

In the fight against infectious disease, public health brawler **Caroline Buckee** is the

WORLD'S CHAMPION

Jeffrey G. Harris, MBA & Richard A. Skinner, PhD

Once it vanquishes COVID-19, the world's public health sector can sit back and take a deep breath — sans mask, no less. After that, though, it must immediately turn its attention to an even more profound threat — one that *can't* be mitigated with vaccines, antiviral agents, or stringent social distancing measures, a leading epidemiologist warns.

Caroline O'Flaherty Buckee, PhD, associate professor of epidemiology at Harvard University's T.H. Chan School of Public Health and associate director of the university's Center for Communicable Disease Dynamics, maintains that the sector must look inward and address a number of systemic shortcomings, including the misalignment of its existing priorities and proficiencies with the realities of the 21st century.

In Buckee's estimation, the public health sector, as currently constituted, has two major weaknesses that, at first glance, might seem to be at odds: (1) It emphasizes high-stakes laboratory exploration at the expense of ground-level practice, and (2) it suffers for lack of advanced competencies in data science and technology.

Buckee, a self-styled "troublemaker," cites what she sees as a growing inability to translate wealthy nation's epidemiological breakthroughs into workable solutions in developing countries that lack not only scientific heft but also political stability, economic wherewithal, and modern infrastructure.

"My feeling is that the COVID-19 pandemic has really exposed a gap — the lack of a pipeline to take some of these findings that we've developed in science and actually make them work in the real world," Buckee said in a just-released installment of *Innovators*, a podcast produced by the global higher education search firm Harris Search Associates.

"Many of the methods that we're developing are quite sophisticated. They're developed in high-income settings, with all the capacity assumed. Then, when you actually try to implement them and operationalize them — translate them in the real world — there's a huge disconnect.

"I think that's something that we're going to have to grapple with now and in the future."

Buckee said an "archetypal example" of this discovery-delivery disconnect is the asymmetric application of the technology known as polymerase chain reaction (PCR), or "molecular photocopying." Developed in the 1980s by American biochemist and future Nobel laureate Kary Mullis, PCR has made possible many diagnostic tools, including the swab-based test that's considered the "gold standard" in COVID-19 detection.

Unfortunately, she noted, many of the chemical reagents used in the test are scarce and therefore prohibitively expensive, particularly in the world's most remote, most impoverished regions.



LISTEN IN



Caroline Buckee, PhD, associate director of the Center for Communicable Disease Dynamics at Harvard University, discusses public health's next big challenge in the latest installment of *Innovators*. The podcast, presented by Harris Search Associates, is available on the web at [HarrisSearch.com](https://www.harrissearch.com) and on leading podcast platforms, including Libsyn, Apple Podcasts, Google Podcasts, Stitcher, Overcast, Spotify, and Player FM.

“That technological advance (PCR testing) requires lab capacity. It requires financing. It requires technical know-how,” Buckee said. “There are parts of the world where people live in poverty. There are remote places where laboratory capacity is limited and technical capacity is limited.”

“Translating the PCR test for COVID-19 in those places to actually do epidemiological surveillance becomes extremely challenging — and essentially impossible under some circumstances.”

Discovery vs. delivery

In a collection of pandemic-related essays that Harvard published this fall, Buckee used the South American nation of Guyana to illustrate her point. “In Guyana, you have remote Amazonian communities that can only be reached by a small plane and a boat,” she wrote. “PCR testing only happens in the capital because that’s where the lab capacity is. If somebody in a remote community comes into a local health clinic with a fever and a cough, even if a nasal swab test is available, you have to get that swab onto a plane that may fly only every other day to the capital. Then somebody has to run the PCR. Eventually, you get a result. But by the time you get that result back to the patient in the remote region, it’s irrelevant.”

Another example: BNT162b2, the first COVID-19 vaccine to receive emergency-use authorization from the U.S. Food and Drug Administration. The vaccine, developed by Pfizer Inc. and German partner BioNTech SE, must be transported and stored at minus 70 degrees Celsius (minus 94 degrees Fahrenheit), “colder than winter in Antarctica,” as NPR has noted.

The equipment needed to maintain such ultra-low temperatures is a rarity in small hospitals and clinics across the United States, so where does that leave countries that struggle just to keep meat and produce from rotting in the heat of the day?

“These are just very concrete barriers” to the universal rollout of tests and treatments, Buckee told *Innovators* host Richard A. Skinner, PhD, a two-time former university president who now serves as senior consultant with Harris Search Associates.

All too often, Buckee said, the developers of headline-grabbing weapons in the war on infectious disease are largely oblivious to how — or even *whether* — their life-saving creations will ease suffering in developing countries.

“I think that reflects an inherent tension between trying to use biomedical research and science and technology to address disease-specific problems and

addressing poverty and other socioeconomic factors that underlie some of the biggest public health issues in general,” she said.

Buckee doesn’t fault the researchers who are scrambling to devise treatments and vaccines. The culprit, she said, is the insular, tradition-laden system in which they operate.

“I think that in public health research, we make our methods sort of in a vacuum, because we’re rewarded for publishing papers that are novel and for getting grants,” she said. “That doesn’t lend itself to the work of public health.”

It’s time to “decolonize” public health, Buckee said.

“Instead of coming up with a great idea in Silicon Valley or at Harvard and then deciding that you’re going to apply it somewhere, you have local organizations identify what the needs are and help in the generation of knowledge and in the design of what technology is going to actually help,” she said.

“That does kind of flip the whole (process).”

In a world of hurt

Buckee, 41, brings a global perspective to her work, but, to be clear, it’s *not* the perspective of some camera-toting, scrapbook-filling tourist prone to gushing over museums, monuments, and historical sites. Her most notable and enduring travel “souvenirs” are grievances — grievances over health inequities.

“For as long as Buckee can remember, she’s been keenly aware that the world is a tragically unequal place,” Chris Sweeney writes in a profile of Buckee that appears in the winter 2020 issue of the journal *Harvard Public Health*. The title of Sweeney’s piece pretty much says it all: “The uses of outrage: Caroline Buckee is mad as hell — and that’s good for public health.”

Buckee’s father, a PhD in theoretical astrophysics, worked in the oil industry, a career choice that resulted in frequent moves for the family. During her formative years, Buckee lived in various parts of the world, including Alaska, Norway, Canada, the Middle East, and the United Kingdom. Each move exposed her to a unique set of health-related challenges, eventually leading her to conclude that all health is — like all politics — fundamentally local.

Early on, Buckee aspired to be a veterinarian. Ultimately, though, she realized she was too softhearted to put down terminally ill or unwanted pets. Not wanting to abandon animal science altogether, however, she chose to pursue a bachelor’s degree in zoology at the University of Edinburgh.



SARA ESHLEMAN / US NAVY

The COVID-19 pandemic has exposed a growing disconnect between laboratory breakthroughs and the delivery of tests and treatments to vulnerable populations in developing countries, Harvard University's Caroline Buckee maintains.

A summer course took Buckee to Tanzania's Usambara Mountains to study plants, birds, and insects. Fieldwork near a malaria clinic proved to be something of a turning point.

"I remember there being a bunch of mums and babies lined up at the clinic," Buckee recalls in Sweeney's piece, "and all I could think was, 'Well, hmm, I'm catching *butterflies*.'"

After completing her undergraduate studies, Buckee earned a master's degree in bioinformatics at the University of York. There, she helped map the DNA sequence of the malaria parasite *Plasmodium knowlesi*, an undertaking that sparked a lasting interest in pathogen genomics.

Buckee then earned a PhD in mathematical epidemiology at Oxford University.

For a time, despite her academic credentials, Buckee wasn't sure what she wanted to do. According to the profile in *Harvard Public Health*, she "took a year off, traveled, went surfing, and briefly kicked around the idea of becoming an avalanche search-and-rescue pilot."

Eventually, Buckee accepted a Wellcome Trust Fellowship, which took her to the Kenya Medical Research Institute.

While in Kenya, Buckee came up with the idea of using cell phone data to track the spread of malaria. She continued to study the technique and its efficacy even after she left East Africa to join the faculty at Harvard's T.H. Chan School of Public Health in 2010.

Buckee's research, which featured data from Kenya and Pakistan, as well as broad swaths of the Middle East and Southeast Asia, confirmed the practice's potential as a powerful epidemiological forecasting tool. Her findings were published in 2012 in the journal *Science*.

Making a difference

The young researcher's groundbreaking work captured widespread attention. In 2013, *MIT Tech Review* named Buckee one of its "35 Innovators Under 35." CNN proclaimed her one of world's top thinkers. *Foreign Policy* magazine featured her in its list of "100 Global Thinkers."

That same year, Buckee was appointed associate director of Harvard's Center for Communicable Disease Dynamics (CCDD), a federally funded research hub dedicated to improving and promoting mathematical modeling and statistical inference in the battle against infectious disease.

More recently, Buckee applied her analytical acuity to the devastation wrought by Hurricane Maria, a Category 5 storm that struck Dominica, St Croix, and Puerto Rico in September 2017.

When the Puerto Rican government announced that Maria had claimed 64 lives, Buckee suspected that the count was ridiculously low. However, because of downed telephone lines and washed-out roads, accurate information from isolated parts of the island was difficult to obtain.

Buckee devised a workaround.

Joined by colleagues from Harvard and Puerto Rico's Carlos Albizu University, she began knocking on the doors of randomly chosen households across the island — 3,299 in all. Based on information gleaned from those visits, Buckee estimated that the storm's mortality rate was 14.3 deaths per 1,000 people. That rate would put the overall death toll in the thousands — a far cry from the official pronouncement of 64 fatalities.

In the end, Buckee's calculations were borne out by the Puerto Rican government's *revised* official death poll: 2,975.

Now, Buckee is honing data-mapping tools with fellow public health researchers in Bangladesh, site of the world's largest refugee settlement, currently home to some 900,000 individuals who have fled the Rohingya genocide in neighboring Myanmar.

Since the beginning of the year, Bangladesh has recorded 73,000 cases of mosquito-borne dengue fever.

"A lot of what I do is fueled by rage," Buckee told Sweeney for the profile in *Harvard Public Health*. "I find anger to be quite motivating."

For better or for worse, Buckee isn't likely to run out of gas any time soon.

"There are so many things to keep us up at night," she said, "that it's hard for the average person to take existential threats seriously."

Buckee's take on remaking the public health sector mirrors her approach to curbing infectious disease: Although the identification — or diagnosis — of a problem is a critical first step, the journey ends only with a cure.

'Data managers without borders'

Buckee's prescription for the sector — it's actually more of a regimen that a single-dose remedy — starts with academia. "I think we have to really change how we think about education — public health training, scientific training," she told *Innovators*.

"My opinion is that we have to start thinking about the development of both technical and contextual capacity *locally*. We have to move from the idea that we have these institutions of higher education that are elite and they train very few people to do a very high level of technical work. We have to come up with a much more distributed system for training people and making sure that they are working *in situ* to solve public health problems using the science and technology that we have available to us."

What's more, she said, regardless of *where* they might be located, educational programs in public health should adopt curricula that ensure their graduates are fully prepared to meet current — and future — needs.

Traditionally, public health has drawn heavily from medicine and the health sciences. For decades, physicians, nurses, veterinarians, and sanitarians formed the sector's occupational backbone. Over time, they were joined by botanists, nutritionists, ecologists, pharmacologists, virologists, and zoologists. In recent years, the sector has seen an influx of geneticists, biophysicists, molecular biologists, and environmental health specialists.

Although all of the foregoing expertise remains essential, it's no longer enough, thanks primarily to the evolution of infectious disease surveillance, Buckee said. It turns out that the skills employed in post-infection contact tracing aren't necessarily the same ones needed for pre-infection *contact anticipation* — not to mention prevention.

"As science has become more and more complex and more and more sophisticated, we are seeing increasing technical requirements for surveillance systems," Buckee said. "What that means is that the human capacity to incorporate new kinds of data and new kinds of technology is lagging behind the financing to make that happen, and that has led to divergent paths between what's possible in theory and what happens in practice.

"There's a capacity gap — and it's growing."

‘WHO ELSE IS GOING TO DO IT?’



HARVARD UNIVERSITY

Caroline Buckee’s groundbreaking research and her ground-shaking advocacy have captured attention in academic public health — and beyond.

In 2013 alone:

- **MITTech Review** named Buckee one of its “35 Innovators Under 35.”
- **CNN** proclaimed her one of world’s top thinkers.
- **Foreign Policy** magazine featured her in its list of “100 Global Thinkers.”

In 2019, Buckee received Harvard’s Alice Hamilton Award, which honors the first woman appointed to the university’s faculty. That milestone took place a century earlier — in 1919. Like Buckee, Hamilton was a public health pioneer, focusing on the then-nascent fields of toxicology and occupational health.



Counting on numbers

Buckee sees it day in and day out. “When I look for someone who’s going to work for me to develop methods for surveillance,” she said, “I want somebody who can use GIS. I want somebody who can work with satellite images. I need somebody who can do nonlinear dynamics modeling. I need someone who understands biostatistics. I need somebody who can easily code and manage databases.

“One of my grad students jokes that what we need is ‘data managers without borders.’”

Speaking with a hard-to-pin-down accent befitting her multinational background, Buckee said the onus for building these newly vital competencies extends beyond higher education.

“I think it should even start earlier,” she said. “You know, in my high school, the statistics (training) that I received was really minimal. I think that we need to have more statistical- and data-numeracy support for everyone.

“*Everyone* needs to be better.”

Buckee blames rampant innumeracy for American society’s growing susceptibility to misinformation, including the anti-science sophistry that seems to have gained currency during the COVID-19 pandemic, thereby undercutting, or at least complicating, the fight to eradicate the virus.

“The unfamiliarity with (data science) is what’s underpinning the proliferation of misinformation that’s making public health so challenging right now,” she said. “People are not numerate. They don’t find statistics easy to interpret, and because they haven’t had that (educational) background, it’s very easy to mislead them. A general problem with the whole system is that people need more grounding — more data literacy.”

Buckee also wants academic public health to help break down what she views as arbitrary — and wholly artificial — divisions within the discipline and, more broadly, the public health sector as a whole.

“We’ve got chronic disease, infectious disease, environmental health — you know, all of these things,” she said. “But when you work in the real world, you realize that these are intersecting threats that impact communities. They overlap; they reinforce each other. From a public health perspective, you want to be thinking about the health of a *population*, and that is complex. It involves multiple different streams of data, different approaches, different kinds of epidemiological work.

“I’m not sure that I even understand epidemiology as a coherent, unchanging, monolithic field. It’s not. It’s evolving rapidly. Understanding *community* health, more broadly, is a challenge for the 21st century, as we face not just pandemics, but urbanization, pollution, habitat destruction — all of these things.”

The bottom line, as Buckee sees it: “Epidemiology is going to continue to be a pillar of health science, but what it really means will change as the world changes.”

In the meantime, Buckee realizes that her constant grouching might be unsettling to some in the public health establishment, especially those who favor “time-honored” approaches (read: the status quo). So be it.

“I feel a responsibility to my students and my postdocs — to show them that you don’t have to be apologetic and grateful all the time,” Buckee wrote in

her recent essay on COVID-19’s impact. “Even in a crisis like this pandemic, I feel a responsibility to raise these issues, to speak out and be brave about these things — because, well, who else is going to do it?”

Surprisingly, for all of her outrage over health inequities and all of her frustration with the difficulties inherent in translating laboratory breakthroughs into field-level interventions, Buckee is, deep down, hopeful.

“I think things are shifting, and I think they’re shifting in promising ways,” she told *Innovators*. “We just need to figure out the best way to exploit what has been the most remarkable explosion of scientific research and technology.

“How do we make sure that it’s globally applicable and that it’s going to help with the overall goal of alleviating suffering?” ■

ABOUT HARRIS SEARCH ASSOCIATES

Harris Search Associates is a global higher education executive search firm. Established in 1997 by Jeffrey G. Harris, the firm focuses on the recruitment of senior leaders to support the growth of universities, research parks, national laboratories, hospitals, and academic healthcare enterprises. Based in Dublin, Ohio, a suburb of Columbus, Harris Search Associates maintains regional offices in Dallas and San Francisco. The firm is a shareholder member of IIC Partners, one of the world’s largest executive search organizations, with 44 offices in 33 countries.

ABOUT THE *INNOVATORS* PODCAST

The *Innovators* podcast features timely conversations with global thought leaders in higher education, research, engineering, technology, and the health sciences. The audio segments, which allow listeners to learn from those at the forefront of change, innovation, and discovery, are available on the web at [HarrisSearch.com](https://www.harrissearch.com) and on leading podcast platforms, including Apple Podcasts, Libsyn, Google Podcasts, Overcast, Stitcher, Spotify, and PlayerFM.



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ABOUT RICHARD A. SKINNER, PHD

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