other findings around the good or bad effects of increased screen time?**

**A:** One of the other interesting things that came from the paper is moving away from the idea of specific guidelines in terms of hours that children can be online, and looking more to see if there are core activities in place to support a child's wellness.

If children are sleeping, eating, doing chores and homework, and interacting with peers and family, then the amount of screen time is not that important. It's when those things get disrupted that screen time needs to be looked at to see if that's what's disrupting those activities. That's a real shift in the literature. And it's a shift in our social consciousness that it's not about hours; it's more about healthy activities as the foundation and making sure screen time is supporting those things, not taking away from them.

**Q: In a way, is that just an acknowledgement of how important the online world is to children? That screen time is part of their life, not a distraction from it?**

**A:** That's exactly right. There is some other interesting research that was recently done that showed that teenagers, in general, see social media as an incredibly vital part of their life. They see it as important in terms of expressing who they are and connecting with other people, whereas parents who were surveyed about social media see it as a waste of time and a distraction.

It's really important that we don't minimize the importance of this platform for youth, even if adults don't see the same value in it, because they have grown up in a way that most people who are parenting them — or their caregivers, their physicians, their teachers — haven't. It's part of our life, and you can't take it away from children. Doing so actually could be harmful for their future progress and education and occupations.

**Q: Is that something you see in your patients or the children that you deal with, that they have that same kind of relationship to it?**

**A:** Most definitely. It's an essential part of their life. There's actually research that shows that when parents try to use taking away a child's phone as a punishment, it can increase depression and suicidal ideation in children. I see it all the time in my clinical work — it is how they experience their world. They need to be taught how to do it in a healthy way, but sometimes I think people look at it as a dichotomy, like it's a good or bad thing. But it's a both thing. And it's an essential part of life for these children.

**Q: Is there anything you recommend that parents do to communicate with their children about technology use?**

**A:** Families should have ongoing conversations about media use in general, and what it means to be a responsible digital citizen. In the same way that we teach our children to be good citizens in the world, it's important to talk about how they show up online.

It's important for parents have explicit conversations about what is and isn't OK to post, and why that is. And also having conversations about how many different accounts a child has. The more social media accounts they have, the higher likelihood they have to develop anxiety and depression. Having just one account is better than having three accounts. Parents need to think about how their child can be online in a way that is moderated and healthy.

**Q: Do you think the pandemic is going to permanently alter the amount of screen time these children have, or how they interact with technology and social media?**

**A:** I think this will permanently alter the course of how we utilize technology and the amount of time we are on screens. I think things like snow days will go away, because there will always be a virtual option. This is going to be embedded in our lives, for children and adults, for a long period of time.

I don't think we understand yet the impact this will have on us, positive or negative, but I anticipate that this will change things and that we will have more screen time than we've ever had. And that will persist. So it's important to go back to those foundational things: Do you have those core habits in your life that are essential for physical and mental health? If those are in place, then if increased screen time turns out to have negative impact, it will be mitigated by that.

# RNA BIOSCIENCE INITIATIVE TRANSFORMS CAMPUS

Major investment in research program leads to breakthroughs and partnerships

By Mark Couch

Six years ago, the University of Colorado School of Medicine made a major investment in an RNA research program that has resulted in a growing community of scientists working together to investigate the ways RNA is entangled with human health.

The RNA Bioscience Initiative, or RBI, was established with \$20 million in funding from the Dean's Office and private philanthropy to cultivate a program that would have a transformational impact on the CU Anschutz Medical Campus.

The return on that investment – in scientific achievements by members of the CU School of Medicine community, in support for collaborative research, in new extramural funding awarded to the campus – has been significant.

The creation of the RBI has resulted in multiple faculty recruitments, enhanced training for fellows, new and expanded collaborations, publication of more than 100 articles in scholarly journals, and support for scientists who have received more than \$56.5 million in grant awards.

“When we directed support to RNA research, we knew it was a major investment in the future of medicine and science,” says CU School of Medicine Dean John J. Reilly, Jr., MD. “What we didn’t know was that the whole world would soon realize how important RNA research was.”

## RAPID VACCINE ROLLOUT

The COVID pandemic awakened the world to the importance of understanding RNA because the most effective way to fight COVID is through vaccines built out of a type of RNA called messenger RNA, or mRNA.

The Pfizer and Moderna COVID-19 vaccines use modified mRNA to give the body’s cells instructions on how to make the spike protein found on the surface of the COVID-19 virus. By prompting cells to make this specific protein, your body then responds by creating antibodies. These antibodies then protect you if you are infected with the virus.

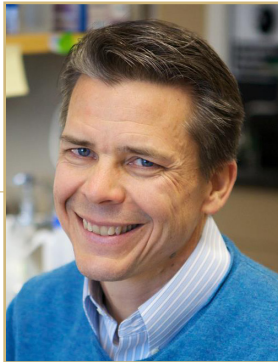
“Decades of research by scientists around the world allowed for developing a life-saving vaccine that could be delivered in record time,” Reilly says. “As traumatic and difficult as this pandemic has been, it would have been much worse if a previous generation of scientists had not invested their time and resources and expanded our knowledge of RNA.”

RNA, or ribonucleic acid, is a molecule that has a role in coding, decoding, regulating, and expressing genes. A strand of RNA triggers reactions propelling activity in a cell.

Understanding how a particular strand of RNA does what it does is extraordinarily complex. Such investigative work is laborious,







Bruce Appel, PhD

**“You can have a pie-in-the-sky plan where we’re going to invest in these big-ticket resources, but you’ve got to have boots on the ground. You’ve got to have people integrated with the people who are trying to solve the problems.”**

complicated, painstaking, winding, always surprising, and never easy. The work requires highly sophisticated technology taking precise measurements, resulting in massive amounts of data.

All those bundles of information are useless, though, without people. It takes people to do the work, to figure out how to frame the study, to interpret what the machines are capturing, and to respond to the new questions that those images raise.

### **SOLVING COMPLEX PROBLEMS**

One of the most powerful contributions that RBI has made to the campus is to train, hire, and recruit people, especially investigators who have worked with RBI on some of their experiments.

“You can have a pie-in-the-sky plan where we’re going to invest in these big-ticket resources, but you’ve got to have boots on the ground,” says Bruce Appel, PhD, professor of pediatrics and head of the section of developmental biology. “You’ve got to have people integrated with the people who are trying to solve the problems.”

Appel is an investigator whose laboratory studies the genetic, molecular, and cellular basis of brain development and myelination. Myelin is a protective cover on nerve cells that allows electrical impulses to transmit quickly and efficiently along the nerve cells. His research has been continuously funded for more than 20 years by the National Institutes of Health and private philanthropic foundations.

Appel and his team look at how the nervous system develops. They want to understand how neural progenitor cells become neurons and glia. Glial cells provide critical support functions for neurons, such as insulation, communication, and nutrient and waste transport.

“Where RBI has been particularly helpful to us is addressing the longest-running problem that I have worked on: How do neural progenitor cells get specified for different cell types, neurons and glia, particularly myelinating glia?” Appel says. “I have worked on this for a really long time. You would think that I would have solved this, and I have not. It’s been really hard, and this is true for everyone else in the field too. We were just stuck.”

It wasn’t for lack of trying. Rather, it’s that the tasks involved are extraordinarily difficult and the questions are not easy to resolve:

How to differentiate the cell types? How to measure the distinctions between the types of cells? How to design the experiments so that you accomplish what you want to do? How to interpret the collected information?

“We could learn a lot about cells once you could identify them, once they have a feature you can see, either gene expression or morphology or electrophysiology or whatever,” Appel says, “but once you get into a population of cells, they all kind of look like each other.”

It turns out that looking at RNA is critical to get a handle on what’s happening, to be able to see the difference between cells.

“We do not generally consider ourselves as RNA-focused biologists,” Appel says. “RNA is just one of the many assays that we use. We use gene expression to identify different cell types and then we use gene expression to understand the effect of certain manipulations, usually genetic manipulations. We have ideas about how the nervous system develops that we wanted to test. Assessing RNA is both a marker and then also part of our tool kit to test gene functions.”

### **CREATING NEW OPPORTUNITIES FOR SCIENTISTS**

Along came the RBI with its pilot grants to help investigators who wanted to incorporate more RNA biology into their experiments. Appel and his team received \$7,000 to fund two sequencing projects for his lab. RBI also provided support for the work of RBI fellows on interpreting the data.

“It’s just a treasure trove of things that will keep us busy for a very long time,” says Appel, who last year received an eight-year, \$6.9 million Outstanding Investigator Award from the National Institute of Neurological Disorders and Stroke. “And this is only one application of many that we will use this resource for. I would say this has been truly transformative. I don’t like to throw that word around too much, but this has been transformative.”

“There are about 12 of us in my section and almost everyone has now used single-cell RNA sequencing with help from the RBI, and almost everyone has had pilot grants. Everyone also has had help with bioinformatics work from the RBI. Just like with our story, this has opened up new directions for people.”

Guiding CU Anschutz researchers along these new directions is Kent Riemony, PhD, senior research instructor of biochemistry and molecular genetics and the research faculty lead of the RBI Informatics Fellows program.

Riemony was the first fellow in the program in 2016. He joined after earning his PhD at CU Boulder in the Department of Molecular, Cellular and Developmental Biology.

“I was considering either a traditional postdoc or potentially transitioning into industry,” Riemony says. “And then I found the Informatics Fellows Program. I was immediately excited to apply for the program because I hadn’t seen anything like it out there on the job market.”

The RBI Informatics Fellows Program trains bioinformatics analysts in RNA biology and data analysis so that they can design, execute, and analyze the results of RNA sequencing experiments.

“The work we do requires an understanding of a lot of different disciplines,” Riemony says. “You need to understand how to write algorithms that are efficient for both processing data and identifying biologically meaningful patterns in the data. Much of our work merges principles from computer science, statistics, and data science with biology. However, if you don’t understand the biology and the various biological systems the investigators are working with, it becomes very hard to translate results into something they can interpret and use.”

Since the program was established, RBI Informatics Fellows have initiated 180 projects with 118 investigators. They have completed

## RETURN ON INVESTMENT IN THE RBI

Since its inception in January 2016 the RBI has:

- Nearly tripled in size, growing from 33 faculty members to more than 90 faculty members and their affiliated labs
- Supported the publication of 124+ research articles
- Invested in 126+ RNA-focused pilot research projects
- Enhanced training in RNA biology, awarding 25+ RBI RNA Scholars fellowships and 70+ RBI Summer Internships
- Established the RBI Bioinformatics Fellows, a team that develops and disseminates informatics knowledge and software critical to analyses of the large data sets inherent to nucleic acids research
- Hosted or co-hosted community-building events, including the Rocky Mountain RNA Symposium

**“As traumatic and difficult as this pandemic has been, it would have been much worse if a previous generation of scientists had not invested their time and resources and expanded our knowledge of RNA.”**

97 of those projects, contributed to 46 publications, and provided analyses that have been used to support multiple National Institutes of Health and other grant applications.

## DEVELOPING TREATMENTS

Beth Tamburini, PhD, associate professor of medicine in the Division of Gastroenterology and Hepatology with a secondary appointment in the Department of Immunology and Microbiology, worked with the RBI team to figure out how to trace an antigen’s path in the body.

Tamburini and her lab team wanted to understand how long antigens reside in the lymph node. In this case, the antigen is a foreign protein to which an immune response is generated. An improved understanding of how long and where protein antigens reside in lymph nodes informs developing therapies that could combat infections and disease that can cause illness and death.

When looking into where foreign protein antigens go once injected into the body, Tamburini discovered a specific cell type called the lymphatic endothelial cell that held protein antigens for an extended period of time. The lymphatic system, made up of lymphatic endothelial cells, transports fluid, proteins, and immune cells from different organs in the body to lymph nodes.

Lymph nodes are like pit stops in the lymphatic network where immune surveillance occurs. When pathogens, such as viruses or bacteria, or other foreign material like vaccines, enter the body, small proteins and pathogens can be swept into the lymph nodes. Cells in the lymph node see the foreign substance and activate the immune response intended to protect the body from these invaders.

After the infection and clearing process, a small number of antigenic proteins remain in the lymph nodes inside the lymphatic endothelial cells. This function of retaining antigens is important for instructing the immune system to respond more quickly and stronger the next time it encounters the same antigenic protein that came from the pathogen or vaccine.

Tamburini had attended a seminar organized by the RBI where a company that designs and makes gene sequencing technology presented a method of tagging other types of proteins in a petri dish. The technology was designed to tag an antibody after it was outside of the host.



“Somewhere in there, it came to my mind, ‘Well, if you could do that with an antibody, can’t we just tag our protein, our antigen, directly and put it into the mouse?’” Tamburini says.

Tamburini and her colleagues created a “molecular tracking device,” a tag connected to an antigen that could be administered as a vaccine. This molecular tracking device allowed them to observe at a cellular level how the antigen was distributed, absorbed, and retained by the lymph node cells.

In early experiments, the tag would rapidly degrade after injection. And that’s where the expertise of the RBI was called into action.

Tamburini’s team worked with the co-director of the RBI, Jay Hesselberth, PhD,

associate professor of biochemistry and molecular genetics, and his laboratory, to develop tags that could survive along with the antigenic proteins to which they were attached.

Tamburini competed for a pilot grant from the RBI. She also was named an Outstanding Early Career Scholar by the Department of Medicine, an award that was supported with a contribution from the RBI. With that support, she was christened an RBI Clinical Scholar. She and her team went to work with RBI Fellows in collaboration with Hesselberth.

Tamburini and her colleagues described their research in an April 2021 article in the journal *eLife*. Among the co-authors/collaborators were Hesselberth and RBI fellows Ryan Sheridan, PhD, and Rui Fu, PhD.

The *eLife* summary accompanying the article explains the importance of the study by Tamburini and the RBI:

“These results provide important insights into the protein archiving system that is involved in enhancing immune memory. This may help guide the development of new vaccination strategies that can manipulate how proteins are archived to establish more durable immune protection. The biological tags developed could also be used to track therapeutic proteins, allowing scientist to determine how long cancer drugs, antibody therapies or COVID-19 anti-viral agents remain in the body. This information could then be used by doctors to plan specific and personalized treatment timetables for patients.”

## RNA BIOSCIENCE INITIATIVE FACULTY RECRUITS

The investment in RNA research by the CU School of Medicine includes recruiting talented faculty to conduct their research on the CU Anschutz Medical Campus. Two members of that cohort – Olivia Rissland, DPhil, and Sujatha Jagannathan, PhD – are profiled on the following pages.

In addition, three other faculty members are part of the initial cohort of investigators in the RNA Bioscience Initiative.

### J. Matthew Taliaferro, PhD

Taliaferro is assistant professor of biochemistry and molecular genetics and core member of the RNA Bioscience Initiative. He was recruited to CU in 2017. Taliaferro’s research focuses on the regulation of RNA localization and spatial organization within cells. His laboratory uses a variety of cutting-edge techniques to study how faulty regulation of RNA localization contributes to development of neurological diseases. Taliaferro earned his PhD from the University of California, Berkeley in 2012 and completed his postdoctoral training at the Massachusetts Institute of Technology in 2017.



### Neelanjan Mukherjee, PhD

Mukherjee is assistant professor of biochemistry and molecular genetics and co-director of the RNA Bioscience Initiative Summer Internship Program. He was recruited to CU in 2017. The goal of Mukherjee’s research is to quantitatively understand human RNA regulatory networks and how their dysregulation impacts human disease, particularly as it relates to production of steroid hormones and cancer. Mukherjee earned his PhD from Duke University in 2010 and completed his postdoctoral training at the Berlin Institute for Medical Systems Biology in Germany in 2017.



### Srinivas Ramachandran, PhD

Ramachandran is assistant professor of biochemistry and molecular genetics and core member of the RNA Bioscience Initiative. He was recruited to CU in 2018. Ramachandran’s research applies computational biology, genomics, biochemistry, and structural biology to understand chromatin dynamics and cellular memory in normal development and cancer. His laboratory also focuses on creation of diagnostic techniques to make health care more equitable and affordable. Ramachandran earned his PhD from the University of North Carolina at Chapel Hill in 2012 and completed his postdoctoral training at the Fred Hutchinson Cancer Research Center in Seattle in 2017.



# READING A BOOK THAT NEVER ENDS

Olivia Rissland explores the boundary of known and unknown

By Mark Couch

Olivia Rissland, DPhil, compares RNA to photocopies of pages of books at a library.

“RNA is to DNA what photocopies are to precious books in library stacks: An abridged reproduction with a temporary existence,” explains Rissland, a scientist with the University of Colorado’s RNA Bioscience Initiative.

You can read just a few photocopies, and only for a limited time. Understanding those copies depends on where and when you read them. Even then, you get a just a few clues about what’s in the book; you don’t get the whole story. Those pages won’t easily yield the library’s secrets.

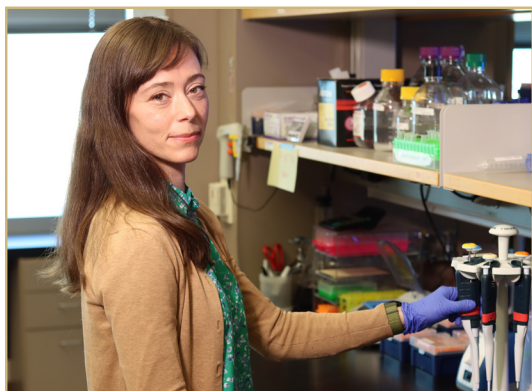
“What is really cool about RNA is what happens to those photocopies once they leave the library is different for each photocopy,” Rissland says.

Figuring out which photocopy to read and how to interpret what it’s saying before it disappears is a challenging task at best. It becomes a staggering enterprise when considering the numbers.

There are some 20,000 genes in the human genome. In humans, genes vary from a few hundred DNA base pairs to more than 2 million bases. Messenger RNA – the temporary photocopy – provides a picture of a piece of the DNA, a snippet of the story.

But ask Rissland about the challenge of studying those photocopies and you discover that it’s more than a practical question for framing a particular study. It’s a philosophy.

“I think about what research is,” Rissland says. “Research exists at the boundary of known and unknown. And so, what we’re always looking for are mysteries and things that don’t make sense. We are trying to understand what it is that we’re missing, that explains what we see.”



Olivia Rissland, DPhil

## INVESTMENTS LEAD TO BOOST IN RNA RESEARCH

Rissland, an assistant professor of biochemistry and molecular genetics, joined the CU School of Medicine in 2017 when the school boosted investment into RNA research, thanks to a gift from The Anschutz Foundation and other supporters. Those funds allowed Dean John Reilly, Jr., MD, to target strategic growth opportunities, which is how the RNA Bioscience Initiative, or RBI, was born.

The goal with these investments is to bring together teams of scientists to work on some of the most challenging questions in human health.

“I think we’re very lucky in the RBI,” Rissland says. “It’s easy for us to foster collaborations. There were five of us who were hired in the same search. We’re all close enough in our work that we can have a conversation with points of common interest. But we’re not so close that there’ll be competition. For me, that is probably the starting point for all the collaborations. We are bouncing ideas with others in the offices right here and then building out from there.”

Rissland’s lab studies what happens to messenger RNA, or mRNA, after it’s made. Specifically, she and her lab team are trying to understand how the mechanics of protein production and of mRNA destruction connect with one another. Why do some mRNAs get destroyed quickly and others slowly?

The processes are connected, but how remains a multifaceted mystery – and a source of endless fascination for Rissland and the team of scientists in her laboratory. Understanding what happens during that interaction could yield insights into genetic factors causing of human disease.

Although all cells have the same collection of genes, cells differ in which genes are turned on and which are turned off. When that process goes awry, adverse health conditions can result, such as cancer, neurodegeneration, or developmental defects.

“Research exists at the boundary of known and unknown. And so, what we’re always looking for are mysteries and things that don’t make sense. We are trying to understand what it is that we’re missing, that explains what we see.”





Olivia Rissland, DPhil

One area of inquiry for Rissland's lab is the impact of "translation elongation speeds" on how fast mRNAs are destroyed. Translation occurs when the ribosome in the cell "reads" the sequence on the mRNA and turns that into a sequence of amino acids, thus building proteins.

"You have these machines – they're called ribosomes – that are the actual interpreters that go between the different languages and make the protein," Rissland says. "The speed at which the ribosome moves matters. A way to think about this is like on a freeway."

You accelerate as you get on the freeway, but your speed can vary once you're on the road. That time span between destinations is "elongation." Your speed depends on weather, it depends on traffic, and sometimes you slow down or speed up depending on the conditions. In a cell, a traffic jam is a signal that there's a problem, "that there's something a little bit wrong about the RNA, then the cell takes action to deal with that," Rissland says.

There are ample opportunities for traffic jams in a cell because the average cell produces 2 million protein molecules every minute. For a researcher, that means there are ample opportunities to explore.

"That's when you sit down and try to come up with what question to ask," she says. "You read the literature and you say, 'Well, what things are here that don't make sense? What things surprise me? Or what is an implication of something that we know if this is true, then that would imply this is true?'"

Questions shape the experiments, and the experiments provide answers.

"The majority of the time it doesn't work the way you think it's going to," Rissland says. "You think it could be answer A or it could be answer B. And it's always answer C."

## CHARTING A NEW PATH

Surprise endings are nothing new in literature or life.

Rissland had planned to go to medical school after completing her undergraduate degree in Biology, Mathematics, and Classics (Latin) at Brown University in 2004. She was awarded a Rhodes Scholarship and went to University of Oxford where she earned a DPhil in molecular biology.

"The plan actually was to come back to the States and go do my MD," Rissland says. "Then I'd be an MD, PhD, and drive off into the sunset."

Well, plans change, and the sun also rises. In Rissland's case, the light on the horizon was the opportunity to become an independent investigator

running a research laboratory.

"When I came of age as a scientist was right when we started having all of these methods that allow us to ask questions about RNA and answer them. Five or 10 years earlier, this just wasn't possible," Rissland says. "For me it was not only that there were all these questions that I wanted to answer, but we also had these tools to answer them. It was just this huge technological revolution. I mean, it's like being a kid in a candy store. How could you say no to that?"

The advent of high-throughput sequencing technology has allowed scientists to look widely and deeply into the full spectrum of genetic variations and other factors affecting biological change that were impossibly laborious to study for previous generations of investigators.

"Classically, we were able to look at gene A or gene B and we looked at them one by one," she says. "What high-throughput sequencing allowed us to do is to not look at things one-by-one, but to look at every single gene at the same time and that gives you just so much more power."

It's the power to think about the themes and larger plot of the story rather than paying attention to one or two characters in a book.

"I am most interested in general principles," Rissland says. "Specific examples don't provide general insight. They are fine, but they're not what really get me out of bed in the morning. And to know if something is general you need to be able to look at many things. High throughput sequencing, then, is a really good match for the types of questions I like to ask."

After completing her doctorate, Rissland did postdoctoral work at the Whitehead Institute, an independent biomedical research institute in Cambridge, Mass., and then launched her laboratory at The Hospital for Sick Children, which is affiliated with the University of Toronto, in 2014.

Since starting her career as an independent investigator, her laboratory has trained more than 20 young scientists, nurturing their research, preparing them for their own careers, and encouraging them to ask questions.

"I think success looks like someone who has taken real intellectual ownership of their project, who pushes back against my ideas, who tells me that I'm wrong. I think when they do that, that's the best part. It means that they have the skills so that they can put those ideas into practice."

It's like reading a book that never ends.

# LEARNING FROM RNA'S MISTAKES ALONG THE WAY

Sujatha Jagannathan follows the detours to discover the direction to go

By Mark Couch

Sujatha Jagannathan, PhD, chases RNA for a living and the pursuit often takes her in directions she didn't expect to go.

It turns out that the detours are the journey's reward.

"Anytime nature breaks things," Jagannathan says, "you can swoop in and understand exactly how the pathway works. Why is it broken? And what happens if you break a pathway like that?"

It's the mistakes that provide the opportunity to learn, she says.

"I study how mistakes in these molecules called RNA are handled by cells, basically," she says. "We all have a genome in which genes are encoded. It's sort of like this big cookbook, where you have every recipe possible. Each cell in our body makes a subset of those genes that gives them their identity."

**"Anytime nature breaks things," Jagannathan says, "you can swoop in and understand exactly how the pathway works."**

Messenger RNA, or mRNA, transfer information from the cookbook to other parts of the cell, where they are key ingredients to making proteins.

## DETOUR LEADS TO RNA RESEARCH

To end up running a laboratory focused on mRNA at the University of Colorado School of Medicine, Jagannathan herself took her own detour. "I went to Duke to do my PhD in microbiology, and I came across this lab that did RNA biology and I said, 'That sounds cool, let's give it a shot,'" she says. "And I fell in love."

Jagannathan had planned to study bacteria – microscopic single-celled "bugs" that can sometimes make people sick – but turned her attention to those microscopic messengers hauling the instructions for life itself.

"There's just something about the idea of this chancy and unstable molecule orchestrator thing, you know," she says. "How it affects everything from how humans are made, embryogenesis, all the way to diseases and aging and this whole plethora of functions, just

fascinated me. And I thought, 'Okay, studying bacteria was nice, but this is what I'm going to do.'"

Jagannathan had completed a bachelor's degree in industrial biotechnology at Anna University in Chennai, India, in 2006 before heading to Duke University, where she earned a PhD in cell biology.

"I specifically studied how RNA molecules go to different places in the cell," she says. "Because putting the same molecule in different parts of the cell can give it different properties, exactly the same molecule in different places has different properties. It's really amazing."

From Duke, Jagannathan went Fred Hutchinson Cancer Research Center in Seattle for a four-year postdoctoral fellowship.

"I knew coming off of my PhD that I wanted training in computational biology, because that's where biology was heading," she says. "I wanted to be able to do these high-throughput approaches, analyze my own data, really take advantage of computation as a tool to understand the intricacies of biology."

In Seattle, Jagannathan worked on research of facioscapulohumeral muscular dystrophy (FSHD), a debilitating disease that slowly consumes skeletal muscle in the face, scapula (shoulder blade), and humerus (upper arm).

Combining her interests in RNA biology and computational biology, Jagannathan collected data measuring RNA and protein levels in cells that express the protein DUX4. That protein induces changes in hundreds of genes that affect dozens of interconnected pathways. With so many connections, specific causes of FSHD are hard to discern. Her studies helped identify patterns for more targeted research.

"Normally, this protein is expressed in early development," she says. "But in people who have this disease, the protein turns on in this skeletal muscle, and turns on genes that should have no business being expressed in skeletal muscle."

Such research is a step-by-methodical-step process.

"When you think of science, it's sort of like climbing a mountain," she says. "Every day, you're putting your head down, and you're just climbing. That can be hard, right? And then when you have a team of people that you're doing it with, you are cheerleading, helping, facilitating, seeing them go up the mountain too."



*Sujatha Jagannathan, PhD*

“The reward is really when you can go to a height and you can see a new vista, something you didn’t know existed, something that’s going to now open up so many new opportunities. I think that’s the joy. Seeing it myself, but also helping other people see it too.”

### **RBI OPENS DOOR FOR COLLABORATION**

For Jagannathan, the RNA Bioscience Initiative at the University of Colorado School of Medicine provided an opportunity to work in a community of scientists with similarly focused research.

“I came to CU because of this group,” she says. “I had other offers, but this was the place that made me feel that as an RNA person, I couldn’t be in a better place.”

Jagannathan, an assistant professor of biochemistry and molecular genetics, and other RNA Bioscience Initiative scientists are clustered in offices and laboratories on the same floor of one of the research towers on the CU Anschutz Medical Campus.

“If I just step out into the corridor, I can run into any colleague and I can ask, ‘Hey, you know, I have this idea, what do you think?’ And they can shut it down or they can say, ‘Here’s another way of thinking about it, or here’s the reagent I have, go do the experiment,

or I can do the experiment for you.’ These are the opportunities of being here. It’s the community, it’s just enabled science that I did not think I would be doing four years ago.”

When the COVID pandemic disrupted operations for several months in 2020, scientists worked from home to review studies and analyze previously collected data. But getting back to the labs was a high priority. Jagannathan served on a working group to help the campus explore childcare opportunities so that working parents could return to campus sooner.

The kind of basic research conducted by the RNA Bioscience Initiative members is fundamental for future scientific advances. Jagannathan notes that vaccines for COVID-19 were developed quickly because of decades of research.

“We wouldn’t have a COVID vaccine if the basic science hadn’t been done for the past 30 years,” she says. “There are people who say, ‘Oh, this vaccine just came out of nowhere.’ No, it did not come out of nowhere. It came out of the work of basic scientists for decades. You have to have that foundation. You can’t build therapies overnight like that if you don’t have people putting in the time.”

The dedication to knowledge is necessary, but not the sole purpose of the scientific endeavor, Jagannathan says.

“It doesn’t make sense for me to say, ‘Here’s the science I want to do, here’s the person who can do that.’ It’s more than that. It’s really about who do I want to come out of the lab. What kind of scientists are we putting out into the world? Are they good citizens? Are they kind people? I want my lab to be a place that can produce really good quality scientists who go out and are a positive presence in the world.”

**“I want my lab to be a place that can produce really good quality scientists who go out and are a positive presence in the world.”**



# PREGNANT WITH COVID-19: A SURVIVAL STORY

## CU physicians save 'miracle mom' and baby

By Katie Kerwin McCrimmon

The young pregnant woman lay fully sedated and belly down in the hospital intensive care unit, attached to a ventilator that was pumping oxygen into her body at the highest possible settings.

But COVID-19 had ravaged Sarah Mays's lungs. Even with the ventilator's help, her blood saturation levels, which should have been hovering close to 100%, had plummeted into the 70s and 80s.

Her vitals were tanking. She was dying.

For the surgical team, it was "go time."

Never during the pandemic had doctors at UHealth University of Colorado Hospital put a pregnant COVID-19 patient on the last-chance, external lung and oxygenation system known as ECMO, much less delivered a 29-week preemie minutes later.



The Mays family with their dog Porter outside their log home in Colorado's Big Thompson Canyon. Andrew feared Sarah was going to die and that he would be raising their daughter on his own. Photo by Cyrus McCrimmon for UHealth.

But the doctors knew that the only way to save Sarah's life and the baby girl who wasn't due for two-and-a-half more months was to give the mother's lungs a chance to rest and recover. And that meant racing on the morning of August 18 to gather nearly two dozen medical experts to carefully orchestrate back-to-back surgeries: first connecting Sarah to ECMO, then performing a cesarean delivery.

Sarah's husband, Andrew Mays, returned to the hospital after a fitful night at a hotel across the street to find that Sarah's condition had gone "down, down, down" that morning.

No one sugarcoated how precarious things were.

Tim Tran, MD, an anesthesiologist and cardiothoracic critical care specialist who was overseeing Sarah's care in the ICU, had to go over the worst-case scenarios. He explained that ECMO, which stands for extracorporeal membrane oxygenation, doesn't always work for critically ill COVID-19 patients. And it's exceedingly rare for doctors in the United States and around the world to use ECMO for pregnant COVID-19 patients. The team felt confident that they could save the baby, but no one could promise that Sarah, 32, would survive.

Tran's warnings devastated Andrew, and confirmed fears that had been gnawing at him. Especially when he was alone at night, he felt like all his dreams were crumbling.

"I cried myself to sleep," he said. "I thought to myself, 'I'm not getting my wife back. I'm going to be raising a baby by myself.' Your whole life is over, just like that."

### CONFUSED BY CONFLICTING MESSAGES

The couple met when they were juniors in high school in Michigan. They had been together 16 years and married for four. A year earlier, they bought their dream home, a charming log cabin yards from a river in a beautiful canyon just outside of a town with a perfect name: Loveland. They went fishing, hiking, and skiing every chance they got. Their golden retriever puppy, Porter, joined the family a year earlier and now their daughter would be arriving soon.

Everything seemed perfect. Then everything fell apart.



Tim Tran, MD, assistant professor of anesthesiology, was the cardiothoracic critical care specialist who oversaw Sarah's care in the ICU.

**“It was an amazing effort. I’m so fortunate to work with such dedicated, talented, and nationally renowned colleagues. We were able to come together utilizing our sub-specialty training and took turns managing things.”**

A COVID-19 infection that Andrew had contracted through work over the summer passed to Sarah in early August when she was just over six months pregnant.

Neither Sarah nor Andrew, also 32, had been vaccinated. They hadn’t opposed COVID-19 vaccines, but they felt like they were getting conflicting advice. Andrew’s mom and sister were begging the couple to get vaccinated. Sarah’s mother opposed the vaccine. Sarah’s pregnant midwife (who didn’t work for UCHHealth) told Sarah she wasn’t getting vaccinated.

On top of confusing messages, Sarah hated needles. So, putting off a vaccine seemed like the simplest choice.

When the virus struck them, they struggled with guilt and deep regrets, but by then it was too late.

The clinical trials for COVID-19 vaccines had not included women who knew they were pregnant. Some trial participants became pregnant after enrollment and did well with the vaccines. Still, because there was so little data initially about COVID-19 vaccines for pregnant patients, the Centers for Disease Control and Prevention was slow to release definitive guidance.

Medical experts now know that COVID-19 is extremely dangerous during pregnancy. Only about one-third of pregnant women are vaccinated and health experts have issued urgent warnings pleading with everyone who is pregnant or planning to get pregnant to immediately get COVID-19 vaccines. Month after month in 2021, the number of pregnant women who died in the United States due to COVID-19 set new dismal records.

### PROVIDING A LIFELINE

Sarah was on the verge of becoming one of these pandemic casualties when a group of highly trained specialists teamed up to give her a lifeline.

The doctors gathered for an urgent Zoom call at about 7:30 a.m. on August 18.

The surgeries and the timing would be complex.

Muhammad Aftab, MD, is a cardiothoracic surgeon who led the team that connected Sarah to the ECMO machine.

ECMO is essentially a set of lungs outside of the body attached to a pump. Aftab and his team needed to thread wide, garden hose-sized tubes, known as cannula, from a vein in Sarah’s neck into her heart. The tubes then pull blood out of the body. The



*Muhammad Aftab, MD, assistant professor of surgery, led the team that connected Sarah to the ECMO machine.*

ECMO machine has an oxygenator that removes carbon dioxide from the blood and replenishes it with oxygen. The oxygenated blood then flows back to the heart. Normally, a person’s lungs do this job. For Sarah, the ECMO machine would have to take over.

“Sarah had severe infection and inflammation in her lungs. She had what’s known as acute respiratory distress syndrome (ARDS). The lungs are made of millions of alveoli. Sarah’s were filled with fluid and unable to exchange oxygen,” Aftab said.

“ECMO doesn’t fix that problem. It buys time for recovery and allows the lungs to heal,” Aftab said.

Doctors at University of Colorado Hospital have been doing ECMO surgeries for 10 years and have the largest, most experienced ECMO team in the Rocky Mountain region. Their depth of knowledge and ECMO research have proven invaluable over the last 18 months as critically ill COVID-19 patients needed “Hail Mary” ECMO treatments to survive.

Aftab recently presented research showing that in the early part of the pandemic, from April to October 2020, nearly 63% of COVID-19 patients who went on ECMO survived at multiple facilities. The Delta variant hit even harder in 2021, however, and many unvaccinated patients were arriving at hospitals more gravely ill, making it even harder for ICU and ECMO experts to save the sickest patients.

ECMO doesn’t work as well for older COVID-19 patients, those who are immunocompromised, and those whose organs are already shutting down.

Doctors hoped Sarah’s age and good health before she got COVID-19 might bode well for her; so, they gambled on ECMO.

“We wanted to save two lives,” said Aftab who is also an assistant professor of cardiothoracic surgery at the University of Colorado School of Medicine on the Anschutz Medical Campus.

### TEAMING UP TO SAVE LIVES

Before beginning the surgeries, the team of doctors created a detailed, step-by-step plan.

“We had to get the baby out. We were out of other options, but how could we do this safely?” said Cristina Wood, MD, an obstetrical anesthesiologist, an expert on high-risk pregnancies, and an associate professor at the CU School of Medicine.



*Cristina Wood, MD, associate professor of anesthesiology, helped create a step-by-step plan for the surgeries.*



“We went through everything: ‘OK, we’re rolling the patient in. We’re doing ‘x’ task, then ‘y’ task.’ We went over the plan, line by line, step by step, including contingencies in case anything did not go as scripted,” Wood said.

First, Aftab and his team would connect Sarah to ECMO. Next, obstetric surgeon, maternal-fetal specialist, and associate professor Camille Hoffman, MD, MSc, would take over to do the cesarean delivery. Nurses would then hand off the newborn to a team of neonatal intensive care specialists, who would focus on the infant.

On top of the double surgeries, other logistical challenges loomed. COVID-19 patients breathe better when they are face down or in the prone position. But, in order to do the surgeries, the team needed Sarah on her back. And, to make Sarah’s blood flow well once she was connected to the ECMO machine, she needed an injection of blood thinners. Those same blood thinners posed risks for Hoffman and her team. Excessive bleeding during the cesarean delivery could endanger Sarah and the baby.

The doctors kept thinking and rethinking the safest way to proceed.

“It was an amazing effort. I’m so fortunate to work with such dedicated, talented, and nationally renowned colleagues. We were able to come together utilizing our sub-specialty training and took turns managing things,” Wood said.

The sheer number of people involved posed yet another challenge. Dressed in full yellow protective gear with face masks and eye protection to keep them safe from the virus, how would anyone know who was who?

Wood has organized other complex surgeries and simulations of emergency “code blues” in the past.

“Communication is so important. Our faces were covered with masks, goggles, and ventilated hoods, so I asked one of our nurses to find stickers we could write on to identify each team member and their role,” Wood said.

The nurses found fluorescent pink sticky notes and attached the improvised IDs to each person’s caps.

Once all plans were in place, the team planned to meet hours later, at 12:30 p.m., to get started. They booked the largest operating room they could find, one typically used for open-heart surgery.

#### ‘PLEASE SAVE SARAH’

After the planning session wrapped up, doctors met with Andrew.

Aftab still was dressed in a suit, rather than surgical scrubs. He had been scheduled to see several patients during an outpatient clinic that morning but canceled all those appointments to focus on Sarah.

As Aftab described how the ECMO machine would work, Andrew wept. He felt responsible for bringing the virus into their home. He and Sarah both kicked themselves when they got sick.



*Sarah Mays and her daughter Kabrini nearly died after Sarah became critically ill with COVID-19 while pregnant. Sarah’s husband, Andrew Mays, feared COVID-19 might claim “both of my girls.” Photo by Cyrus McCrimmon for UCHHealth.*

“Whatever you need to do, please save Sarah,” Andrew begged.

Aftab held Andrew’s hand.

“I told him, ‘We are here to help. We are going to take good care of Sarah. We will do our best to give her the best possible chance to survive,’” Aftab said.

Andrew nodded and felt some comfort.

“It made me feel like he was a person too. I was going through serious stuff, but he was going to do everything in his power to save Sarah.”

Before the surgeries started, Andrew had time to visit Sarah once more and give her a pep talk.

He suited up in full protective gear, shuffled into the room, and bent far down so he could try to get face to face — or in this case, mask to ventilator — with Sarah.

Her eyes were closed.

“She was completely out of it,” Andrew recalled.

Still, he prayed that she could hear him and feel his love.

#### RIDING THE COVID-19 ROLLER COASTER

Sarah had been riding what doctors described as the “COVID-19 roller coaster” for weeks. People who are sick with the coronavirus — both at home and in hospitals — can seem to improve, then get worse, then rebound again, and suddenly crash. That’s one of the reasons why COVID-19 is so dangerous.



That's partly why Sarah got so sick. She thought she was recovering. Then, she couldn't breathe.

COVID-19 had hit both Andrew and Sarah hard in early August. He had attended a small in-person meeting at work. One co-worker was vaccinated and didn't get sick. The rest soon tested positive. Andrew tried to keep his distance from Sarah, but two days after he got sick, so did she.

At one point, Andrew got dehydrated, and he and Sarah went to the ER at UCHHealth Medical Center of the Rockies in Loveland. Sarah was coughing. Staff members took their vitals, said they were OK, and sent them home to recover.

**"It made me feel like he was a person too. I was going through serious stuff, but he was going to do everything in his power to save Sarah."**

Over time, Andrew started to improve, and Sarah hoped she was a day or two from feeling better too. Instead, she declined dramatically. She was coughing around the clock and couldn't catch her breath. The woman who loved zigzagging up hiking trails soon could not stand up in the shower or climb a single flight of stairs to the couple's master bedroom.

Sarah's grandmother in Michigan was so worried that one day she sent an ambulance to bring Sarah from her home in the Big Thompson Canyon back to the hospital in Loveland. The paramedics called Sarah when they were en route. Sarah thought she could tough it out and told the paramedics they didn't need to come.

Finally, after about two weeks of struggling, Sarah knew it was time to get help. Andrew took her to an urgent care facility. Her oxygen saturation was low: 84%. The providers called an ambulance, which took Sarah first to the hospital in Loveland, then on to University of Colorado Hospital, where specialists could better care for Sarah and her baby.

She arrived on August 13 and had to go on a ventilator the next day. After five days of multiple ups and downs, she was heading into surgery. Andrew was terrified but tried to be positive for Sarah.

"I was quite emotional," Andrew said. "I held her hand and stroked her leg. I tried to be calm so I could calm her down. I told her everything was going to be fine. She needed to be strong. Sarah is not good with doctors, hospitals, needles, and all of that. It was very, very stressful before she got put on the vent."

"But you feel like there's a glimmer in there. I was trying to convince both of us that everything's going to be OK."

He promised Sarah that soon they would both meet their baby girl.

"I can't wait to get both of you home," he said.

Then, Andrew had to say goodbye.

## THE DANGERS OF COVID-19 DURING PREGNANCY

Soon after Andrew left Sarah's room, doctors got a new, ominous update.

"Sarah had worsened. Everyone was worried that her heart was going to stop. If a pregnant woman codes, neither she nor her baby are going to live unless we act quickly," said Hoffman, the obstetric surgeon.

"We were hoping for a little more time," added Wood, the obstetric anesthesiologist. "But we obtained additional labs and realized we had to pull the trigger. We needed to go."

The doctors raced into the operating room ahead of schedule and got underway by about 10 a.m.

As planned, Aftab began. He and his surgical fellow, Jeremy Leonard, MD, connected Sarah to the ECMO machine. The procedure took about an hour and went very well. Immediately, Sarah began to rebound. Her vitals were looking good, and her oxygen saturation levels climbed back up close to where they belonged.

In fact, Sarah looked so good so quickly that Hoffman wondered for a moment if she should delay the cesarean delivery and give the baby more time in her mom's belly.

The team persuaded Hoffman that it was best to proceed as planned. The ECMO machine was doing its job, but sustaining another life is hard work and Sarah needed a break.

"The physiology of pregnancy takes a lot of blood flow from the mom and sends it to the placenta for the fetus. If the mom is dying, you want to let all the blood return to the mom. You take the baby out as a life-saving measure," Hoffman said.

At 11:42 a.m., tiny Kabrini Mays made her debut. She weighed 3 pounds, 4.9 ounces, and stretched 15 inches long.

"She looked great for a 29-weeker," Hoffman said. "She was vigorous. She was pink. She made a little crying effort, which is always heartwarming."

Kabrini was named after the Mother Cabrini Shrine along I-70 west of Denver. On ski trips, Sarah and Andrew always noticed the sign and thought the name spelled with a "k" would be perfect for a girl.

Hoffman handed the newborn off to neonatal expert, Jim Barry, MD, and his team from the NICU.



*Camille Hoffman, MD, MSc, associate professor of obstetrics and gynecology, led the team that conducted the cesarean delivery of Kabrini after Sarah was connected to the ECMO machine.*



*Jim Barry, MD, associate professor of pediatrics, and his team from neonatology took over Kabrini's care after she was delivered.*

By about 1 p.m., the surgeons were finishing up and both mother and baby were doing remarkably well.

The doctors were in awe of what they had just experienced.

"I've never been through anything like this. I will never forget this case," Hoffman said. "We came together quickly. Everyone interacted so well as a team.

"The best-laid plans worked out as well as we possibly could have hoped. There were so many steps, and everything went exactly as planned. That never happens in obstetrics. We all were so happy and relieved," Hoffman said.

### SARAH'S RECOVERY

Most ECMO patients need to stay on the machine for 10 days to 2 weeks, some even longer.

Sarah proved to be anything but typical. After just three days, Sarah was becoming more alert and felt a desperate pull to meet Kabrini and reunite with Andrew.

"She woke up on the 21st and said, 'I'm going to be out of here in two days,'" Andrew recalled.

A day later, Sarah got to see her daughter via video.

"That motivated me to get out of bed," Sarah said.

Andrew cuddled with Kabrini and told her, "Mommy loves you and is going to see you very soon."

Sarah was rebounding far faster than anyone expected.

It wasn't really a surprise to Sarah.

All along she had had a feeling that she was going to survive. She remembered almost nothing from the time she arrived at the hospital. And she had a sense of how rough things had been on Andrew.

"I know how terrified I would have been, but all along, I kept hearing his voice. I heard, 'You're going to be fine.' He must have been saying those things to me," Sarah said.

As Sarah improved, the ECMO team decided to test Sarah's lungs. They clamped the cannula on the ECMO machine — without removing them — to see if Sarah could maintain her oxygen levels.

She did well.

Her next challenge was to regain some strength, and to do that, her team needed her to get up and try walking. The blood-filled tubes from the ECMO machine still were attached to Sarah's face and neck and felt extraordinarily heavy.

"Three or four nurses were helping me stand up. I could barely walk to the chair, but I was determined," Sarah said.

Along with working on her physical strength, Sarah started pumping her breastmilk for Kabrini.

"I wanted her to have the antibodies," Sarah said.

Wood, Sarah's obstetric anesthesiologist, credits Sarah's maternal instincts for her speedy progress.

"Moms are the strongest people in the world. Sarah was so determined.

She walked around with these huge bypass tubes. The strength it took her to overcome that, to get off ECMO and go see her baby was incredible. I work with a variety of patient populations, but mothers always impress me the most," Wood said.

### 'I NEED TO GO SEE MY BABY'

On August 22, Andrew and Sarah learned that Kabrini was having trouble with her bowels.

She had malformed intestines that had developed early in the pregnancy and had nothing to do with Sarah's case of COVID-19 or Kabrini's premature birth. Kabrini would need to receive care next door on the Anschutz Medical Campus at Children's Hospital Colorado.

The next morning, Sarah learned that Kabrini was about to be moved. She enlisted a nurse to rush her in a wheelchair to the NICU for a quick visit before Kabrini's transfer.

"I need to go see my baby," Sarah told her nurse.

While it's complicated to detach ICU patients from their monitors, Sarah's nurse sprang into action.

"She ran me as fast as she could," Sarah said.

She sped Sarah in a wheelchair down two floors in an elevator then far across the hospital to the NICU.

"I got to hold Kabrini for two hours. It felt like 10 minutes," Sarah said. "I gave her lots of hugs and kisses. I told her I was going to see her very soon and that she was going to be just fine. That gave me even more motivation to get better."

By August 23, Sarah's team removed the ECMO tubes and by August 26, she left the hospital, far sooner than anyone had expected.

"We were absolutely flabbergasted that she was getting out so early," Andrew said.

Kabrini ended up needing surgery to fix her malformed intestines. She stayed at Children's Hospital Colorado for several weeks and Sarah and Andrew visited every single day. For the team at Children's Hospital Colorado, Sarah was a celebrity of sorts. Everyone took to calling her the "Miracle mom."

Kabrini, too, seemed motivated to bust out of the hospital early. Her doctors expected her to need to stay until close to her original due date at the end of October. Instead, she was released on October 8 and got to spend Halloween at home, where Kabrini donned a mermaid costume.

"Everyone at Children's was so sweet and luckily Children's is the No. 1 pediatric gastrointestinal hospital in the nation," Sarah said.

### GET VACCINATED

These days, Andrew and Sarah feel blessed to celebrate every milestone, including their recent wedding anniversary.

Andrew can't stop kissing his "girls." After all his family endured, he is relishing simple moments.

Kabrini is growing fast. She now weighs 8 pounds, more than double her birth weight, and she is nearly 20 inches long. She makes funny faces and expresses herself with her arms.

Both Andrew and Sarah — and all their doctors — are on a mission to encourage people to get their COVID-19 vaccines. They want all people, including those who are pregnant, to protect themselves and avoid scary ordeals, like the one the Mays endured.

“If I would have heard a story like mine, there’s no doubt in my mind that I would have walked right in and gotten the vaccine right away,” Sarah said. “I strongly encourage everyone — particularly pregnant women or those who want to get pregnant — to get the vaccine.”

“If I had gotten vaccinated and still got sick, chances are I could have fought the virus more easily,” Sarah said. “Please strongly consider it. I went back and forth so much, and I wanted to do the right thing.”

Andrew already has received his first two vaccine doses. Sarah’s doctors recommended that she wait 90 days after being released from the hospital. She’s now slated to get her first vaccine dose around Thanksgiving, an occasion when her entire family will mark the holiday with extraordinary gratitude.

Tran, Sarah’s ICU doctor, also is pleading with people to get vaccinated.

“It’s remarkable that Sarah survived,” said Tran, who is an assistant professor at the CU School of Medicine. “Sarah was very fortunate. A lot of people aren’t as lucky.”

Nearly all the people who are dying now of COVID-19 are unvaccinated. Their illnesses are largely preventable, Tran said.

Sarah’s survival gave caregivers a big boost just when they needed it.

“We are all very demoralized,” Tran said. “Please get vaccinated.”

Both Sarah and Andrew have some post-traumatic stress from all that they endured. While Sarah was released from the hospital quickly, she temporarily lost her speech and suffered deficits in her short-term memory. She has fully recovered now, but still has flashbacks and dreams, typical responses for people who have been sedated in ICUs for long periods of time.

“I dream that I’m roaming the hospital. I’m acting like a nurse and going into patient rooms. That’s funny because I’ve always been terrified of blood and needles. But I always wanted to go into the medical field,” Sarah said.

Sarah helps manage programs that provide before and after school care for children in northern Colorado. She’s back at work now, as is Andrew, who works as a general foreman for a telecommunications company.

## WELCOME HOME

Andrew never will forget the day when he finally knew everything was going to be OK.

Kabrini was still at Children’s Hospital Colorado and was doing well.

Andrew and Sarah needed to check on their house and their dog. Their neighbors had jumped in to help as the couple spent their days at the hospital with Kabrini and nights in Aurora at the Ronald McDonald House, a charity that provided them a free home away from home.

Smoke from wildfires had blocked views of the mountains for weeks over the summer and into September.

As the couple turned west from I-25 toward Loveland, Longs Peak and Mount Meeker, two beautiful, soaring peaks, jutted up into crystal blue skies.

“It was one of those moments. I couldn’t say a lot. But it hit me. I was driving



*The Mays were apprehensive about COVID vaccination when Sarah became pregnant. They now strongly recommend the vaccine. Photo by Cyrus McCrimmon for UCHealth.*

and I had my wife beside me,” he said. “It was the first clear day.”

They drove farther, and as always, felt immediately at home in their canyon, with its stunning beauty and a churning river that has carved a path through soaring walls of granite. They got closer to their home, crossed one bridge over the Big Thompson and another over a smaller tributary.

There, they found their neighbors lined up in their front yard.

“They welcomed us home,” Sarah said.

She and Andrew teared up over the simple, kind gesture.

“You start to appreciate everything and not care about the little things,” Sarah said. “I look at life differently now. I’ve always appreciated my life. But, without all the help I got, I wouldn’t be here watching Kabrini grow.”

Andrew, too, often feels utterly in awe of his miraculous wife and baby.

“There are no words to describe how grateful we are. If it weren’t for Sarah’s nurses, doctors, surgeons, and prayers from around the world, we wouldn’t be here.”

## A BRACELET FOR HEALING AND HOPE

Back at the hospital, during the scariest days, Andrew’s mom flew in from Michigan to support her son. She’s Jewish and brought Andrew a special “hand of God” bracelet to help ward off evil and protect his wife and baby.

“Do not take it off until Sarah and your baby are home,” Andrew’s mother told him.

Andrew wore the bracelet around the clock. And when Sarah’s survival was most in doubt, Andrew held his wrist to his wife’s hand, pressing the omen to her skin and hoping to pass along the bracelet’s healing powers.

“It’s a beacon for people who need help,” Andrew said. “I felt an extremely strong need to keep it on and to know that I had it with me.”

The bracelet seemed to work.

“I felt prayers coming to me. It was the strangest feeling,” Andrew said.

Sarah and Kabrini did indeed make it home. And once mother and baby were safely out of harm’s way, Sarah and Andrew joined hands and slid the bracelet from his wrist to hers.

“We always have it on to help protect our family,” Sarah said.

The couple plans to raise Kabrini in the Jewish faith, and when she celebrates her transition to adulthood, Andrew and Sarah plan to give her a very special gift.

“At her Bat Mitzvah, we will give her the bracelet.”

*This article was originally published in UCHealth Today on Nov. 8, 2021.*



# CU PHYSICIAN ON 2022 PARALYMPICS TEAM

Pam Wilson qualifies for the U.S. wheelchair curling team

By Greg Glasgow

Pam Wilson, MD, was your typical recreational athlete before the 1978 car accident that left her partially paralyzed and using a wheelchair for mobility. After the accident, sports became a vital part of her recovery — a way to strive, compete, improve, and measure her progress as she went through physical therapy and rehabilitation.

“Sports was a really big deal,” says Wilson, who competed in basketball, track and field, and swimming in the years immediately following the accident, and even was a national skiing champion. “It probably saved my life in some ways.”

Wilson thought about competing in the Paralympics at that point in her life, but something else was calling her even more strongly — medical school. She received her degree from the University of Colorado School of Medicine in 1989 as one of the first medical students in the country to go through their classes, internship, and residency in a wheelchair.

Wilson, who now works in the Department of Pediatric Rehabilitation at Children’s Hospital Colorado, has always had a love of sports, but she recently reawakened that competitive part she had missed. She has been training in the winter sport of curling, in which teams of four people use specialized brooms to guide the path of a stone as it glides over the ice to a target.

**“One of the things I hope to do is to inspire some of the kids I work with to think beyond the disability and think about other things they can do with their life.”**

Wilson, a regular presence at the Denver Curling Club, traveled to Beijing in October for the wheelchair curling world championships. After her victory there, she was named to the Team USA Paralympic team for the sport. She plans to return with her team to Beijing in March to compete against the best curlers from around the world.

For Wilson, it’s a chance to answer some questions about what could have been.

“After my accident, I came to a place in my life where I could have gone on and tried to excel in my sporting career, or I could go to medical school, and I chose the path of going to medical school,” she says. “But there was always this lingering sense of, ‘Should I have waited a little bit longer and seen if I could have been a Paralympian back then?’ But that was not the path I chose at that point in my life. And I’ve always wondered if I could do it or not. With this new sport of curling, I have a chance to come back and close up some loops in my sporting career.”

## A SENSE OF COMMUNITY

Wilson is one of five curlers on the U.S. wheelchair curling team; they won the Worlds “B” competition in Finland in April 2021, defeating Switzerland in the final round to advance to the World Finals in Beijing. For Wilson, the sport offers social as well as athletic benefits.

“It’s a super-cool sport because, first off, it’s a sport for everyone,” Wilson says. “Anybody can curl at any level, so if you have bad knees or something, you still can do curling. Curling also develops a community, because you’re playing against all these people, but after you’re done curling, you all hang out and talk. There’s a real sense of community that you don’t get in some other types of sports.”

Wilson values that sense of community in her work at Children’s Hospital as well. She even took some of her colleagues at the hospital to the Denver Curling Club recently so they could get a taste of what the sport is all about. She sees other similarities between her work as a doctor and her work on the ice, among them focus, teamwork, and communication.

“It’s super important that you communicate on the ice and talk about what you’re doing, and it’s important in clinic that we communicate with the families exactly what pathway we’re going



*Pam Wilson, MD, (first on the left) associate professor of physical medicine and rehabilitation, says that participating in the 2022 Paralympics is a dream come true. “This Paralympic experience, to me, is like climbing Mount Everest,” she says. “I’ve been planning this journey for a long time, and finally being able to do it is like summiting Everest. I can’t tell you how excited I am about making this team.”*

to be on,” she says. “Having fun is important too. I have fun in the curling rink, and I have fun when I work with families in clinic. There are a lot of positives both ways.”

As a specialist in pediatric rehabilitation medicine, Wilson often works with children who have disabilities. She shares her experiences with them as inspiration to envision a life where they aren’t defined by their disability.

“Sports was super important for me in making the transition to being a person with a disability,” she says. “One of the things I hope to do is to inspire some of the kids I work with to think beyond the disability and think about other things they can do with their life. Sports is just one of the options for them. It could be theater or something like that. We always want the kids to optimize the things they’re doing in life and not let their disability hold them back.”

## HOPING FOR A MEDAL IN BEIJING

As they prepared for the Paralympics in March, Wilson and her teammates got together to train once a month, working individually in their home cities the rest of the time. Wilson is on the ice at the Denver Curling Club or the new Rock Creek Curling in Lafayette at least four times a week.

The team also gets together online regularly to talk about strategies and run game simulations. Wilson and her teammates want to be ready for the contest that is the ultimate goal of every athlete with a disability.

“This Paralympic experience, to me, is like climbing Mount Everest,” she says. “I’ve been planning this journey for a long time, and finally being able to do it is like summiting Everest. I can’t tell you how excited I am about making this team.”

**“We always want the kids to optimize the things they’re doing in life and not let their disability hold them back.”**

# TREATING METASTATIC UVEAL MELANOMA

Brigette Douglass's care provided by CU cancer and eye doctors

By Rachel Wittel

Brigette Douglass lives by the 10% rule: To avoid losing sight of the big picture of her life, she never lets anything consume more than 10% of her focus.

This approach has allowed a full embrace of family, career, and world travel adventures while also becoming one of the longest-participating patients in a clinical trial for metastatic uveal melanoma.

Douglass started treatment for her metastatic uveal melanoma six years ago as a participant in a clinical trial of tebentafusp (Kimmtrak), a groundbreaking immunotherapy drug approved by the FDA in January.

The initial phases of her care were provided at Jefferson Health and Wills Eye Hospital. Beginning in 2019, when the clinical trial became available at the University of Colorado (CU) Cancer Center, Douglass moved with her family to Colorado.

## BEING THE BOSS OF LIFE'S CHANGES

Douglass was diagnosed 13 years ago with uveal melanoma, a subset of ocular melanoma that affects pigmented tissue inside the eye. In fall 2009, during her daughter's senior year of high school, Douglass started experiencing migraines and vision loss in her left eye. She thought it could be a retinal detachment. Her uveal melanoma diagnosis came as a shock.

When one specialist suggested that Douglass wouldn't be able to attend her daughter's graduation, she tapped her 10% perspective and tackled one step at a time. First, she focused on getting an appointment with

an appropriate specialist. For Douglass, the 10% perspective prevents any single concern from dominating every decision.

"Big things are much more manageable than a bunch of small things. Now, mind you, buying a big house or becoming a grandma would be much better big things, but in managing this devastating illness, you have to have a balance," Douglass says. "When anything becomes your sole focus, it can literally suck the life out of you."



Brigette Douglass has participated in a clinical trial treatment for metastatic uveal melanoma since 2016.

After undergoing radioactive plaque therapy – and recovering at home with a lead plate taped to her face – Douglass was back to work within two weeks. Showing no signs of metastasis for more than five years, she celebrated much more than her health. Douglass watched her children graduate high school, accepted a new CEO role at an aluminum extrusion mill, and continues to watch her children grow in their careers as an engineer and a resident physician at UCHHealth.

**“We want patients to be part of discovering new therapies and also potentially get earlier access to medications.”**

About six years after her diagnosis, Douglass learned that her condition had spread to her liver, a common site for metastases. Douglass pursued a few additional procedures following her metastasis, including a liver resection and numerous chemoembolization treatments, but she was always back on her feet working or hosting parties within a week. By September 2016, she qualified to start the new specialty drug, tebentafusp, in its first phase of clinical trials.

## TIMING IS EVERYTHING

Treatment and survival rates of uveal melanoma that has metastasized have changed minimally in the last 20 years, according to an integrated team of providers from the CU Cancer Center.

“About 10 years ago, things dramatically changed for patients with metastatic melanoma derived from the skin, largely in part to immune therapy,” says Karl Lewis, MD, professor of medical oncology and a provider on Douglass's care team. “With our newer immune therapies, 50% to 60% of our patients with metastatic melanoma are alive five years and beyond. There were tremendous advances in a relatively short period of time, but what was left behind was uveal melanoma. Uveal melanoma didn't tend to induce an immune response.”

An estimated 2,500 to 4,000 people are diagnosed with uveal melanoma in the U.S. each year, and between 50 to 100 people in Colorado, according to Scott Oliver, MD, director of the eye cancer



program at the Sue Anschutz-Rodgers Eye Center and associate professor of ophthalmology at the CU School of Medicine. He says up to 75% of patients with aggressive, high risk uveal melanoma can metastasize by five years.

However, in new data to be presented later this year, Oliver discovered only half of the patients treated for uveal melanoma at CU had metastasized at five years.

“This is the good news. The bad news is that once metastasis occurs, patients historically have only survived another nine months,” Oliver explains. “That’s why this is a big deal. Tebentafusp is the first medication that’s ever been approved for treatment specifically of uveal melanoma that has metastasized.”

Tebentafusp is provided through an IV infusion and targets the patient’s immune system, giving it the power to recognize and attack melanoma. This process bridges the immune cell with the melanoma cell so that the body, rather than the drug, does the work itself. While the first treatments need to be given in a hospital because patients may develop a severe reaction, continued treatment can be completed at clinics and then patients can return home.

Beyond receiving a metastatic uveal melanoma diagnosis, patients like Douglass must have a particular genetic profile, or immune phenotype called HLA-A\*02:01, in order to qualify for the new drug. It is estimated that only one-third of the patients who go on to develop metastatic uveal melanoma will then qualify for tebentafusp.

Lewis says Douglass was in the right place at the right time to start the clinical trial and continue it with the CU Cancer Center. The trial evaluated 378 patients across medical centers worldwide.

“Not only was she diagnosed with this very devastating cancer at a time when this clinical trial was opening, but she also had the correct HLA type,” Lewis says. “She met the other criteria for eligibility in terms of being otherwise healthy, she was able to get on the study, and then the drug worked for her. Brigitte, in a lot of ways, is very unique and certainly very motivated. This is not everyone’s reality, but the reason we keep doing it is because we do find drugs that work.”

#### SHIFTING THE PERSPECTIVE TO CONTINUING CARE

As Douglass approaches her sixth year with the treatment, she feels like she’s in a time machine. Not only has she gained more time back, minimizing lab and doctor visits from weekly to monthly, but she’s hopeful for the future of others who now have access to this medication.



*Brigitte Douglass and her family. Photos courtesy Brigitte Douglass.*

“I’m excited that it’s going to be rolled out to more places. The hour or three hours you’re investing weekly is really nothing. It’s back to that 10% of your life,” Douglass says. “I’ve seen too many people with this disease quit their jobs, go on disability, and that’s not what you have to do. This treatment allows you to become president of a company again like I did, move around the country, travel, and live a normal life.”

Grateful to never feel like a number during the trial, Douglass says she’s always felt the celebration of something beyond herself and the hospital system.

“Having trials like this one is certainly a big part of our mission as the only NCI-designated comprehensive Cancer Center in our region, and one of only 50 or so in the United States,” Oliver says. “We want patients to be part of discovering new therapies and also potentially get earlier access to medications. It helps to have our deployment of leading-edge medicine as close to the clinic as possible.”

In addition to innovation and access in therapies, Douglass has her eyes set on a future that treats uveal melanoma like a long-term condition with increased educational opportunities.

“My hope is that I get to be around to support people as they go through this, and rather than this being a death sentence, that it becomes a chronic disease,” she says. “The way I look at it now is this is a chronic disease where I go in weekly for a shot. It’s what somebody who has rheumatoid arthritis might do or somebody with diabetes might do.

“If we can get to a point where we continue to provide a healthy plan for people – exercise, food, as well as the therapy – that’s what I’m hoping to do. We shouldn’t just stop here. We should look at other groups and not forget about the other percentage who are not currently eligible.”

# ALUMNI CORNER

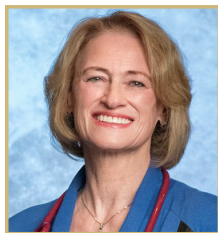
## 2021 SILVER & GOLD ALUMNI AWARDS

The University of Colorado School of Medicine and the CU Medical Alumni Association honored seven outstanding physicians recognized for health care delivery, and for service to their communities and to CU at the virtual Silver & Gold Alumni Awards on October 28, 2021. The CU Medical Alumni Association and Office of Alumni Relations congratulates these remarkable alumni on their achievements to help advance medicine and better their communities.



### **Barbara Arnold, MD '68 – Silver & Gold Award**

As one of the pioneering women leaders in medicine, Barbara Arnold, MD's career was characterized by advocacy. She first met with legislators within a month of finishing residency and founded the National Organization of Women in Ophthalmology (WIO). It took three years to convince the Council of the American Academy of Ophthalmology that women should be admitted as voting members of the Council, but Arnold was persistent. As the third elected president of WIO, Arnold initiated the annual WIO Summer Symposium starting in 1998 in Aspen. The four-day symposium has grown each year, setting attendance records for a meeting that showcases innovative scientific presentations and fosters networking. Arnold has combined her passion for medicine and art by teaching watercolor not only to her WIO group, but also to partially sighted people.



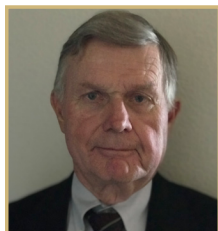
### **Deb Parsons, MD '84 – Distinguished Achievement Award**

Deb Parsons, MD, an internal medicine physician, has been heavily involved in statewide health policy through the Colorado Medical Society. She has sought to improve the patient and doctor experience at a legislative level. Parsons's focus is wide-ranging: fighting the opioid epidemic, maintaining and strengthening the body of law governing professional review, and improving Medicaid. Her teams prioritized physician well-being to address burnout and invested in residents and medical students. She continues to work in medical student education at Rocky Vista University.



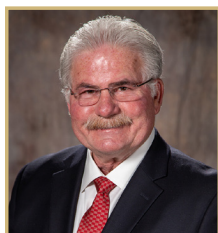
### **Donald Crino, MD '91 – Richard Krugman Distinguished Service Award**

Donald Crino, MD, began his involvement with the CU Medical Alumni Association after retiring from anesthesiology, sparked by a fond memory of receiving his first stethoscope from the alumni as a young medical student. Trading his title of physician for board member, Crino immersed himself in the Problem-Based Learning Program, mentoring young medical students. Additionally, he has worked alongside Matthew Rustici, MD, on Medical Student Innovation Projects, which encourage students to use ingenuity to solve issues within their communities. Crino is driven by giving back to the community.



### **Daniel Smith, MD '66 – Humanitarian Award**

In June of 2000, cardiothoracic surgeon Daniel Smith, MD, and his friend Mark Sheehan, MD, went on a service trip to Cambodia and observed the dire medical needs of a country whose infrastructure and social landscape had been devastated by the Khmer Rouge. Physicians had been explicitly targeted by the regime, which made Cambodia lacking in health care professionals even decades after the government officially fell. Smith and Sheehan were inspired to establish the Christian Medical Ministry to Cambodia in 2004. The project has continued to grow since then, with the organization training new health care practitioners in Cambodia as well as organizing aid trips with fellow physicians.



### **Mark Sheehan, MD (Fellow '81) – Humanitarian Award**

Cardiologist Mark Sheehan, MD, traveled in 2000 to Cambodia, where the Khmer Rouge had governed from 1975-1979. The violence from that period created a critical need for physicians. Sheehan and his friend, Daniel Smith, MD '66, were struck by the poor conditions they observed. After careful thought and prayer, the two physicians jumped into action and founded the Christian Medical Ministry to Cambodia in 2004. Their goals were to provide specialized medical care to the poor, train health care practitioners in Cambodia, and bring the most complex medical cases to the United States for treatment. Their mission continues to this day. Currently, Sheehan is fundraising to build a larger clinic for the group in 2022.



#### **Tamaan Osbourne-Roberts, MD '07 – Recent Graduate Humanitarian Award**

Family medicine physician Tamaan Osbourne-Roberts, MD, has structured his health policy career to mirror his clinical focus as an interpreter and connector. Osbourne-Roberts started in medical school with co-authorship of policy leading the American Medical Association to support the Affordable Care Act and went on to co-author national policy on excessive use of force in policing and limiting the use of sedative restraint in law enforcement. He has served in multiple local and national policy roles, including as Chief Medical Officer for Colorado Medicaid and as President of the Colorado Medical Society, where he was the first person of color—and at 37, the youngest person—to serve in that role. Most recently, he returned to school at Yale University, where he is pursuing his MBA in hopes of bridging the worlds of public health and business in service of the most vulnerable.



#### **Matt Rustici, MD '08 – Recent Graduate Achievement Award**

Matt Rustici, MD, is an associate professor of pediatrics at CU. Rustici began his academic career as director for the Problem-Based Learning course at CU School of Medicine, which uses simulated real-world patient cases to challenge students, illuminate how illness and treatment are affected by social determinants of health, and foster student curiosity. As a member of the CU Medical Alumni Association, he collaborated with medical student leaders to establish the Innovation in Medical Education Fund, which includes a competitive grants program, leadership training and grant-writing mentorship for student-lead initiatives to addressing local health disparities. Rustici is co-director of the Transition To Residency (TTR) course at the university and chairs a national TTR course symposium. In 2021, he was named a Macy Faculty Scholar and will spend two years creating TTR course materials to improve education for graduating students.

## **AWARD NOMINATIONS**

The CU Medical Alumni Association is seeking 2022 alumni award nominations, including our two new recent graduate awards. If you know a CU School of Medicine alumnus/a who has demonstrated remarkable humanitarianism, career accomplishments, professionalism, or service to CU, please contact [vanessa.duran@cuanschutz.edu](mailto:vanessa.duran@cuanschutz.edu).

## **SAVE THE DATE 2022 CU School of Medicine Alumni Reunion**

Mark your calendars and save the date for September 30 - October 1 for the 2022 CU School of Medicine Alumni Reunion! This year we will be celebrating class years ending in two and seven and bringing back class years ending in one and six. Join your fellow classmates and relive your best memories during medical school. Festivities include tours of the world-class CU Anschutz Medical Campus, an update from Dean John J. Reilly, Jr., MD, time to celebrate with your classmates, and more.

## **STAY INVOLVED**

There are several opportunities to get involved with the CU Medical Alumni Association. If you are interested in mentoring current medical students, you can volunteer for the FirstUp First Generation Mentorship Program, which pairs first-generation medical student with first-generation alumni. You can also help support student community projects for the Innovation in Medical Education initiative through mentorship and or philanthropic donations. The CU Medical Alumni Association Board of Directors is looking for members. New board members would be elected in July 2022, and do not need to live in Colorado to participate. If you are interested in helping to move the CU Medical Alumni Association's mission forward, or would like to be a mentor, please contact [vanessa.duran@cuanschutz.edu](mailto:vanessa.duran@cuanschutz.edu) to learn more.





## LOTTE DYRBYE NAMED CHIEF WELL-BEING OFFICER

Lotte N. Dyrbye, MD, MHPE, has been named Senior Associate Dean of Faculty and Chief Well-being Officer for the University of Colorado School of Medicine.

Dyrbye is the first to hold this newly created position at the CU School of Medicine. In this role, she will oversee faculty affairs, faculty and leadership development programs, and diversity, equity, and inclusion efforts, and she will lead initiatives that reduce burnout among physicians, residents, and medical students. She will also hold an appointment as professor of medicine.



*Lotte N. Dyrbye, MD, MHPE*

Dyrbye has been with Mayo Clinic in Rochester, Minn., since 2001, where she has made many creative contributions to education programs, taught medical students and residents, and implemented several innovative programs in support of faculty development, diversity, and well-being. She is professor medicine and medical education and co-director of the Mayo Clinic Department of Medicine Physician Well-Being Program.

“The past two years have been extraordinarily challenging for everyone, particularly for health care workers who have overcome tremendous obstacles to provide excellent and compassionate care throughout the pandemic,” said CU School of Medicine Dean John J. Reilly, Jr., MD. “We are fortunate to have Dr. Dyrbye joining us at CU.”

Dyrbye graduated from the University of Wisconsin Medical School in 1996 and completed an internship and residency in internal medicine at the University of Washington School of Medicine. After working in private practice for a few years, she accepted an appointment at Mayo Clinic in September 2001, where she rose through the ranks to become professor of medicine and medical education at the Mayo Clinic School of Medicine in 2014. She earned a Master of Health Professions Education from the University of Illinois at Chicago College of Medicine in 2009.

She has also led significant initiatives to promote faculty development at Mayo Clinic, including serving as assistant dean of faculty development for the Mayo Clinic School of Graduate Medical Education and creating and implementing Mayo's Academy of Educational Excellence. Through these efforts, Dyrbye has helped create useful and popular programming, including short videos, that can fit into the busy schedules of faculty. The “Take5” videos are broadly available for use in Mayo Clinic faculty meetings and cover key topics of interest, such as how to deal with patients expressing bias toward learners. In 2018, the videos were viewed more than 33,000 times.

As co-director of the Program on Physician Well-Being at Mayo, Dyrbye has led numerous national and multi-institutional studies, conducted randomized clinical trials of possible solutions, and been an innovator. She has received 19 competitive research grants to support her work, and she is frequently invited to give presentations nationally and internationally. Dyrbye is author of more than 140 journal articles, abstracts, and other written publications related to physician well-being. Her articles have been cited more than 18,000 times.

Dyrbye is co-author of the National Academy of Medicine's consensus study, “Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being.” The book was named the 2021 winner of the James A. Hamilton Award, given annually to the authors of a management or health care book judged outstanding by the American College of Healthcare Executives.

## RONALD SOKOL NAMED CHIEF SCIENTIFIC OFFICER, CHILD HEALTH

Ronald J. Sokol, MD, has been named Chief Scientific Officer, Child Health, for the CU Anschutz Medical Campus, effective May 1, 2022.

The newly created position is responsible for building and coordinating child health research activities on campus, developing strategies to deepen and broaden our scientific programs and the core services supporting them, developing faculty retention and recruitment strategies, and defining strategic and operational priorities for child health research.

Sokol will mobilize campus research resources and technologies to better understand the biological causes of diseases that affect infants and children, and which may extend into adulthood. In collaboration with leaders from the School of Medicine, the Anschutz Medical Campus, and Children's Hospital Colorado, he will help guide basic, translational, clinical, and population health research activities related to child health.

Sokol, professor of pediatrics, has led the National Institutes of Health-funded Colorado Clinical and Translational Sciences Institute (CCTSI) since 2008. At the CCTSI, Sokol and his team have been responsible for overseeing the implementation of programming supported by more than \$187 million in National Institutes of Health funding. He will remain director of the CCTSI.

“As the leader of the Colorado Clinical and Translational Sciences Institute, Dr. Sokol has demonstrated a commitment to collaborative research, dedication to clinical care, and a passion for community engagement that provides a solid foundation for this important new leadership role on the Anschutz Medical Campus,” said Dean John J. Reilly, Jr., MD. “We look forward to the vision he will provide as Chief Scientific Officer, Child Health.”



*Ronald J. Sokol, MD*

Sokol co-founded the Pediatric Liver Center – one of the first pediatric liver centers in the United States – to integrate high-quality multidisciplinary pediatric hepatology care, including pediatric surgery and nutrition, with clinical and translational research. In addition, Sokol has chaired the NIH-funded Childhood Liver Disease Research Network, a network of 14 leading centers in North America studying nine rare childhood liver diseases, since 2002.

A major focus of Sokol's research has been defining the causes, development, best management strategies, and outcomes of infant and childhood liver diseases. He has run a basic science laboratory for more than 35 years, and led translational and clinical research related to pediatric gastroenterology and hepatology, publishing more than 280 original articles and 125 book chapters or review articles. Sokol holds five patents related to the use of antioxidants in the treatment of cholestasis, and his research discoveries have changed the way cholestasis-induced vitamin E deficiency in children and adults is diagnosed and treated.

## ANSCHUTZ HEALTH SCIENCES BUILDING CONSTRUCTION COMPLETED

Construction of the Anschutz Health Sciences Building has been completed and CU School of Medicine programs that are relocating to the new building began moving in earlier this year. The seven-story building, with more than 390,000 square feet of space, is the first new university building constructed on campus in more than 10 years.

The building will house major programs including the Colorado Clinical and Translational Sciences Institute, the Department of Psychiatry, the Colorado Center for Personalized Medicine, and the Center for Advancing Professional Excellence.

Groundbreaking for the building was celebrated in January 2019 and construction continued through the pandemic. One of the first major events scheduled for the building is Match Day for the medical student Class of 2022.

## CAMPUS DESIGNATED RARE DISEASE CENTER OF EXCELLENCE

The University of Colorado Anschutz Medical Campus – home to Children's Hospital Colorado, UHealth University of Colorado Hospital and the CU School of Medicine – has been designated as a Rare Disease Center of Excellence for its research and commitment to advance care for patients with rare diseases.

The new designation from the National Organization for Rare Disorders (NORD) was announced in November 2021 and includes 30 others medical centers across the country. Each center was selected by NORD in a competitive application process requiring evidence of staffing with experts across multiple specialties to meet the needs of rare disease patients and significant contributions to rare disease patient education, physician training, and research.

"We are thrilled to be designated as a Rare Disease Center of Excellence by NORD," said Matthew Taylor, MD, professor of medicine and director of adult clinical genetics at the CU School of Medicine. "As we are witnessing more tools to diagnose rare diseases and can see many novel treatments for rare diseases on the near horizon, we believe that the network of researchers and clinicians at UHealth and Children's Hospital Colorado will increasingly serve the needs of patients and families affected by rare diseases."

"Recognition as a NORD Rare Disease Center of Excellence is a tribute to the high-quality care we provide across the mountain states region and across the nation, and we are proud for our patients to see even more evidence that they are receiving world-class health care in their own neighborhood," said Shawn E. McCandless, MD, professor of pediatrics who practices at Children's Hospital. "This is also a truly exciting opportunity to partner with other sites across the country to further enhance and refine care for patients with thousands of types of rare disorders."







Caley Orr, PhD, left, associate professor of cell and developmental biology, working in the Arma Veirana cave. Participating in a dig at an infant burial site in Italy shapes how he teaches anatomy, Orr says. “By learning more about how human lives have been valued in life and in death, it enhances our sense of humanity in medicine.”

## DISCOVERY OF ANCIENT INFANT BURIAL SITE

CU anatomist Caley Orr investigates human evolution in Europe

By Rachel Sauer

The remains of an infant that researchers came to call Neve emerged slowly from 10,000 years of sediment. Near the back of Arma Veirana cave above the village of Erli in northwest Italy, delicate brush strokes initially revealed perforated shell beads and pendants, and then, on the last day of the 2017 excavation season, fragments of a tiny human cranium.

For Caley Orr, PhD, associate professor of cell and developmental biology at the University of Colorado School of Medicine, it was a profound moment.

Well-documented burials from the early Mesolithic period are rare, and infant burials from that time, which immediately followed the last Ice Age, are rarer still. The Mesolithic period is of particular interest in prehistory because it is the last cultural period in Europe when hunting and gathering was the primary way of living, before giving way to the farming societies of the Neolithic.

As detailed in research findings published in *Scientific Reports*, burying a 40- to 50-day-old infant with such care and objects of value indicates not only material and emotional investment in the child’s interment, Orr says, but may illuminate how personhood was attributed to even the youngest among hunter-gatherer groups during the era.

It also highlights “how we can better understand the human body,” Orr says. “By learning more about how human lives have been valued in life and in death, it enhances our sense of humanity in medicine.”

### MAKING THE DISCOVERY

Orr and his wife, Jamie Hodgkins, PhD, associate professor of anthropology at the University of Colorado Denver, have worked together in Europe since 2011, looking for early incursions of human populations. Several dig seasons in Bulgaria yielded little success, but in 2015 their Italian colleagues invited them to participate in research in the Ligurian pre-Alps; specifically, at the Arma Veirana cave.



The cave is a popular picnicking and recreation spot for people who live in the area and had also been looted for artifacts throughout the centuries. “The cave would have been a prominent landmark during the Pleistocene period,” Orr explains, which is often referred to as the Ice Age, a time period that began about 2.6 million years ago and lasted until 11,700 years ago.

The research team initially began excavating older deposits at the mouth of the cave, finding a rich layer of tools and the remains of meals and butchered animals left behind by Neanderthal people and dating to over 50,000 years ago. Team members hypothesized that they could strategically dig into the cave’s curved slope and “intersect younger dirt that might have evidence of more recent humans,” Orr says.

This would help scientists understand not only migration and dispersal patterns as Earth continued to warm following the Ice Age, Orr explains, but also shed light on the culture, adaptations, and population dynamics of hunter-gatherer groups in the area.

The team excavated to layers dated to approximately 10,000 years ago, or the early Mesolithic period, and began finding shell beads that they hypothesized could have come from the Mediterranean coast about 15 kilometers away. Then, on the last day of the 2017 summer dig season, researchers found an in situ, or in place, cranial fragment.

“All of us were heading back to teach, students were heading back to class, and we knew we couldn’t rush it, we knew it would take weeks,” Orr says. “So, we made the painful decision to cover it very carefully and ask the local villagers to watch the site for us and hope that things stayed in place.

“We’re fortunate to have wonderful relationships with the people who live in that area. They love what we’re doing there and have a lot of pride in the history, so we had assurance that everything was going to be OK. And it was.”

### A BURIAL MADE WITH CARE

The next summer, the research team returned to the cave and over an intensive five-week excavation gradually uncovered what emerged as a female infant burial. They found a line of beads, shells that had clearly been strung together and an eagle owl talon. They also found part of a humerus, phalanges and metacarpals, or bones of the hand, vertebrae, ribs, and a significant amount of the skull still in place.

Laboratory analysis revealed wear patterns on the holes in the beads indicating that they had been used for a period of time before being placed in the infant’s grave. “They likely weren’t made for burial,” Orr explains. “It represented a significant amount of work to produce all of those beads, and on foot as a Paleolithic person it wouldn’t have been easy to go down to the Mediterranean. These were valued objects and it would have been a significant investment to bury a child with them.”

Gradually, the researchers began referring to the remains of the infant as Neve, which means “snow” in Italian, though Orr admits this arose from

his misspelling of the Neva River Valley where the cave is located.

“There’s some debate in archaeology about whether we should be giving names to individuals whose culture is quite remote,” Orr explains. “That baby’s people gave her a name, most likely, so is it right to impose this name? We’re quite sensitive to that, but the team also felt the emotional weight of what we were uncovering, and always referring to the baby as AVH-1 (the specimen number) didn’t seem right either. We opted to err on the side of giving her a more humanized name, an Italian name.”

Finding an infant burial from this era was significant for several of reasons, Orr says, including the fact researchers have uncovered so few of them.

“There’s a lot of conversation in the literature about the personhood of infants during this era or earlier,” Orr says. “Because we haven’t found a lot of infant burials, it’s been hypothesized that they weren’t fully recognized as individuals worthy of burial.

“The burial of infants is not necessarily in question – we do have the example of monozygotic twins in what’s now Austria dated to 27,000 years ago, and a few good examples from the later part of the Mesolithic – but there are more unknowns about the concepts of personhood and group membership. With adult burials, it varies a lot across geography and sites, but there’s evidence of egalitarian treatment of genders in funerary practices. How does this extend to children? That’s something we just don’t know.”

The discovery of an infant burial with evidence of deliberation and care, and objects of clear value placed with the child, is significant in understanding the cultural structure and values of early societies.

### MAKING CONNECTIONS

After pausing the dig in 2019 to renew permits, and then COVID-19 interruptions the following two summers, Orr says the team hopes to return to Arma Veirana this summer to continue learning about Neve and the culture to which she belonged.

He says his work in the field also influences how he teaches anatomy in the CU School of Medicine.

“The lessons we learn from cadavers go beyond how to name body parts,” he explains. “We need to see them first as patients. These are people, so for students it’s a matter of learning how to respect them as humans and develop that sense of humanity. I hope I impart that to students where I can.

“I see a lot of connections between that and our research in Italy. I don’t think anybody who has worked on the research ever felt coldly clinical. My wife was pregnant with our daughter in 2017 when we first made the find, and then at 6 months old she came back with us. Everybody, I think, felt the emotional weight of what we were doing, and I don’t think that’s a detriment to scientific work. I think the emotion and the responsibility of telling the story of this child has made the science better.”

**“By learning more about how human lives have been valued in life and in death, it enhances our sense of humanity in medicine.”**

University of Colorado  
Anschutz Medical Campus  
Office of Alumni Relations  
13001 E. 17th Ave., Box A080  
Aurora, CO 80045

Nonprofit  
Organization  
U.S. Postage  
Paid  
Denver, CO  
Permit No. 831

**RETURN SERVICE REQUESTED**

*"Connecting alumni with each other and the university."*

*Advancing Science and Improving Care* UNIVERSITY OF COLORADO SCHOOL OF MEDICINE

# CREATE A LASTING IMPACT



School of Medicine  
UNIVERSITY OF COLORADO  
ANSCHUTZ MEDICAL CAMPUS

CU School of Medicine alumni like Sarah Milliken, MD '08, are helping current students pay it forward. By financially supporting the **Innovation in Medical Education Fund**, CU alumni enable students to take on innovative service projects in their community, gaining real-world experience. Together with the CU Medical Alumni Association, our graduates help the next generation of physicians and ensure that CU continues to produce the best doctors in the country. Supporting the passions of our students through the Innovation in Medical Education Fund creates a lasting positive impact in the field of medicine.

If you would like to support future medical student projects, visit [giving.cu.edu/medinnovations](https://giving.cu.edu/medinnovations) or contact Vanessa Duran, at [vanessa.duran@cuanschutz.edu](mailto:vanessa.duran@cuanschutz.edu) or 303.724.2517.

“*Knowing someone believes in you is priceless. Gifts to the Innovation in Medical Education Fund directly support our medical students as they complete hands-on projects that make a difference in their community. The experiences they gain while following their passions and aiding their local community is a win-win for everyone.*”

**Sarah Milliken** | CU School of Medicine Class of 2008

