

PANDEMIC

& Beyond

Keep an eye on the animals

COVID-19 taught us to
watch for emerging
diseases — **P06**

Early warning from the sewers

Epidemiologists monitor
wastewater for signs of threats to
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What we learned from COVID-19

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Being cyber safe

UAE's chief of cybersecurity has his
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Khalifa University Science and Tech Review

KUST Review is dedicated to publishing authoritative, reliable and accessible information about science, innovation and technology news and trends. Although we report on news from around the world, we highlight advances, innovators and topics of interest from the Middle East and North Africa region. Our mission is to spread knowledge of and enthusiasm for science and technology in the Arab world and beyond through responsible and trustworthy journalism.

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Correction: "A framework for innovation," a story in the March-May 2023 issue of *KUST Review*, incorrectly named the director of the Center for Membranes & Advanced Water Technology at Khalifa University. Dr. Shadi Hasan is the current CMAT director.

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LETTER FROM THE EDITOR

THE WORLD WAS QUIET.

Schools shuttered. Workplaces suddenly became ghost towns. Shops and entertainment venues locked their doors. Social events were canceled. And we adapted with e-learning and telecommutes, increased online purchasing, streaming services and Zoom calls.

COVID-19 left its mark on all aspects of human activity. But slowly life returned to if not normal, then a new normal, where we all know what PCR tests are and intimately understand how easily a new disease can upend our lives and livelihoods.

Now a scientific community that itself was hamstrung by closed labs and an interrupted supply chain is looking back at what we can learn from it all as well as forward to the next inevitable pandemic.

In this issue of *KUST Review* we look into a few of the things those scientists and researchers are telling us.

For instance, Habiba Al Safar talks about the labs that were established during the pandemic to detect the COVID-19 virus. And Nawaf Al Moosa writes about how his team leveraged its capabilities in machine learning to support the response to the COVID pandemic. This showcases the strength of universities and their ability to leverage research in science and technology to find proactive solutions and support local governments during crises and disasters.

Suzanne Condie Lambert looks at what we know about long COVID and how monitoring wastewater can offer real-time information on the health of a community — and give a heads up when a new disease arises.

Jade Sterling investigates where the research dollars were focused and traces the history of mRNA vaccines in a graphic collaboration with artist Anas Albounni. We learn how the lockdown of labs led to an insect being named after a deadly virus.

And a panel of experts from around the world explores what we can learn from the pandemic itself.

We also look at how researchers think we can reconfigure our communities to better support social distancing when the next pandemic hits and how an innovative smart mask born during the days of quarantine can help us breathe easier.

Other stories in this issue include how technology is preserving history, language and traditions for the Bedouin people.

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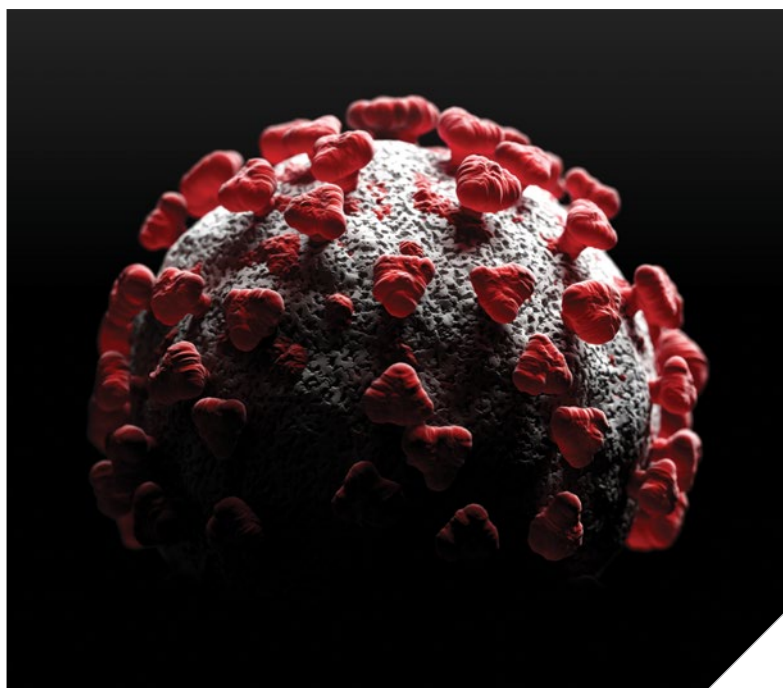
Be informed and stay curious.

Dr. Arif Sultan Al Hammadi
KUST Review Editor-in-Chief

Arif Sultan Al Hammadi

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PANDEMIC AND BEYOND



Beyond the loss of millions of lives, the COVID-19 pandemic stressed the world in ways previously unimaginable: socially, politically, economically and more. The worst now seems to be over, but it's important to look back to learn what we did right, what we did wrong and how we can prepare for the next big thing.

In this issue of *KUST Review*, we examine what scientists are telling us about these things.

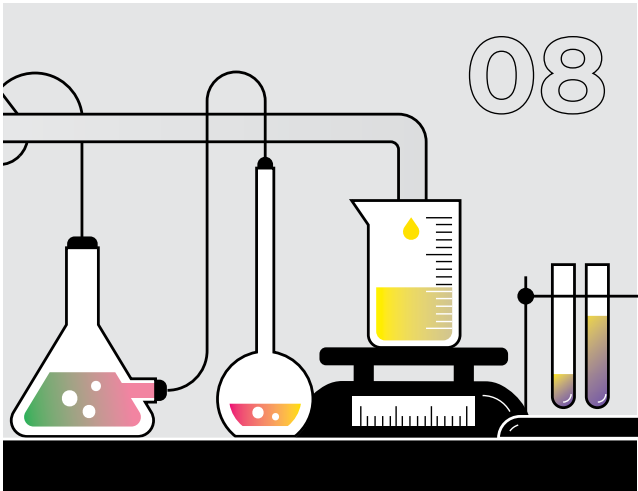
You'll also find an exclusive interview with the UAE's chief of cybersecurity, His Excellency Dr. Mohamed Al Kuwaiti, who talks about how the pandemic exposed countries and businesses to risks; stories about how technology is preserving Bedouin traditions; and much more.

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© **CAPTION:** Raccoon dogs, as interpreted here by an AI illustration, are among the animals whose DNA was found in positive SARS-CoV-2 swabs taken from the Chinese market where COVID-19 was thought to spread.

Keep an eye on the **animals**



and the disease
will take care of itself

By: **Jade Sterling**

If we've learned anything from COVID-19, it's the need to keep an eye on emerging diseases.

"If basic surveillance and laboratory capacities are compromised, will health authorities catch the next severe acute respiratory syndrome (SARS) or spot the emergence of a pandemic virus in time to warn the world and mitigate the damage?"

Dr. Margaret Chan, director-general of the World Health Organization, asked in 2009. It's obvious now.

Tracking zoonotic pathogens — those that jump from animals to humans — is crucial for detecting disease emergence at the earliest time possible. Zoonotic pathogens will continue to emerge, and it will be impossible to track everything and prevent disease outbreaks, but a global zoonotic disease surveillance system could minimize the opportunity for emergence, transmission and global spread.

Most new pathogens are zoonotic. Driving their increasing emergence are land-use and food-production practices and population pressure. SARS-CoV-2 is just an example of a zoonotic virus whose emergence was highly likely, says the

Independent Panel on Pandemic Preparedness. Experts also say zoonotic outbreaks are becoming more frequent, increasing the urgency for better detection and more robust preparedness.

The earlier a zoonotic disease can be detected, the better. Data sources need to distinguish an abnormal disease pattern from a typical one. Data can be sourced from animal owners, veterinarians, community members and health care providers, for example, and the data can range from informal observations to biological samples.

Data needs to be analyzed and presented in easily understood formats for decision-makers to use the information. Evolving IT has led to breakthroughs and new ways to collect and transmit epidemiological, clinical and demographical information. Data management and decision software and systems to analyze, present, interpret and use information are also rapidly improving.

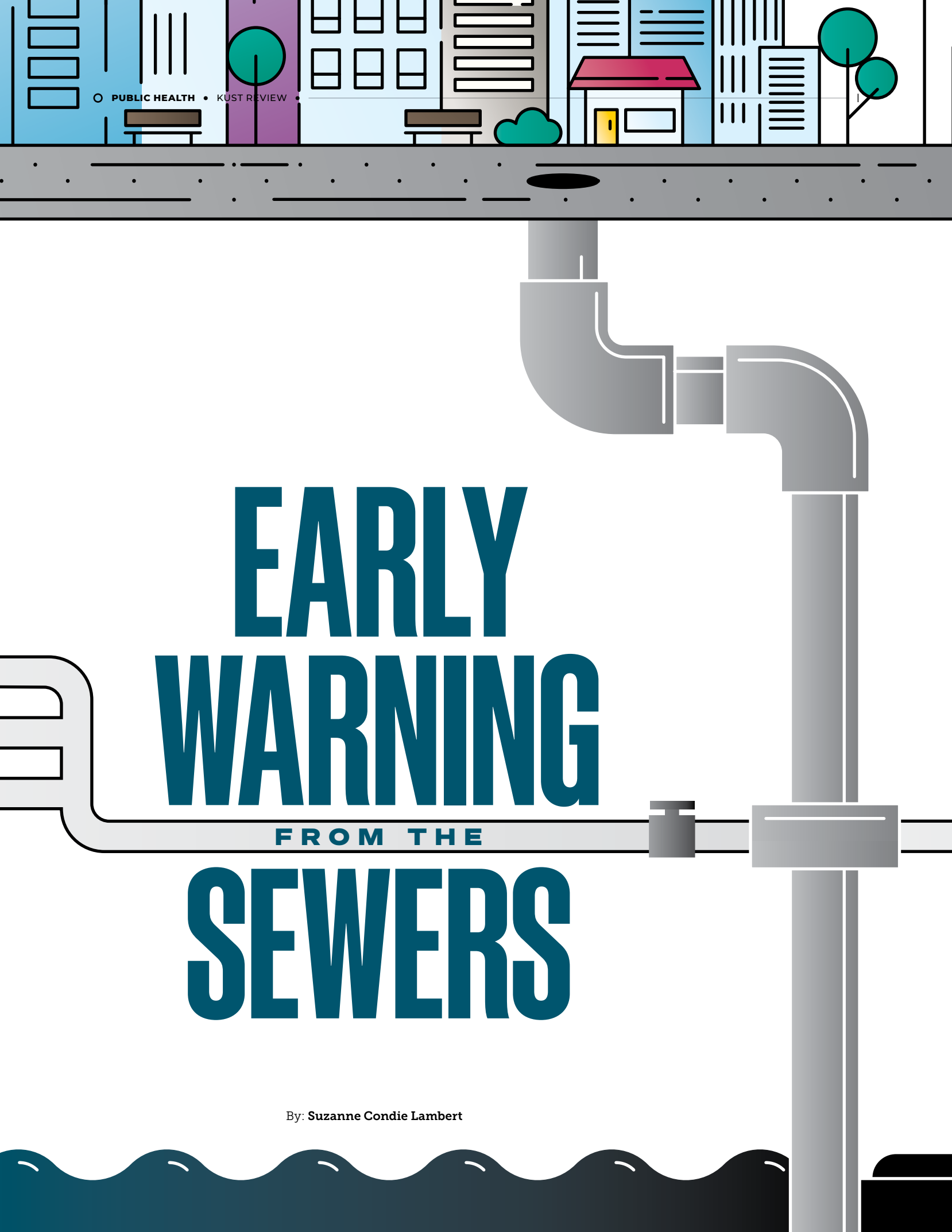
Widespread Internet access also allows more timely dissemination of information. Even the World Health Organization's Global Outbreak

Alert and Response Network relies on web-based data for daily surveillance.

Disease-surveillance systems are judged on timeliness, simplicity, flexibility, reliability and sensitivity. In a 2009 report, the National Research Council (U.S.) Committee on Achieving Sustainable Global Capacity for Surveillance and Response to Emerging Diseases of Zoonotic Origin was unable to identify "a single example of a well-functioning, integrated zoonotic disease surveillance system across human and animal health sectors."

An effective global zoonotic disease surveillance and response system did not exist in 2009. Building one should be a priority.

Meanwhile, watching animals could also help prevent threats. Bats, perhaps the original source for the COVID-19 virus (continuing on to humans possibly via raccoon dogs), could be key to avoiding the next catastrophe. "Bats have the potential to teach us a great deal about how to fight off disease," University College Dublin's Emma Teeling says in the Guardian. ●



○ PUBLIC HEALTH • KUST REVIEW •

EARLY WARNING FROM THE SEWERS

By: Suzanne Condie Lambert



Epidemiologists monitor wastewater for signs of threats to community health.

The virus raged around the world, terrifying the populace with its seemingly random strikes.

Most victims showed no signs of the disease or had mild complaints. Just a fever or fatigue, maybe.

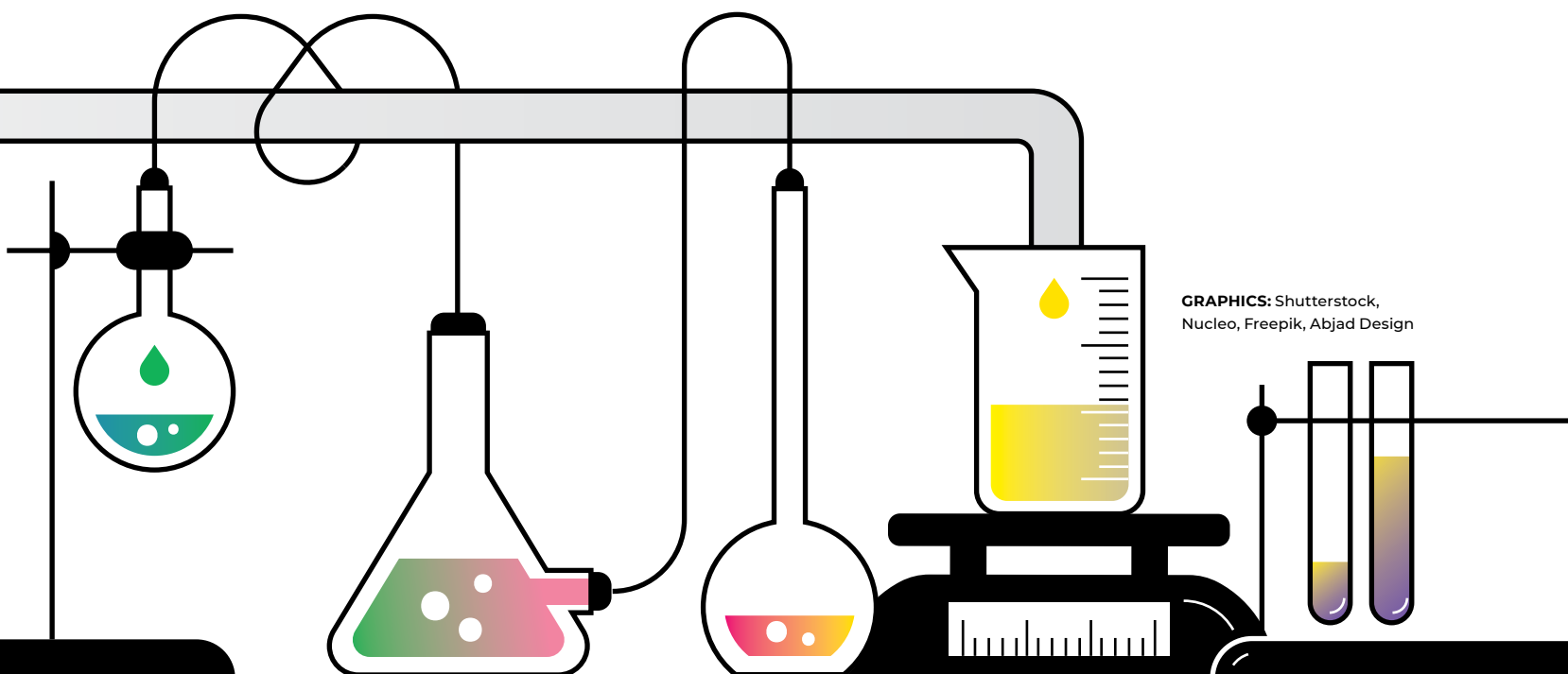
Others suffered more serious symptoms, with some becoming unable to breathe on their own. A not insignificant number of patients developed long-term disabilities. In extreme cases, people died.

While the planet waited for a vaccine, governments responded by imposing social-distancing rules as the disease hit again and again in seasonal waves. Events were canceled. City pools were closed. Families avoided public parks.

And epidemiologists in the United States monitored the outbreak by surveilling wastewater — including the untreated waste from household drains and toilets — for evidence of the disease at large.

No, we're not talking about COVID-19. We're talking about poliovirus, the pathogen that killed or paralyzed about a half-million people a year worldwide during its peak in the 1940s and '50s.

But the same basic wastewater-surveillance techniques epidemiologists used in Midcentury America to track polio outbreaks would prove useful again some 70 years later when the coronavirus pandemic put an unready world into lockdown. >>>



GRAPHICS: Shutterstock, Nucleo, Freepik, Abjad Design

Of course, the techniques have become much more sophisticated since the 1940s, but the basics remain the same: Take small samples of fecal matter from sewer systems, examine the material in a lab and determine what sorts of pathogens have taken root in a community — whether that community is a city, a neighborhood or even a prison.

Real-time snapshot

Advances — most notably the emergence in the 1990s of polymerase chain reaction (PCR) to amplify sections of DNA from a small sample — have improved the process, enabling public-health authorities to track disease in a way that might prove difficult by other means because of lag time between tests and results or because the disease is frequently under-reported.

This could be because the disease is often asymptomatic or has the kind of nonspecific symptoms that patients are unlikely to report until they get serious, such as influenza, gastroenteritis or, yes, polio. Or the patient or doctor may simply choose not to test.

In those cases, testing sewage removes those barriers from the equation and takes an anonymous,

nearly real-time snapshot of a community's health in a way that would be difficult to achieve by individually testing its members.

"You would have to sequence a ton of clinical or nasal swabs to get that level of resolution," says Smruthi Karthikeyan, a postdoctoral scholar and lead author of a recent study on using genomic surveillance to detect SARS-CoV-2 infections during 10 months of the pandemic at the University of California, San Diego, in an interview with the *Journal of the American Medical Association*.

It also gives health authorities an early alert when a new disease is taking a foothold in a community, perhaps warning of an incipient need for more hospital beds or other measures.

Data without biases

Another advantage: It doesn't have the problem of biases often affecting traditional public-health data.

"A major benefit of wastewater monitoring is that it can capture the health markers of anybody who lives or works in a building connected to a centralized sewer system," says Aparna Keshaviah, an expert in wastewater

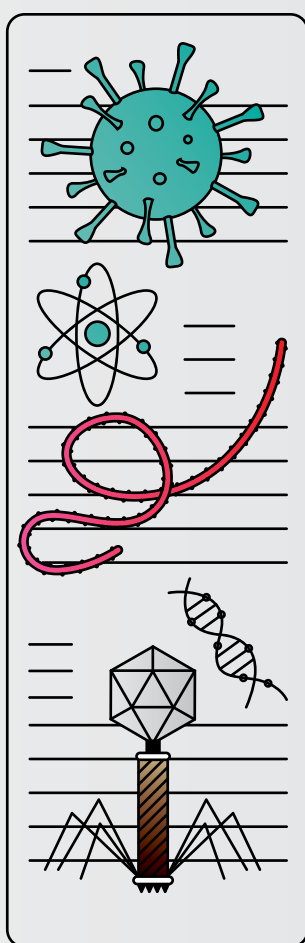
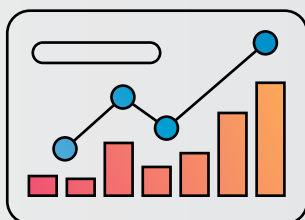
epidemiology and principal researcher at Mathematica, a U.S.-based organization that uses data, analytics and technology to address social challenges.

"In other words," she tells *KUST Review*, "it doesn't rely on people to have the will or means for a health-care visit to be counted, and so is less biased than traditional public health data."

The surveillance can also let those same health authorities know when the storm has passed and it's time to end such restrictions as social distancing, mask regulations and quarantines.

And it works. Many studies have shown that wastewater monitoring provides an accurate view of disease in a community. COVID-era studies also confirmed that the technique was an accurate reflection of the coronavirus' course in a community.

A Dutch group, for example, began monitoring the sewage from seven cities and an airport in February 2020, detecting the presence of COVID-19 at five sites just about a week after the first case was reported in the country. Meanwhile, Karthikeyan's work at UC-San Diego found variants of concern up to two weeks before they turned up in clinical tests. >>>



PRESERVING SAMPLES FOR POSTERITY

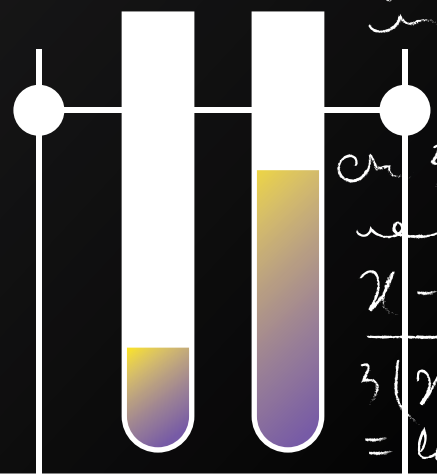
Taking samples from a community's wastewater can help public-health authorities track and monitor disease practically in real time. But researchers from the University of Basel in Switzerland and Rockefeller University in the United States are suggesting another use for the technology: creating biological time capsules.

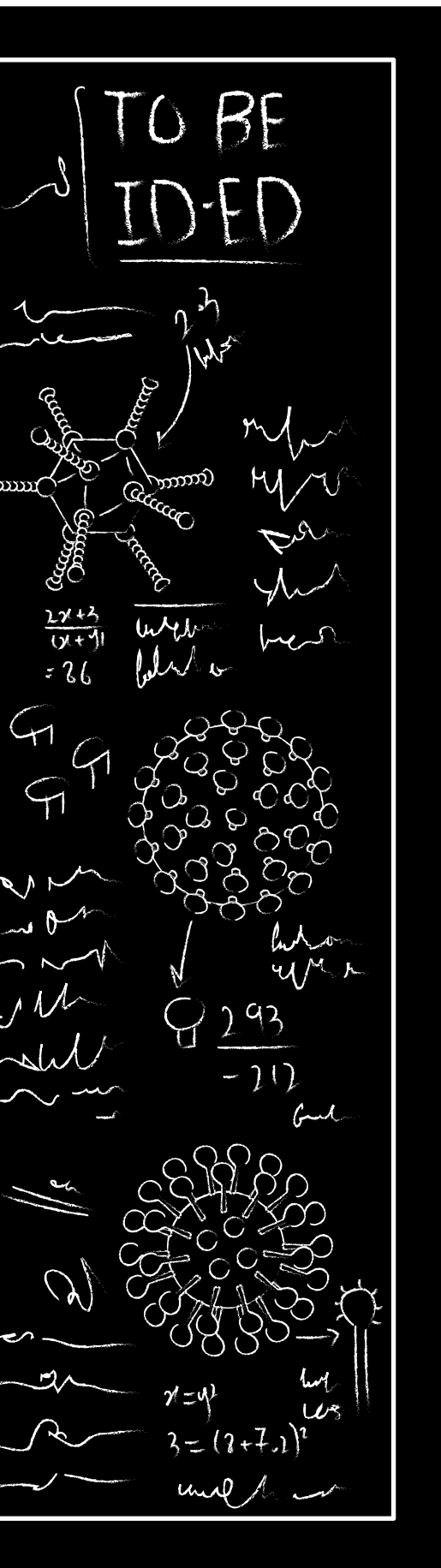
In a paper in *BMC Infectious Diseases*, David S. Thaler and Thomas P. Sakmar suggest systematically storing biological material taken from sewage to create an archive of sorts in case today's viruses become important in the future.

Preserved "before" and "after" samples could also help scientists studying, for example, a pathogen's arrival in a city or on a cruise ship, the researchers note.

"There is so much great work throughout the world on monitoring wastewaters for immediate information. If only you could 'go back in time,' then it might become possible to learn more about the origin and early spread of infections," Thaler tells *KUST Review*. "Also it might help (researchers) understand how effective mitigation measures were. The limiting factor right now is to work out simple, inexpensive ways to obtain and store many samples. Historical records help with understanding so many things."

Other biological repositories and records include living cell and tissue collections, eDNA and material from museums and medical facilities.





Used around the world

At least 55 countries worldwide use wastewater monitoring to track COVID-19. In 2020, the United States launched its National Wastewater Surveillance System, working with health systems across the country to track disease and trends.

And in 2021, the European Union asked all member states to put in place wastewater monitoring to track COVID-19 and its variants, with the EU's Environment Commissioner Virginijus Sinkevičius telling EURACTIV.com that the process is a "cost-effective, rapid and reliable complementary tool."

Another benefit: The testing can immediately assist more than researchers looking to track disease. It can also provide a real-time heads-up to members of the community.

"In communities where the wastewater data are made public in a timely fashion (for example, when public-facing wastewater dashboards are updated weekly with new information on wastewater viral levels), individuals can monitor the data to gauge their risk of exposure to COVID-19 and make more informed decisions about what risks they're willing to take," Keshaviah says.

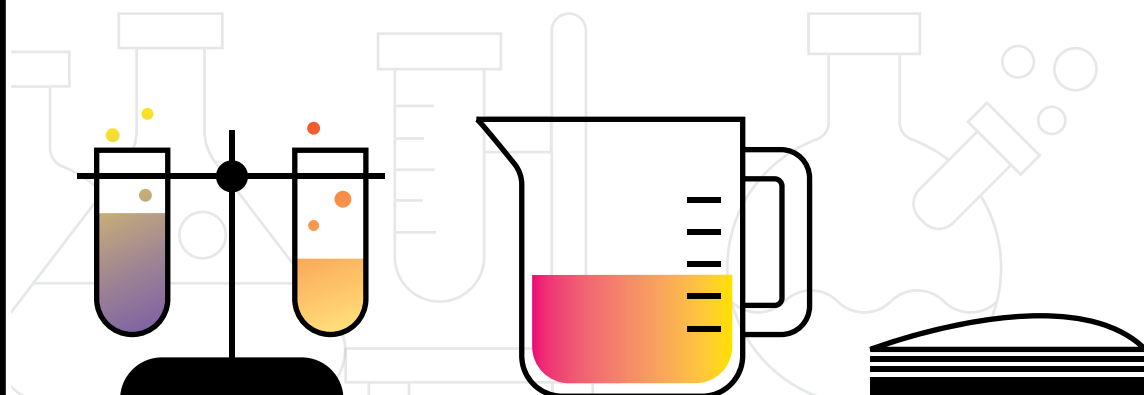
The testing, however, relies on the existence of robust wastewater-treatment and -disposal systems. Most wastewater monitoring, therefore, occurs in more economically advanced nations.

This leaves low- and lower-middle-income countries unable to take full advantage of the public-health benefits. According to Utrecht University's Edward R. Jones and his team in a paper published in *Earth System Science Data*, most wastewater isn't even collected in those countries.

Communication is key

Another problem: Information is only as good as the communication network it relies on.

"During this pandemic, many communities launched local or regional wastewater monitoring for the SARS-CoV-2 virus that causes COVID-19. But based on results from a global wastewater survey we recently conducted in partnership with the Rockefeller Foundation and the United Kingdom Health Security Agency, the resulting data have not always been shared in a timely fashion with neighboring communities, let alone with other countries across the globe," Mathematica's Keshaviah tells *KUST Review*.

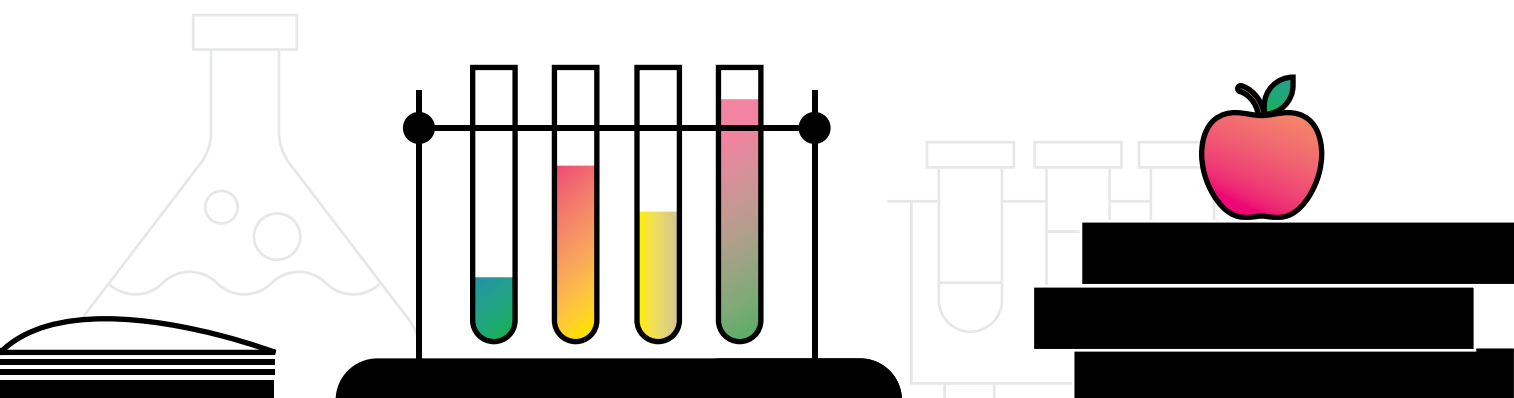
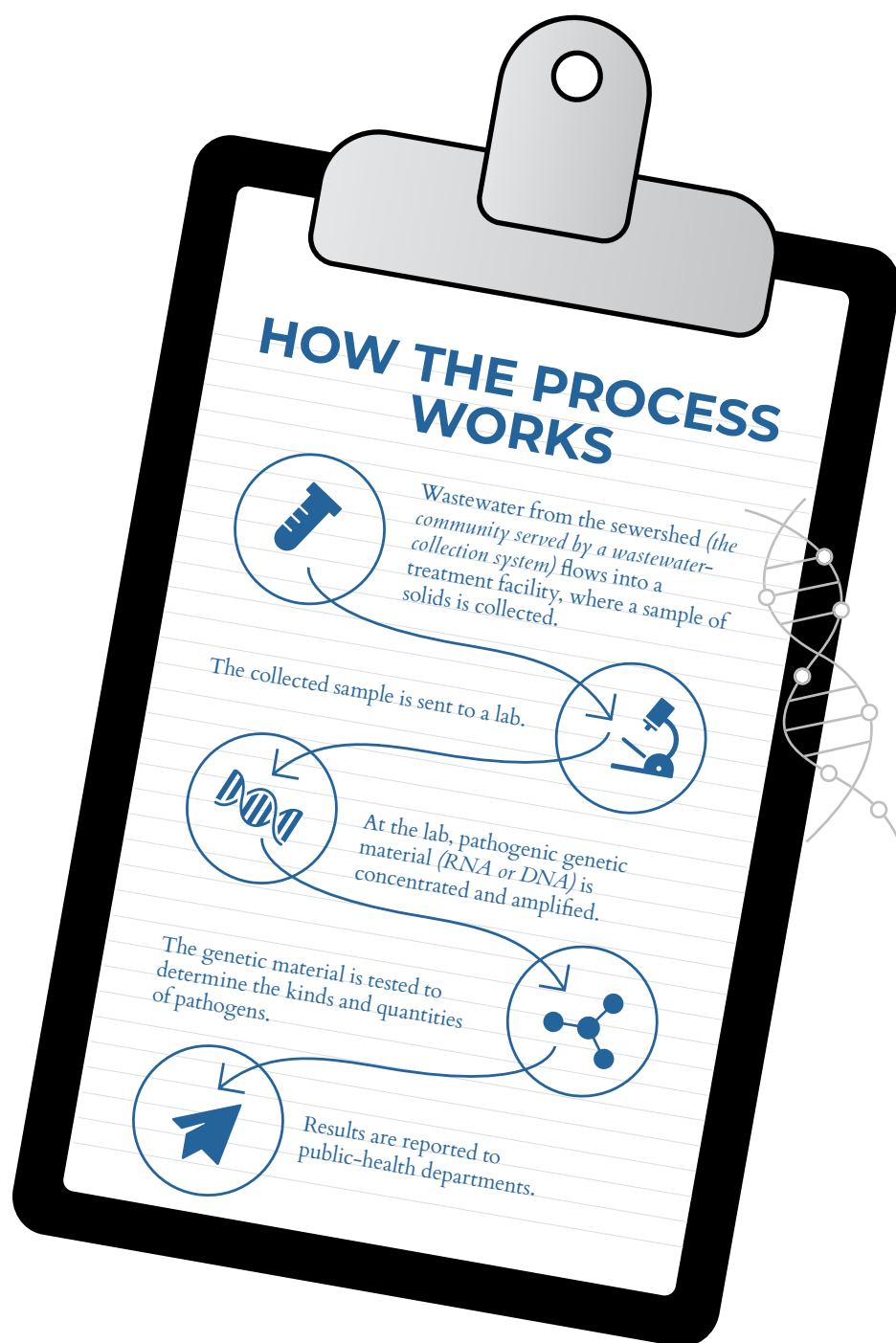


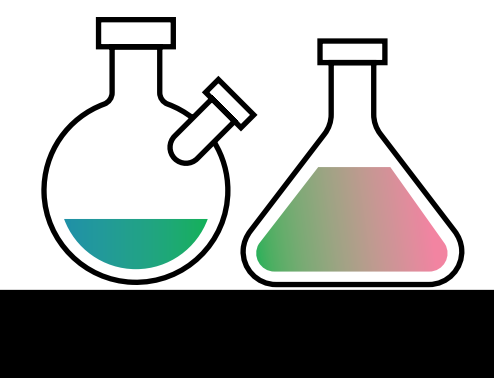
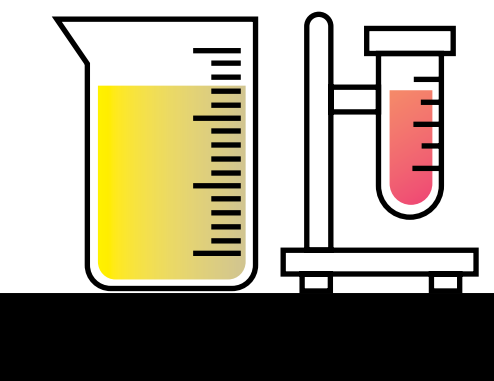
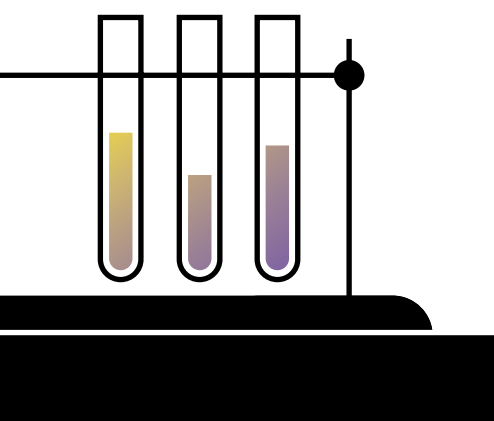
"In today's interconnected world, international travel is 56 times more common than it was in 1950, and so one country's local infectious disease outbreak can quickly become a global pandemic," she says.

"If we're to have any chance at getting an early warning of the next new health threat before it explodes into another pandemic, we need global leadership to coalesce the many individual wastewater initiatives that now exist into a multi-nodal, unified disease-monitoring network that's always on and always communicating."

Wastewater monitoring can be used for more than detecting disease. It has also been used to detect the use of illicit drugs in a community.

The European Monitoring Centre for Drugs and Drug Addiction used data from studies conducted since 2011 to plot the prevalence of such substances as cocaine, methamphetamines and cannabis in 80 European cities and towns, revealing what it called distinct geographical and temporal patterns. >>>





Concerns about privacy

Surveillance could perhaps do more. And that raises privacy and civil-liberties concerns.

A paper from academics in law and medical programs at Wayne State University and the University of Maryland that was published in the *Journal of Law and the Biosciences* notes that there are legal and ethical implications to consider, such as governments using evidence of a pathogen in public wastewater to justify additional screenings of certain neighborhoods or impose penalties on those who refuse to cooperate.

Or, the authors posit, an entire neighborhood could be forced into, say, a targeted quarantine. This could be especially problematic if that neighborhood includes a majority of people of a certain ethnicity or a religious institution.

Mathematica's Keshaviah sees a potential for concern that small communities and individuals might be identifiable via wastewater monitoring, but also a solution:

"When wastewater data are collected at centralized wastewater treatment plants that serve many hundreds, thousands or millions

of people (which is the most cost-effective way to detect novel threats), there's little chance that the data could be identifying. However, when monitoring occurs at the neighborhood or facility level, when the threat being monitored is quite rare, or when wastewater data are combined with other data sources, the risk of identifying individuals can increase.

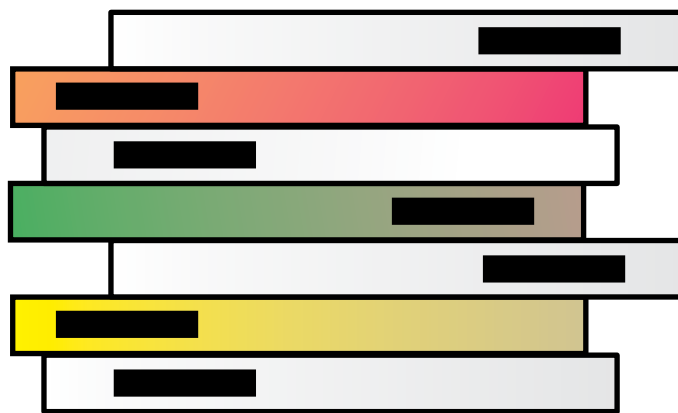
"That said, just as with medical data, wastewater data can be blinded before they're shared, so that individuals or communities are not stigmatized by the results.

"The data can be collected at a localized level to inform decision making, but shared in such a way that obscures the precise communities represented by the data, to preserve privacy," she says.

In the meantime, wastewater monitoring continues to help public-health authorities track disease via the public sewers.

In October 2022, researchers with the U.S. Centers for Disease Control and Prevention and various public-health programs published an article about investigating a potential emerging viral threat in New York City.

They found polio. ●



UNIVERSITY PLAYED A BIG BEHIND-THE-SCENES ROLE IN

HOW UAE MANAGED THE PANDEMIC

by collaborating with the Ministry of Interior
and Department of Energy

By: **Suzanne Condie Lambert**

The UAE was quick to turn to wastewater monitoring when the COVID-19 pandemic struck. "The United Arab Emirates was the first in the region and the fifth worldwide," Professor Habiba Al Safar, the director of Khalifa University's Center for Biotechnology, tells KUST Review.

Al Safar and teammates Shadi Hasan Ahmed Yousef and Alvaro Lopes, in partnership with the Ministry of the Interior and Abu Dhabi Department of Energy, established the surveillance pipeline and strategic plan to tackle the pandemic in its earliest days.

It wasn't an easy task, Al Safar says. "We established a scientific committee to discuss the best way to approach this pandemic by introducing an environmental surveillance program in the UAE. And given the full lockdown and the shortage of the supply chain of chemicals, equipment and reagents, we had to come up with a plan with existing equipment and laboratory facilities in the country. We had to build a dedicated laboratory for this program, and we did it in less than four months."

Supply-chain issues made importing chemicals and consumables difficult. "However, the team worked around the clock to prepare in-house reagents in this country," Al Safar says. "We had

the full support from the government, and that helped the program to keep going non-stop," she adds.

Over the course of the pandemic, the university and government team members in Abu Dhabi helped inform UAE response policy, meeting weekly with top government officials and providing alerts when they spotted incoming waves, variants and disease hotspots.

This project also led the team to publish, with many surveillance programs established around the world using the project's protocol, Al Safar says. The wastewater monitoring, which has since been turned over to the Ministry of Interior, gave the government the information it needed for early detection of upcoming waves. This helped it create procedures and manage lockdowns.

"The UAE has managed the pandemic very well," she says. "All the procedures and precautions that the decision makers were conducting and the massive PCR testing drives were to the benefit of our society and beloved people."

In other responses to the pandemic, Khalifa University launched in 2020 a research and development program to rapidly develop knowledge and solutions in the areas of

epidemiology; digital tools for virus-spread mitigation and resiliency; and diagnostics and medical devices. Sixteen projects were funded at a total level exceeding AED 10M.

These included developing membranes for anti-viral masks; detailed knowledge regarding how the COVID-19 virus transmits between mammals and humans; and a mobile app that captures health data and detects early signs of COVID-19 symptoms. ●

PHOTOS: Khalifa University



DECADES

IN THE MAKING

Nearly every function in the human body is carried out by proteins. Cells are constantly manufacturing them using single-strand messenger RNA, which is made from a DNA template. Scientists used this mRNA to make the COVID-19 vaccine.

By: Jade Sterling

Each strand of mRNA holds the information on how to make one type of protein. The cell reads the mRNA, follows the instructions and makes a protein. mRNA is a recipe book for the body's cells. The idea? Make precise edits to the recipe, inject people with it, sit back and watch the body make all the proteins you need.

Viruses come in different shapes and sizes. Some are DNA viruses, which contain DNA that integrates with the host DNA in certain cells, using that cell's replication mechanism to multiply. These viruses can activate cancer genes in the host — the human papillomavirus (HPV) is known to cause cervical cancer, for example.

RNA viruses carry RNA and do not integrate that RNA into a host's DNA. Instead, the RNA is directed to the host ribosomes in cells, with the ribosomes replicating the virus.

These viruses do not interact with host DNA. Once inside the body, the cell reads the vaccine mRNA and begins to make harmless spike proteins of its own. From there, the body recognizes them as a foreign threat and launches an immune response, teaching itself to respond to spike proteins.

Should the actual coronavirus come knocking, your cells now know what to do. The main drawback to mRNA vaccines? The mRNA breaks down very easily. It needs to be delivered inside a protective fatty barrier and kept cold.

mRNA vaccines are a groundbreaking way to elicit an immune response and their real impact is just beginning.

Their applications don't stop at COVID-19; we might soon be able to figure out the recipe for a cancer or HIV vaccine. ●

History of mRNA Vaccine

TRADITIONAL VACCINE DEVELOPMENT TIMELINE:

5-10 years to reach FDA approval in the U.S.



Discovery & Development



Preclinical Trials



Human Trials



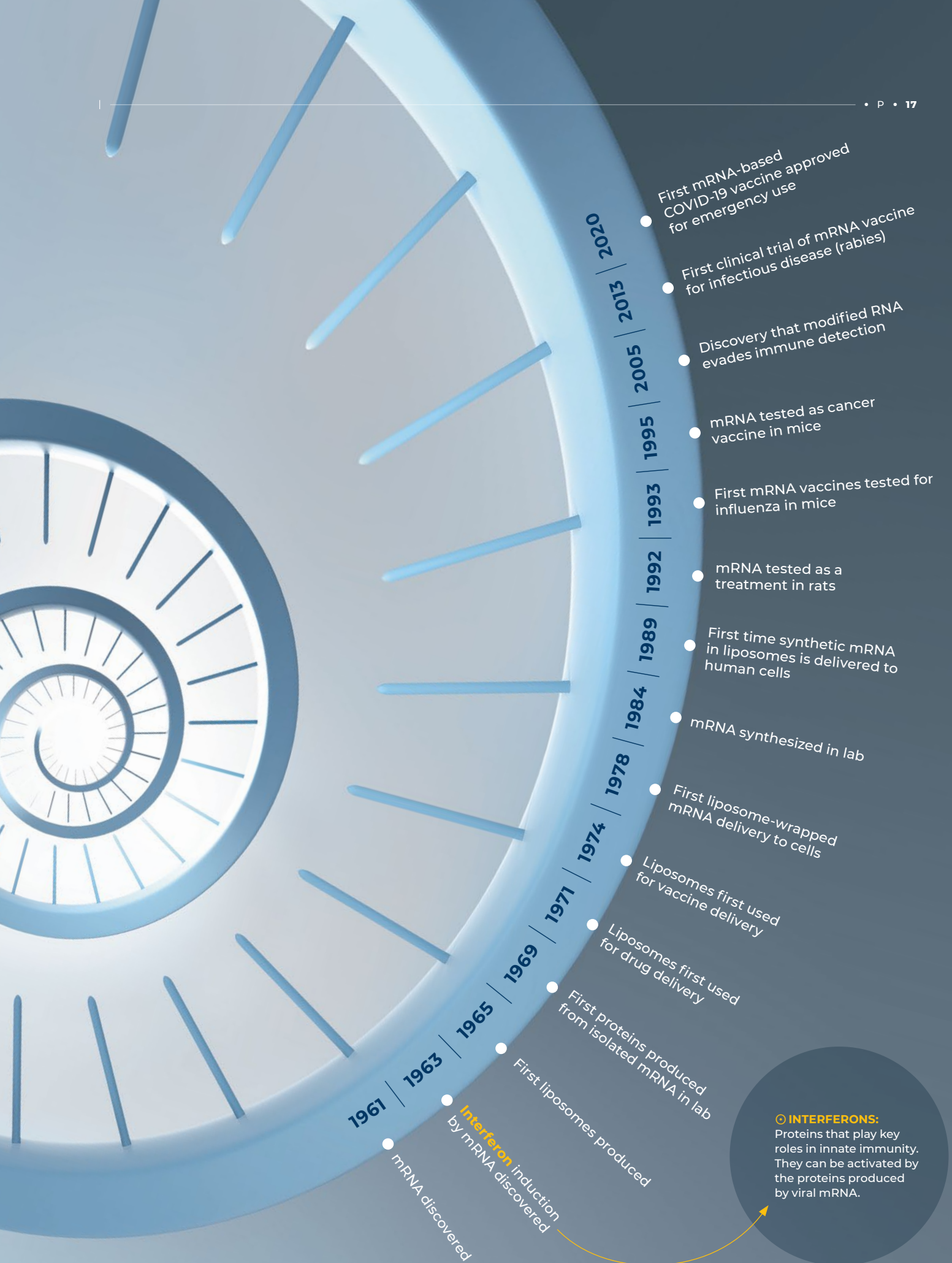
Licensing



Manufacturing



Distribution





Making this our last pandemic

Bill Gates and WHO panel say diseases are inevitable, but large-scale outbreaks like COVID-19 can be prevented.

By: **Jade Sterling**

There are a lot of people, Bill Gates included, who could have said “I told you so” at the start of the COVID-19 pandemic. In 2015, Gates warned a pandemic could happen and that the world was unprepared.

In *How to Prevent the Next Pandemic*, published seven years later, two years into a pandemic, Gates says, “Outbreaks are inevitable, but pandemics are optional.” At first glance, this seems optimistic, if not impossible: In a world this interconnected and interdependent, how can we reasonably and ethically contain outbreaks?

But the experts agree with Gates.

The World Health Organization’s Independent Panel for Pandemic Preparedness and Response says the COVID-19 pandemic was a sign of how vulnerable our world is:

“Our careful scrutiny of the evidence has revealed failures and gaps in international and national responses that must be corrected,” the panel writes in a 2021 report. “Current institutions, public and private, failed to protect people from a devastating pandemic. Without change, they will not

prevent a future one. That is why the panel is recommending a fundamental transformation to a new system of complete pandemic preparedness. If we fail to take this goal seriously, we will condemn the world to successive catastrophes.”

“No one wants to live through this again — and we don’t have to,” Gates writes. “If we make key investments that benefit everyone, COVID-19 could be the last pandemic ever.”

These key investments? Make and deliver better tools, including vaccines; improve disease monitoring; and strengthen health systems. Gates also advocates for a cross-disciplinary Global Epidemic Response and Mobilization (GERM) team that could contain outbreaks with speed and efficiency.

Some of these investments are already in the making: wastewater monitoring could keep an eye on infections in a community; mRNA vaccine technology has proved its efficacy; telehealth and health wearables changed the way we interact with health-care systems.

Others need more work. Gates calls for data to be available in real

time, but data-protection laws and systems lag, and ethical concerns should not be ignored. Plus, changes need to be implemented worldwide, not just in countries that can afford it.

Gates’ calls for monitoring and responding to outbreaks are admirable, but a global coordinated effort is not realistic right now. Pandemics cross borders; they need countries to work together. They need collective investment and effective communication strategies. The COVID-19 pandemic proved some places are not ready, for various socioeconomic and political reasons.

Eeshani Kandpal, senior economist in the Development Research Group of the World Bank, says pandemic-preparedness efforts should focus on the relationship between health inequity and broader social and economic vulnerability.

“The COVID-19 pandemic demonstrates that pandemic preparedness planning cannot be divorced from the fight against inequality,” Kandpal writes in a 2022 editorial for the *British Medical Journal*. “Addressing these dual challenges will require investment and political will. Gaps in countries’ capacity to finance health were large before the pandemic and have further widened in its wake, creating a fault line that threatens health security for all. Centering health equity in pandemic preparedness planning is not just the right thing to do, but also the smart thing.” ●

◎ **LEFT:** Public spaces around the world were empty as COVID-19 quarantine measures took effect.

PHOTOS: Shutterstock, Unsplash

Follow the Money

Public-sector support was critical in the fight against the virus, but private groups contributed too.

By: Jade Sterling

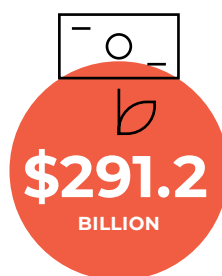
The COVID-19 pandemic hit the world in early 2020 and the world hit back. With cash.

According to Devex, an independent media platform specializing in global development based in Washington, D.C., as of June 27, 2020, investments totaling U.S.\$291.2 billion were made globally through 1,489 program announcements and 1,204 grants. This money didn't go to health care research though: 86 percent of funding announcements had an economic link to their objectives, with just 1.3 percent clearly linked to health objectives and 0.8 percent for vaccines and treatments.

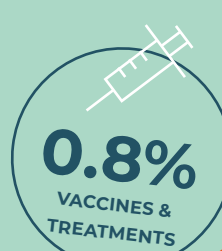
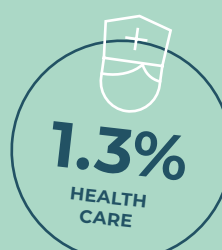
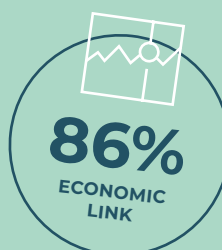
Yet health care research into the virus proceeded, and within nine months, two vaccines were ready to go. Research and development like that needs investment.

"Understanding who has been doing what is challenging, since there are no complete databases on global research and development. Some sources are proprietary, and in many cases, funding is non-transparent," says Bhaven Sampat, an associate professor in the Department of Health Policy and Management at Columbia University. "However, the data we can piece together reveal a consistent picture of public-

TOTAL INVESTMENT MADE GLOBALLY



FUNDED FIELDS



PHOTOS: Unsplash



sector support for downstream research, development and production.”

Sampat’s research found the largest funding response came from the U.S. government, with roughly U.S.\$15 billion of the U.S.\$4 trillion allocated to the COVID-19 response given to R&D for vaccines and treatments. A worldwide rush of research on treatments and vaccines had begun, and as the world’s largest funder of biomedical research, the National Institutes of Health (NIH), took steps to coordinate the efforts of public and private researchers globally, to focus on promising candidates and avoid duplicate research.

“Other global actors also contributed funding for therapies and vaccines,” Sampat says. “The European Union has provided financing from the European Investment Bank, member states such as France and Germany have provided research funding, and while data is unavailable from China and Russia, both appear to have made substantial investments in R&D and are responsible for seven of the fourteen vaccines in Phase 3 trials.”

PHILANTHROPY TO THE RESCUE

Philanthropic actors have also had a huge part in the response. Not only did philanthropies donate money to vaccine and treatment development but they also played a coordinating role, helping to facilitate the global scale-up. “In Latin America, the Carlos Slim Foundation supported at-risk manufacturing of the Oxford/AstraZeneca vaccine in Argentina and Mexico,” Sampat says.

At-risk contracts are advance market commitments: They are promises to purchase the product, enabling manufacturers to raise the financing to build the facilities and workforces necessary for emergency production. In vaccine manufacturing, there’s a regulatory aspect too. The Oxford/AstraZeneca vaccine was still awaiting approval, meaning the manufacturers would be turning out doses without knowing whether they’d pass regulatory scrutiny. Risky business.



TOTAL FUNDS

\$4T

COVID RESPONSE

\$15B

R&D FOR VACCINE AND TREATMENT



RAPID RESPONSE?

“The COVID-19 pandemic tested the NIH’s ability to fund critical research to answer research questions that significantly affect public health and require urgent scientific clarity,” Tinglong Dai, professor of operations management and business analytics at Johns Hopkins University, says. Dai’s research focuses on the health care ecosystem and health care operations management. Dai looked into the funding awarded by the NIH for COVID-19 research, finding just 2 percent of the NIH-funded projects had anything to do with COVID-19 research in 2020.

“In 2020, COVID-19 research accounted for 5.3 percent of the annual NIH budget of U.S.\$41.7 billion,” Dai says. “In the first three months of the global pandemic, a total of six grants were awarded for COVID-19 research, with the NIH spending a total of 0.1 percent of its >>>



annual budget on COVID-19 research in this time. By the end of 2020, that total had risen to 5.3 percent.”

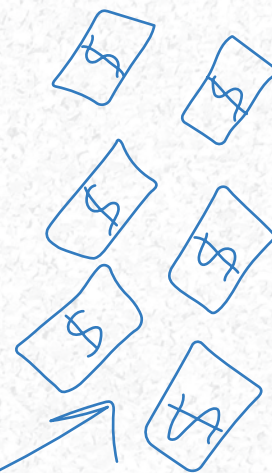
Dai and his fellow researchers found that infrastructure and education accounted for 55.9 percent of NIH COVID-19 funding, yet many of the major clinical questions surrounding transmission were left unanswered, creating challenges for evidence-based policymaking. This may have influenced the public response to COVID-19 measures such as mask mandates and social distancing. The researchers also pointed out that the lack of rapid clinical research funding to understand COVID-19 transmission may have contributed to the politicization of the virus.



“Some of the most basic questions that were being asked of medical professionals in early 2020, such as how it spreads and whether masks protect individuals, went unanswered,” Dai says. “In the absence of evidence-based answers, political opinions filled that vacuum. As the largest research-funding arm of the federal government, the NIH has a responsibility to fund research that can address misinformation with evidence. A resilient health care system in times of crisis should be able to pivot funding toward specific grants answering critical gaps in knowledge.”

Dai says he believes the NIH should develop mechanisms to rapidly award funding to addressing scientific unknowns associated with sudden, large-scale health emergencies: “Supporting sound clinical research aimed at developing evidence-based recommendations is important for public policy and promotes public trust in the medical profession during a pandemic.”

Although the NIH response may have been sluggish, venture capitalists were quick off the mark.



READY, SET, GRANT!

Official advice from the NIH suggests that grant planning should begin nine months in advance of the deadline for the grant. That's inefficient at the best of times, but needing to pre-empt a crisis no one saw coming makes it a disastrous way to award funding.

Fast Grants is an aptly named response to this funding issue, set up by Patrick Collinson, CEO of Stripe, and Tyler Cowen, economist at George Mason University. On April 7, 2020, Fast Grants launched a call for grant applications, offering a decision within 48 hours. It was immediately swamped, granting its entire budget of U.S.\$12 million in less than a week.

FAST — GRANTS

COVID-19 RESEARCH FUNDING

LAUNCHED: April 7, 2020

BUDGET: \$12 Million

STATUS: Paused

CONCEPT: 30 mins to apply — response in 48h

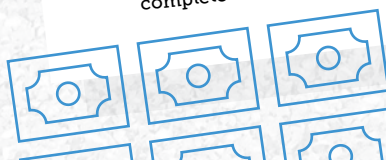
CRITERIA:

- Applicants must be a principal investigator at an academic institution.
- Already working on a project that could help with the COVID-19 pandemic within the next six months.
- In need of additional funding to complete the project.

RESULT:

130
Grants in the first week

\$40
Million granted to date



The eligibility criteria were simple: Applicants must be a principal investigator at an academic institution, already working on a project that could help with the COVID-19 pandemic within the next six months, and in need of additional funding to complete the project.

In that first week, Fast Grants awarded more than 130 grants, offering the money “as fast as your university can receive it.” Fast Grants promised it would take less than 30 minutes to apply, and a decision would be made within two days, with Cowen making the final decisions to distribute the money. It was immediately obvious that there were thousands of projects just waiting for a final injection of cash, and the venture capitalists behind Fast Grants put up more money for a second call on July 12, 2020.

Applications are now paused “due to receipt of a very large number of qualified submissions,” according to the Fast Grants website. As of 2022, Fast Grants has awarded more than U.S.\$40 million to COVID-19 research that can be finished within six months.

FAST RESULTS

Receiving the money may be super speedy compared with traditional funding avenues, but Fast Grants wanted super speedy results in return. “Most existing funding bodies focus on supporting longer-term work,” the Fast Grants website reads. “Given COVID-19’s human costs, speed is of paramount importance.”

Following successful applications, many projects were completed and contributed significantly to the global pandemic response: Wataru Akahata at Kyoto University and Erec Stebbins at the German Cancer Research Center worked on developing vaccines; Carolyn Bertozzi at Stanford University identified predictive biomarkers for COVID-19 disease progression; Steven

Marc Friedman at University of Toronto investigated saliva as a test for SARS-CoV-2; and Alain Townsend at Oxford University looked into antibodies to the virus’ spike protein.

Collinson and Cowen were inspired by a similar funding mechanism dating back to the days of World War II.

The National Defense Research Committee (NDRC) was an organization created in 1940 to “coordinate, supervise, and conduct scientific research on the problems underlying the development, production, and use of mechanisms and devices of warfare” in the United States. In its 12 months of activity, it funded the research into some of the most important technology used during World War II, including radar and the atomic bomb.

Although it became the Office of Scientific Research and Development in 1941 and was eventually terminated in 1947, in its one year of existence, the NDRC provided U.S.\$6.5 million to scientific research. And it granted this money quickly.

“Within a week, the NDRC could review the project,” reads the memoir of Vannevar Bush, leader of the project in 1940. “The next day, the director could authorize, the business office could send out a letter of intent, and the actual work could start.”

Although radar and sonar received the bulk of the NDRC attention, arguably its most important project eventually became the Manhattan Project, the full-scale effort to produce nuclear weapons.

No longer beholden to the U.S. military for funds, the project ran full steam ahead with NDRC funds. >>>



THE NATIONAL DEFENSE RESEARCH COMMITTEE

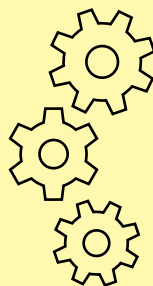
FORMED: JUNE 27, 1940

DISSOLVED: JUNE 28, 1941

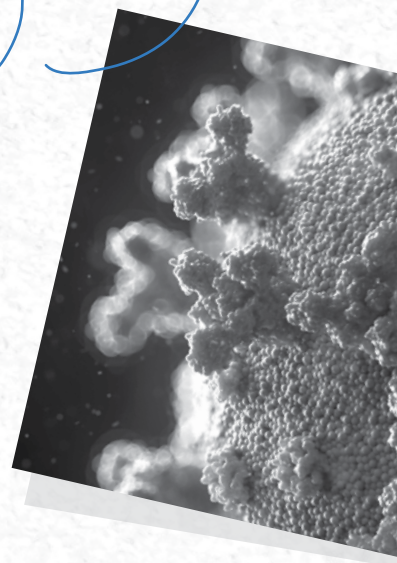
ROLE: COORDINATE, SUPERVISE AND CONDUCT SCIENTIFIC RESEARCH.

ACHIEVEMENTS: PROVIDED \$6.5 MILLION TO SCIENTIFIC RESEARCH.

PHOTO: Harry S. Truman Library and Museum



*FG = NDRC
same model*



In a global conflict, time was of the essence. In a global pandemic, it's the same story. Time mattered in the early days of the Second World War. Days mattered.

THE NEED FOR SPEED

Days mattered in the early days of the pandemic, too: Getting money to researchers was literally a matter of life or death.

Researchers at Columbia University suggest that had the US begun social distancing just one week earlier, the country could have prevented 36,000 deaths through early May 2020.

It is estimated that if social distancing had been implemented **1 week earlier** back in May 2020, we could've prevented

36,000

deaths



"In major metropolitan areas, we found significant reductions in transmission when social distancing and other control measures were implemented," Jeffrey Shaman, epidemiologist at Columbia University, writes in a paper published in 2020. "Our simulations indicate that had these same control measures been implemented just one to two weeks earlier, a substantial number of cases and deaths could have been avoided. Such dramatic reductions in morbidity and mortality due to more timely deployment of control measures highlights the critical need for an aggressive, early response to the COVID-19 pandemic."

The U.S. response wasn't entirely sedate, however. In May 2020, a program named Operation Warp Speed was initiated to

accelerate the development, manufacturing and distribution of COVID-19 vaccines, therapeutics and diagnostics. The program promoted mass production of multiple vaccines and types of vaccine technologies, allowing for faster distribution of clinical trials confirmed one of the vaccines was safe and effective.

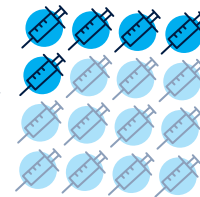
The plan anticipated that some of these vaccines would not prove safe or effective, making the program more costly than typical vaccine development, but potentially leading to the availability of a viable vaccine several months earlier than typical timelines.

By January 2021, Operation Warp Speed had put its U.S.\$18 billion budget to good use, funding five of 16 SARS-CoV-2 vaccines around the world to Phase 3 clinical trial stage. The US threw money at the problem, and it paid off with the development of the Moderna and Pfizer/BioNTech vaccines.

OPERATION WARP SPEED

Funded 5 of 16 SARS-CoV-2 vaccines around the world to Phase 3 clinical trial, which led to the development of three of the leading vaccines.

\$18
BILLION



BIONTECH
Pfizer
moderna

It's important to note, however, that the NIH was mandated by Congress to disburse its COVID-19 funds over a nearly five-year time frame. This allows for more planning and longer-term research, while negating the need for a huge change in funding processes.

With other initiatives such as Operation Warp Speed, it could be claimed that the NIH did not need to change the way it awards funding, especially when combined with a perhaps expected injection of billions of dollars in public-private collaborations and investment from the private sector.

*funding
long-term
research*

WHEN PRIVATE AND PUBLIC PLAY TOGETHER

Although governments around the world struggled to respond to COVID-19, scientists and researchers made the most of expedited resources to tackle the virus.

In only a few weeks, public-private partnerships (PPPs) were formed. These collaborative relationships mostly include governmental agencies and intragovernmental organizations (such as the World Health Organization as public actors, and university and research institutes, commercial pharmaceutical companies and professionals as private actors. Complementary expertise and knowledge is pooled, and the rewards are shared.

“We saw the rapid formation of PPPs to develop new vaccines for the novel coronavirus,” says Vijay Pereira, associate professor of humanities and social sciences at Khalifa University. “The private sector offered the funds and tapped into the knowledge base of partners from academic, public, and private-sector organizations to leverage each other’s strengths towards a common goal.”

In many ways, partnerships between academia and industry make sense: There are many societal problems in need of a technological solution, and industry is willing to pay for these solutions. Researchers with interests in line with public concerns can contribute to solving the problem, and industry can then get these solutions to the public.

To put it bluntly: Industry players spend money to make money and will spend that money on research that can ultimately make

them more money. This is great for times of crises like the COVID-19 pandemic and the increasingly extreme climate change — crises that are a central risk to human prosperity and health.

But this leaves researchers looking into less industry-friendly science at a loss. Government funding is harder to get, and there’s no money to be made from the more esoteric scientific questions.

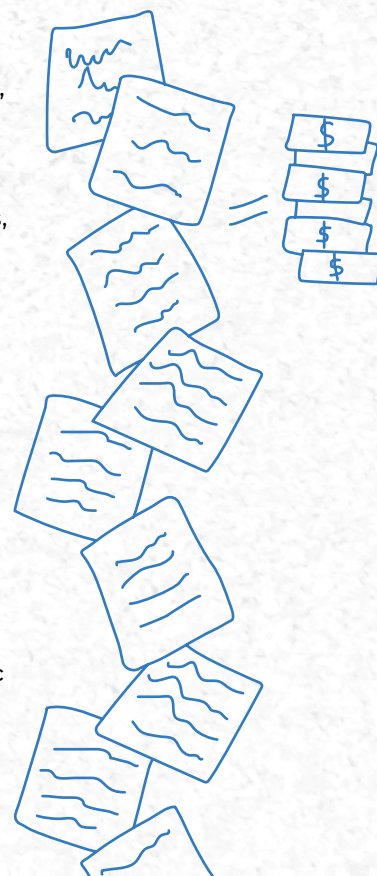
Industry funds applied-solutions-oriented science, not science for science’s sake (the so-called “blue sky” science). And yet there is value in science for its own sake, for research into questions that don’t have an immediate application. Value that goes beyond the potential much of this science will ultimately have (mRNA vaccine, anyone?). Converting this value from curiosity to cold hard cash is where the problem lies.

Unless you’re a billionaire research scientist, you’ll need external funding for your work. Traditionally, this involves you or your team bidding for funding, writing endless documents about your work and your ideas, with the application review process and administration taking months. If funded, projects are given a time frame: In three to five years, you should have an answer, a result.

Whether your proposal receives funding will rely heavily on whether your purpose and goals closely match the priorities of granting agencies.

The COVID-19 pandemic was the perfect example of science with immediate application being prioritized and a dramatic shift in the way research is funded. >>>

*science
for
science's
sake*



RECOVERING FROM COVID-19

As money and focus were channeled into COVID-19 research over the past few years, it had to come from somewhere. In many cases, projects that would otherwise have been funded had to be overlooked in favor of grappling with an emerging crisis.

The National Institute for Health and Care Research (NIHR) in the United Kingdom funded research into COVID-19 with UK Research and Innovation (UKRI), a non-departmental public body sponsored by the Department for Business, Energy and Industrial Strategy; a public body, yes, but one intrinsically linked to the department overseeing business and industry in the United Kingdom. Industry-funded research, if you will.

At the same time, the NIHR is embedded in the UK's National Health Service, meaning the research findings it funded were quickly provided to the NHS doctors and nurses to prevent and treat COVID-19.

"Under NIHR's restart framework, urgent public-health research into COVID-19 continues to be our number one priority," the NIHR website reads. "We do, however, recognize the importance of also investing in longer-term research."

Part of this longer-term research is an investigation into the lessons learned during the pandemic on managing the recovery of research into other conditions.

"While the pandemic inevitably reduced the amount of research we have been able to do into other conditions, we have worked hard to maintain a diverse and active portfolio," the NIHR website reads. While research into other conditions continued, it was severely affected by a reduction in capacity and accompanying NHS services.

In December 2020, Cancer Research UK announced cuts of £45 million to its research budget. CRUK is responsible for roughly half

of publicly funded research into cancer in the UK. The Canadian Cancer Society predicted that the pandemic would cost them CA\$100 million in lost donations during the ongoing financial year, which amounts to more than half their budget. The American Cancer Society saw a decrease in revenue of around U.S.\$200 million.

\$\$ covid > \$\$ cancer

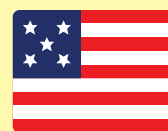
CUTS & LOST DONATIONS TO CANCER RESEARCH



£45
million GBP



\$100
million CAD



\$200
million USD

The Association of Medical Research Charities predicts that it will take more than four years for spending in the sector to return to pre-pandemic levels, and a decade to rebuild lost capacity and capability.

While the NIH may have been slow to pivot toward funding COVID-19 related projects, it did not cut funding for cancer research, meaning NIH-funded research into other (equally critical) health care issues was able to continue during the pandemic. After all, it's not like other diseases or health care problems disappeared with the arrival of COVID-19.

Unfortunately, much research into those problems was halted, not necessarily due to a lack of funding, but safety concerns. The vice-chancellor of Cambridge University instructed "unless it is related to COVID-19, all research undertaken on university premises will need to be paused." Clinical trials around the world were also forced to stop as it was simply unsafe for patients to visit hospitals unless absolutely necessary, and medical staff were needed elsewhere to support care for



research paused for safety

COVID-19 patients. All this adds up to serious delays in finding treatments for other serious illnesses. How these projects will recover from the pandemic remains to be seen.

Short-term measures are bound to have a long-lasting impact on the research world. As funding decreased for non-COVID-19-related projects, recruitment had to stall, meaning there are quality researchers out there with no jobs. Lab closures mean projects can't be completed by their deadlines, with grant money running out and PIs unable to pay their lab members. Not to mention the long-term economic downturn as a result of the pandemic means science funding could face longer-term impacts and cuts. The cancer charities seeing fewer donations is a direct result of a weakened economy.

Many of the world's largest research funders did adapt their funding policies in response to the pandemic but these changes can't have saved every project.

THE FUTURE OF FUNDING

The COVID-19 pandemic put a spotlight on health care research and its pathways for funding. It's clear that research in academia would benefit from significant restructuring to deal with global challenges that require fast solutions.

"Our findings revealed critical flaws in the funding of critical public health research in the United States," says Dai, the Johns Hopkins University professor who looked into COVID-19 funding. "Research responsiveness — that is, an infrastructure that allows for rapid and near-real-time learning in terms of clinical practice, public health measures and management principles — is a critical dimension of health care resilience.

"While, in the future, research infrastructure should be rapidly expandable and facilitated during times of crisis to better understand the impact and solutions, non-crisis-related

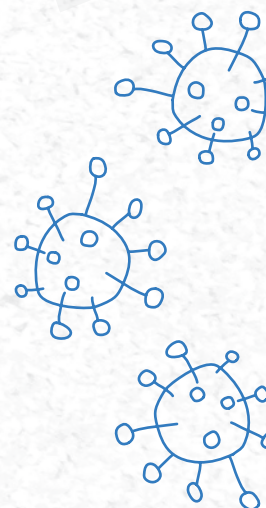
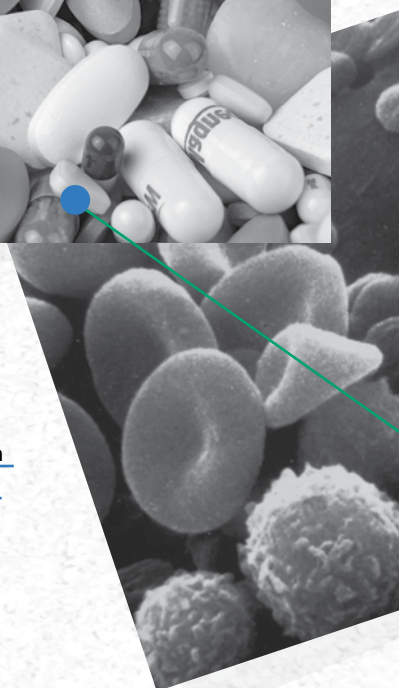
research should not be halted, but supplemented by crisis-related research to minimize disruptions in other health care and public-health priorities. Additionally, surveillance of novel threats should be funded before an issue even arises, so we can be better prepared in the event of a new crisis."

"The COVID-19 innovation system represents a departure from business as usual," says Columbia's Sampat. "Considering the remarkable progress to date, especially on vaccine development, this raises the question of whether this model is useful only for crisis times, or whether biomedical innovation policy in 'normal' times might productively incorporate some elements of the COVID-19 model as well."

In the wake of the pandemic, we can all reflect on what we got right and what we got wrong. It's clear that getting funding to scientists in a matter of days helped enormously in dealing with a global health threat, but the volume of applications for such grants proved how much science there is out there in need of just a final boost of investment.

A need for quick answers to some of the most pressing questions highlighted the burdensome process of applying for grants and accessing funding. The pandemic not only paused projects, but impacted researcher careers, especially those in the early stages, and now there may not be roles to return to.

"Applying the COVID-19 model beyond the pandemic would mean more public funding for late-stage research, clinical trials, development and manufacturing," Sampat says. "The pandemic has demonstrated that effective biomedical research policy does not end with drug and vaccine development alone." ●



*public
funding
for
late-stage
research*

BREATHING eASIER

TECH CONCEIVED DURING THE
PANDEMIC AIMS TO CALM A
POST-COVID WORLD

By: Maggie Kinsella



GRAPHICS: Abjad Design

A face mask developed during the pandemic to reduce stress and anxiety is evolving into a digital tool that can continue to serve its original purpose in a post-mask environment.

One of the winning teams of the 2022 Women to Impact venture of King Abdullah University of Science and Technology (KAUST) created a face mask called takeABreath that monitors the wearer's stress and anxiety levels. The wearable biosensors read the wearers' biological responses to stress.

It then uses gaming technology to recommend breathing exercises to reduce anxiety. The team — Anna-Maria Pappa, Sofia Dias and Leontios Hadjileontiadis of Khalifa University and Sahika Inal of KAUST — conceived the product during the height of the pandemic and are adapting the technology to offer relief for those who struggle with stress and anxiety.

"In the end we do this to help people," Pappa, who in 2019 was one of MIT Technology Review's Innovators Under 35, tells *KUST Review*. And now the team is adapting the technology into an app that, in its initial phase, begins with a simple breath into

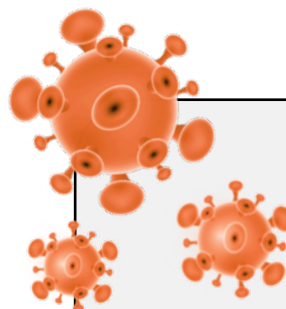
a phone and will eventually operate concurrently with wearable biosensors.

Users breathe into smartphone microphones, which capture the breath rate. After the data is analyzed, the app recommends personalized breathing games to calm the heart rate and the wearer's stress.

Breathing correctly, the team members say, is a skill people have to learn. They compare it to an athlete building endurance. "Breathing in for seven seconds is not easy," Dias says.

"We are hoping in one year to have the conceptualized idea transformed to a product. This will only happen with the intensive research efforts that we are currently undertaking, the support from Khalifa University and potential angel/venture funders," Hadjileontiadis tells *KUST Review*.

The ultimate goal is for every breath to be a tool to "unlock our mindset toward stressless living," says Hadjileontiadis, KU's department chair of biomedical engineering. The team is working through challenges around the many different brands of mobile devices and hopes to have a marketable product soon. ●



THE NEXT GENERATION OF FACE MASKS

People around the world wore masks in their daily lives during the pandemic to help prevent infection. Now, a new kind of mask might help diagnose illness. Engineers from MIT and Harvard say their new prototype can produce a COVID-19 test result in 90 minutes.

The wearer breathes normally into the mask, and droplets produced by exhaling and coughing collect on a pad. The wearer then presses a button to activate the test.

A small bit of water is released, flowing through the pad and rehydrating freeze-dried cells that react to the presence of coronavirus markers.

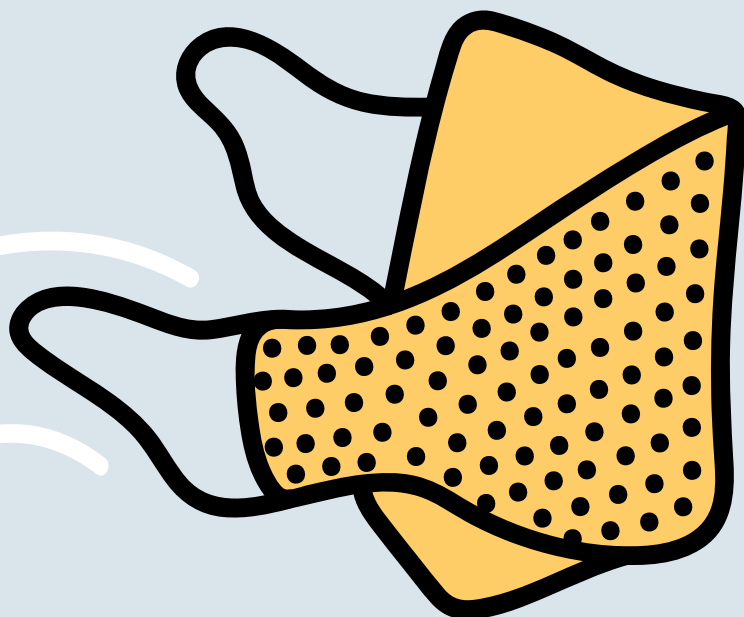
After about 90 minutes, a colored line indicates whether the result is positive or negative. It looks like a pregnancy test. The team used a typical N95 mask and the results were published in *Nature Biotechnology*. This technology had been developed to detect other viruses such as Ebola.

Innovator in UAE

Meanwhile, researchers at Khalifa University have been working on the NavaMASK, a sustainable and environmentally friendly mask made with a bio-based polymer that can be composted and integrated back into the ecosystem.

"The NavaMASK not only addresses the pressing issue of mask waste but also highlights the importance of using renewable resources and minimizing environmental impact," Shadi Hasan, director of KU's Center for Membranes & Advanced Water Technology, tells *KUST Review*.

GRAPHICS: Freepik





ASK THE EXPERTS

WHAT HAVE WE LEARNED FROM THE PANDEMIC?

The worst of the pandemic seems to be behind us, but we're just starting to get a better picture of how it affected the world. We asked experts in a variety of fields for their perspectives. Here's what they said:



Prof. Patricia M. Davidson joined the University of Wollongong as vice-chancellor in May 2021. Prior to her current role, Davidson was dean of the Johns Hopkins School of Nursing in Baltimore in the United States. In 2021 she was the recipient of the Consortium of Universities for Global Health (CUGH) Distinguished Leader Award.

PANDEMIC IS A REMINDER OF OUR DUTIES TO EACH OTHER

Calamities in history, such as war and pandemics, create an inflection point and a time for recalibration and focus across society. As well as causing much hardship, the COVID-19 pandemic has taught us many lessons.

Firstly, we are all on this planet inextricably linked. Barriers and restrictions may have a short-term benefit in curtailing the spread of contagions, but they cause many unintended consequences, from loneliness to economic devastation. We need international collaboration, and we need to support global governance.

Secondly, leadership is critically important at a global, national and local level. People make a difference, and taking care of the most vulnerable should be a societal imperative and the responsibility of leaders.

Dealing with ambiguity and resilience has become the hallmark of modern leadership, and sometimes these lessons have been painfully learned.

And lastly, amidst the suffering and loss has emerged the emphasis on the power of science and the possibilities it generates. The emergence of the importance of RNA and the rapid delivery of vaccines and antiviral therapies has been nothing short of remarkable and a life-saver.

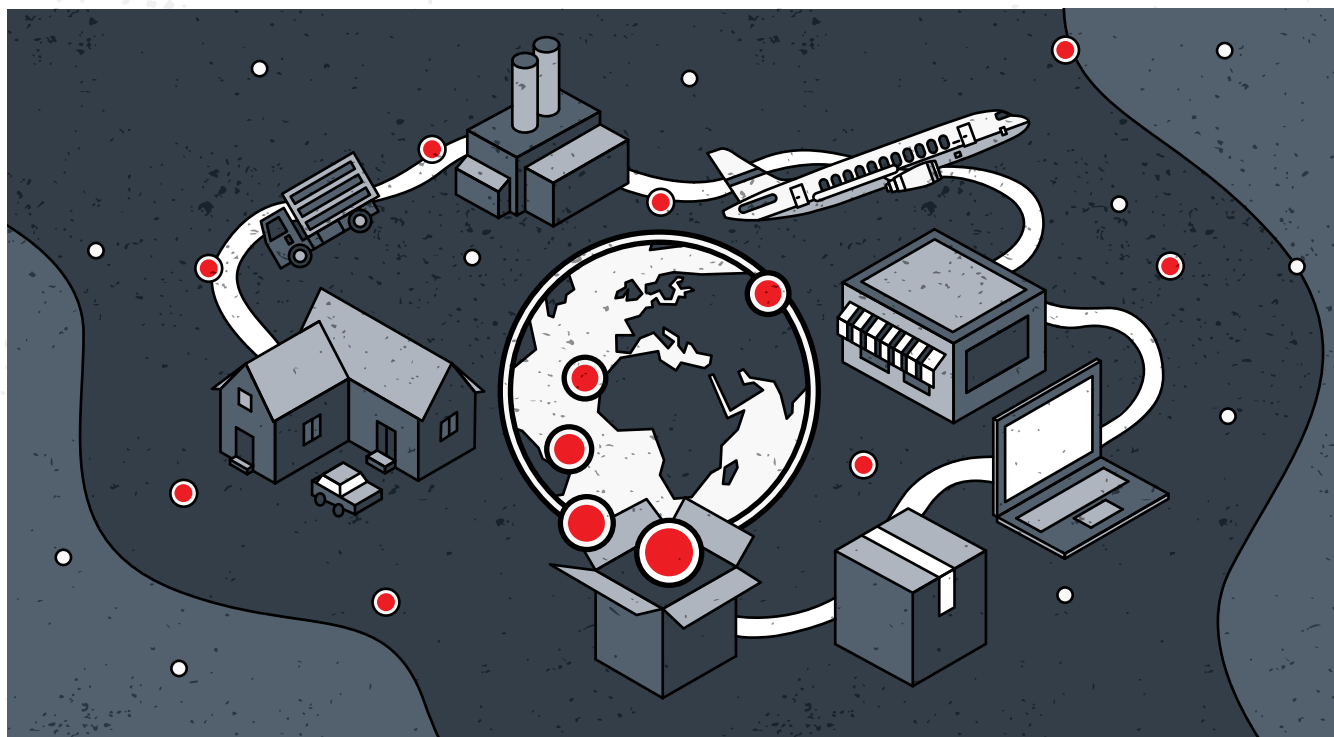
Amidst the rhetoric of nationalism and populism has also been the extraordinary stories of local communities and global collaboration. Critical lessons for me reflecting on the pandemic are: that we fail to take care of our planet at our peril; our people are important; leadership is critical; and the possibilities of science are endless.

To quote Joyce Lau (2022) in the Times Higher Education, universities can be “beacons of hope in undiplomatic times.” Science and the quest for knowledge can be a global language and a source of common ground. Leveraging the power of science and taking care of our people and planet can leverage



possibilities for good. Failing to learn the lessons of this pandemic will be at our peril.

We owe it to the lives lost and immense suffering to strive to make our planet healthier and more equitable for all.



SUPPLY CHAINS MUST BE NIMBLE AND SAFEGUARDED

One of the standout lessons from the past two years is how fragile our global supply chains have become. Today's world is a hyperconnected, interdependent ecosystem, a spider's web of partners and relationships spun across all four corners of the globe. This vast network relies on so many variables that, in the face of COVID-19 were put under tremendous stress.

Governments, businesses, and organizations everywhere had to adapt overnight to a "new normal." That "normal" was ever-changing as the virus continued to mutate with scientists and medical professionals striving to keep up and keep us safe.

It is against this backdrop that the thinking of the renowned naturalist Charles Darwin seems appropriate. His research led to the conclusion that it is not the strongest of the species that survives, nor the most intelligent that survives.

It is the one that is the most adaptable to change. The ability to adapt in the face of adversity is the very characteristic that

enabled the supply chain of vaccines and other necessities to flow around the world.

A report released mid-pandemic from DP World, a global leader in supply chains, highlighted that 83 percent of companies were reconfiguring their supply chains.

The most interesting point, however, is that these reconfigurations were to diversify their supply chains, further increasing the number of countries with which they traded, adding yet more complexity to the system, as opposed to reversing globalization in favor of nationalism and localism.

While it remains vital that countries retain sovereign capabilities, particularly across critical sectors and national infrastructure, it is emboldening that off the back of the pandemic, organizations want to increase their number of trading partners rather than retreating.

To reward this positive mindset and deliver prosperity, we must work hard and continually develop technologies and systems to digitalize and safeguard our global supply chains and ensure the web of interconnectivity remains strong. >>>



Dr. Ray O. Johnson is CEO of the Technology Innovation Institute and ASPIRE in Abu Dhabi.



Dr. Binu George is a developmental pediatrician and heads the Child Development Department at NMC Royal Hospital in Abu Dhabi. He also is an advisor to child-development activities for the Early Childhood Authority and the Department of Health in Abu Dhabi.

INCREASED SCREEN TIME HAMPERED CHILD DEVELOPMENT

The pandemic brought home the advantages of technology. From entertainment to food-delivery apps to even ongoing education for children that enabled distance learning, technology helped us bear the brunt of the quarantine and isolation brought by the pandemic. However, the very same technology also forced us into some parenting choices that are now being increasingly recognized as having caused more harm than good.

Specifically, we need to talk about the increasing “screen time” that kids were subjected to during this period. Given the extremely limited opportunities for socialization, recreation, and play activities available, families were more and more forced to entertain and occupy their kids through digital platforms of entertainment. This has had debilitating effects for all children but none more so than pre-schoolers.

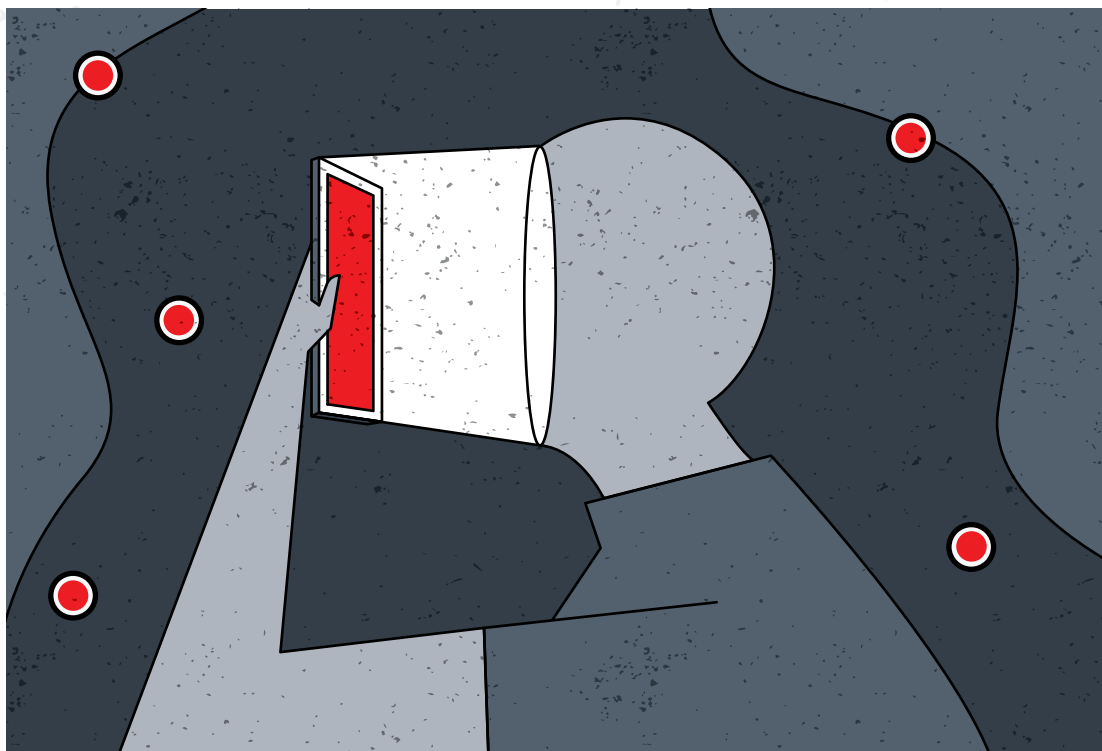
The ages of 0 to 4 years are when brain growth and development are at their peak. It

is at this age that social and play experiences help shape our skills and attitudes, which, if on track, are visible as developmental milestones and can be monitored.

Pediatricians around the world are finding an alarming increase in deficits in communication, language, attention and interaction skills of children who were at this age during the pandemic. A large percentage of these children were spending hours of the day sitting glued to entertainment channels, especially via streaming and media apps like YouTube.

This ensured that they not only missed out on the already meager opportunities to socialize and interact, thus developing social communication skills, but also preferentially started ignoring these for more “screen time.” This “screen addiction” is visible in every society in the world, and so is the increasing morbidity of developmental delays.

It is imperative that parents are educated about the unfettered use of devices to entertain their pre-school children and engage in more nurturing involvement to promote development.





Doug Munro is a retired academic and automotive-industry executive. During his career, he worked in 10 countries. He holds a Ph.D. from Ohio State University.

WE CAN'T BLAME THE PANDEMIC FOR SUPPLY-CHAIN WOES

Supply chain is a term that few, outside of those who deal with them in their industry, had heard of before COVID. Now it seems like supply chain has become the whipping boy for all economic problems in a disruptive world.

Certainly, COVID created many challenges — population lockdowns, plant and office closures, and transportation disruptions, to name just a few. Inevitably, these events required producers, wholesalers, retailers, and the systems that moved products between those environments to scramble to adjust to a rapidly changing environment.

And since lockdowns, particularly in China, continue to impact economic activity in that country, the COVID hangover persisted. But these are not the only factors that have impacted supply chains.

Manmade actions, including tariffs, the war in Ukraine, gas-pipeline shutdowns, OPEC output decisions, and increasing political tensions leading to trade restrictions, also play a major role.

In addition, aging populations in developed countries, leading to a reduced labor force, created a worker shortage, which is often compounded by political opposition to immigration. Some of these events have been accentuated by COVID, but most would have arisen had there been no pandemic.

A perfect example of a manmade supply-chain disruption, independent of, but perhaps accentuated by, COVID, is Brexit. Approved by UK voters in 2016 and implemented at the end of 2020, this political action essentially guaranteed that UK economic activity would be significantly disrupted.

The Brexiteer's slogan was "Take Back Control." Unfortunately, that ignored the complexities of an interconnected world.

A good case study is the vehicle industry. Vehicles are the largest export from the UK by

value, and more than half of those go to the EU. Brexit puts that in jeopardy.

The argument from Brexit supporters is that the UK's newfound freedom will allow the country to expand globally. However, since all of the major auto manufacturers in the UK are foreign-owned, and all have well-established global distribution, it is unlikely that British exports will be allowed to go their own way.

Adding to the disruption, more than 50 percent of the content of UK-manufactured vehicles is imported, largely from the EU.

The result will be that the sophisticated supply-chain processes that define the "just in time" assembly processes of large vehicle manufacturers will be disrupted by border checks, and exports will likely be subject to ongoing duties. Neither of these will work in the UK's favor.

So, while the UK's Society of Motor Manufacturers and Traders argues that "Automotive ... has clearly been amongst the worst hit sectors" due to COVID and has driven "significant supply-chain disruption," the fact is that COVID was a problem, but the big hit has been self-inflicted.

In 2015 the UK automotive trade group forecasted that UK vehicle production in 2020 would reach 2 million; the actual total was less than half that amount.

Between 2019 and 2021, global vehicle production fell approximately 13 percent; UK vehicle production dropped 32 percent. It is difficult to blame COVID for the difference.

There is no question that COVID posed challenges around the world, but it is unfair to blame the pandemic for all that has gone wrong.

The "freedom" Brexit brought to the UK shows only that we have learned ways to blame the virus for a lot that has gone wrong.

As Janice Joplin elegantly sang, "Freedom's just another word for nothin' left to lose." That may be the main lesson for the UK in a post-COVID world. ●

THE BUG NAMED AFTER A BUG

The coronavirus was a challenge and an opportunity for researchers in the Balkans

By: **Suzanne Condie Lambert**

The coronavirus left its mark on the world — and on a new species of insect found in the Western Balkans.

When **Halil Ibrahim** and his team at the University of Prishtina discovered a new species of caddisfly — a flying insect similar to a moth whose eggs and larvae thrive in freshwater lakes, streams and ponds — they named it *Potamophylax coronavirus*.

The insect was discovered in Kosovo's Bjeshket e Nemuna National Park before the pandemic, but the work of analyzing and describing it was done as the scientific world faced such challenges as lab lockdowns and difficulty accessing supplies. This left Ibrahim time to finish desktop research on previously started investigations. "Hence the name of the new

species reflecting pandemic with all these obstacles," Ibrahim tells *KUST Review*. But the name also has a second meaning.

It reflects "the hidden 'pandemia,' i.e. pollution and degradation of freshwater ecosystems in Kosovo and Western Balkans during the past two decades," Ibrahim says. "Many rare and important insect species, including the newly described *Potamophylax coronavirus*, are endangered by these activities."

"The name is a good tool in increasing awareness for environmental protection," he says. Ibrahim and the team published their results in *Biodiversity Data Journal*. ●

ILLUSTRATION Abjad Design

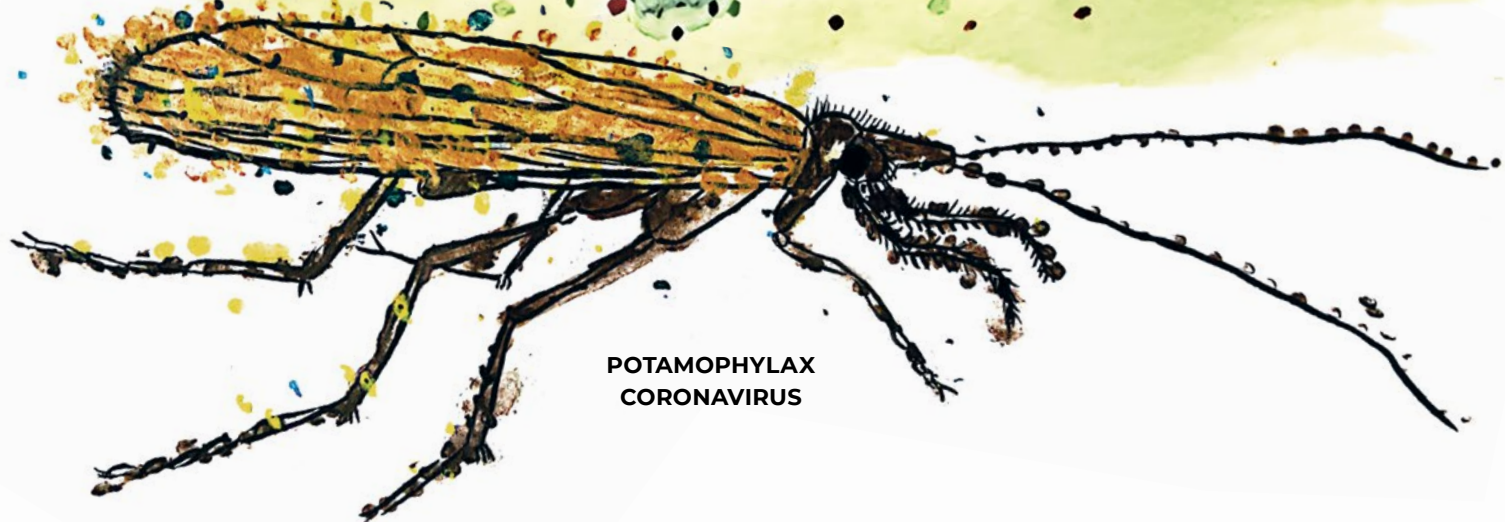


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Many rare and important insect species, including the newly described *Potamophylax coronavirus*, are endangered by these activities.

– Halil Ibrahim

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**POTAMOPHYLAX
CORONAVIRUS**

COVID WAS NO BARRIER

for Amateur Bird Enthusiasts in the UAE

By: Maggie Kinsella

Research slowed during the pandemic for non-COVID matters as sputtering supply chains and closed labs made work difficult. But for a pair of amateur bird enthusiasts in the UAE, the skies were open and delivered an unexpected discovery.

The pair, former chemistry teacher Oscar Campbell and physics teacher Simon Lloyd, made the outdoors their lab and discovered at an Abu Dhabi golf course a bird previously thought to be extinct and unknown in the UAE.

The steppe whimbrel is native to the Russian plains, remote areas of Kazakhstan and central Asia and is one of four whimbrel subspecies. It was declared extinct in 1994 and rediscovered in 1997, but its wintering grounds, in Mozambique, were not discovered until 2016. The UAE is a mid-way stop.

Campbell has been observing birds for many years, but spotting the juvenile steppe whimbrel was noteworthy.

"It's a significant finding," Campbell says, because although there are an estimated 100 of them in existence, the fact that they found the young bird in the UAE means the species is continuing to breed.

Campbell and Lloyd had been doing monthly surveys of birds around the grounds of Sadiyaat Beach Golf Club for about three years before they spotted the bird in August 2020. Campbell says the team at the golf club were excited about hosting such a rare bird. Getting a look under the wing is crucial to identifying a steppe whimbrel. It was tricky, Campbell says.

"Part of the problem, of course, is most of the time you can't see the underwings of a bird. And when you can see them, it's flying so it's moving fast. We took hundreds

of pictures. There are a bunch of identifying details but the precise features of the underwing pattern are definitely the most diagnostic," Campbell tells *KUST Review*.

Campbell, now an environmental scientist, regularly spends time out exploring and surveying birds for several other properties around the Emirates. He is currently working with a team on the third edition of *Field Guide to Birds of the Middle East*. The book is scheduled to be published in 2024.

Amateur scientists around the world are becoming more involved in research in a process growing in popularity known as citizen science. Amateurs work in collaboration with scientists to contribute data, analyze the data collaboratively or otherwise participate in projects. ●



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**Getting a look under
the wing is crucial
to identifying a
steppe whimbrel.**

Oscar Campbell

”

○ Abu Dhabi

© **CAPTION:** Steppe whimbrels
winter in Mozambique. One was
spotted in the UAE on its way
there in 2020.

PHOTO CREDIT: Oscar Campbell /
Nautica Environmental Associates
MAP: European Atlas of the Seas

● Mozambique

● Central Asia





The Placebo Problem

By: Jade Sterling

Pandemic tested
ethics in nutritional
clinical trials

Leigh Frame, Ph.D., likes vitamin D. Executive director of the Office of Integrative Medicine and Health at George Washington School of Medicine and Health Sciences, she is especially interested in the role of vitamin D as an immune modulatory hormone. She was starting a pilot study to determine the effectiveness of vitamin D supplementation via patch delivery (through the skin) versus pill delivery (via the gut) when the pandemic hit.

Vitamin D is a fat-soluble nutrient that also functions as a steroid hormone. Many of the body's organs and tissues have receptors for vitamin D, which suggest important roles beyond what we currently know about its role in bone health.

"We had planned to bring 30 healthy subjects to the medical campus, who would otherwise not have needed to visit the campus," Frame says. "Now, each visit would represent an added risk to them, which raises concerns in terms of

the principles of beneficence and justice. Given that the benefit to these subjects is minimal as this study is not looking at potential therapeutic benefits, the risk of contracting COVID-19 through being on campus greatly outweighs the potential benefit to society. It would not have been ethical to proceed with this trial during the COVID-19 pandemic."

A sudden halt

The sudden emergence of COVID-19 meant clinical research was halted — or even terminated — in deference to the immediate needs of caring for patients and clinical trials focusing on the treatment and prevention of coronavirus infection were prioritized over studies focusing on other diseases. Once social distancing had been introduced by governments as a public health measure to prevent or slow the spread of disease, trial sponsors and investigators were required to determine whether ongoing trials should proceed. >>>

PHOTOS: Freepik
GRAPHICS: Abjad Design

Several factors determined the fate of these trials, including trial location, the indication for the trial, the urgency of continuation, the safety of participants and staff, and risks to trial integrity.

The main question: Would it be ethical to continue?

"The field of research ethics has developed in response to research conducted without proper consideration for ethical issues or with blatant disregard for ethical concerns," Frame wrote in a 2020 publication on ethical concerns in placebo-controlled supplementation studies. "The design of most research studies today involves more nuanced issues of research ethics relating to the Principles of Research Ethics."

PRINCIPLES OF RESEARCH ETHICS

- ▶ Respect for persons
- ▶ Treat participants as autonomous
- ▶ Protect participants with decreased autonomy

BENEFICENCE

- ▶ First, do no harm
- ▶ Maximize benefits to participants
- ▶ Minimize risks to participants

JUSTICE

- ▶ Fair recruitment of participants
- ▶ Participants asked to bear the risk should benefit from the research

From Ethical Concerns in Placebo-Controlled Supplementation Studies: How to Design a Rigorous Randomized Controlled Trial. Permission from Leigh Frame.

“Each visit would represent an added risk. It would not have been ethical to proceed during the pandemic.”

While Frame's trial was put on hold, numerous studies were conducted on the potential of vitamin D to reduce risk of infection with COVID-19. Frame's study looked at the efficacy of different supplementation methods: We already know that vitamin D supplementation can be beneficial, so investigating how this is best achieved fell short of the principle of beneficence. Using vitamin D as a preventative and potential adjunct treatment in COVID-19, however, was an unknown and potentially important in the fight against COVID-19.

"If you do a PubMed search for 'vitamin D' and 'COVID,' 936 results are returned from 2020 to 2021, plus 273 in 2022 as of June," Frame says. "Those are substantial numbers, however if you restrict those results to clinical trials only, 30 results ranging from study protocols to completed results are returned from 2020 to Jun 2022. That is actually a very large number considering the extremely tight timeline from the emergence of COVID-19. Many of these studies, however, are observational in nature, meaning they are looking at vitamin D status in relation to COVID-19 infection and its progression and outcomes."

Addressing the risk

Observational studies are very low risk for the subjects, introducing very little additional risk to participants but offering potential benefit to society, though not the individual, Frame stresses. "Prioritizing this type of study during a pandemic makes sense ethically, not just due to the low risk, but because we have some evidence to inform a potential intervention that may prove beneficial. Vitamin D has known actions in viral infections and in the immune system more broadly. Therefore, it could be reasoned that vitamin D supplementation for prevention or as a potential adjunct therapy would be beneficial with minimal potential for harm."

In these studies, the risk/benefit ratio is in favor of continuing. Keeping in mind the principles of beneficence and justice, it would be ethical to proceed.

"In fact, you could argue it would be unethical not to proceed," Frame says. "Given the potential benefit to society, especially in a global pandemic, coupled with the potential benefit to the individual and the minimal risk they'd face. As this research would be done in those mostly likely to be affected by COVID-19, this bolsters the ethical nature of such studies. Plus, conducting research in those of greatest risk to morbidity and mortality from COVID-19 would further strengthen the justice component and could be used to improve health equity."

Many of these studies found the same thing: insufficient blood levels of vitamin D were associated with increased risk of COVID-19 susceptibility, severity, and mortality. >>>





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As a member
of the research
study team, it
is your duty to
protect your study
participants and
to ensure that
your research
is conducted
ethically.

-Leigh Frame

”

Further research is still needed to determine the precise role and efficacy of vitamin D as a preventative or therapeutic measure in cases of COVID-19, but since vitamin D deficiency is common around the world, any link to it possibly helping surely justifies investigation.

Frame, and the principles of ethics in trial design, have concerns: One major concern with such studies is their use — or not — of placebo. Using a true placebo, an inert substance that participants believe is the therapeutic, has small positive effects in most cases, known as the placebo effect. However, this is likely smaller than an active control, in this case, a low dose vitamin D supplement.

Research is revealing that vitamin D has much broader effects than previously assumed, as it is an immune-modulating hormone.

Vitamin D deficiency may lead to health issues involving infection, autoimmunity, cancer, chronic diseases such as cardiovascular disease, and even mental illness. Withholding vitamin D in clinical trials, therefore, may see harm done.

“As demonstrated in the Tuskegee Study of Untreated Syphilis, it is unethical to withhold treatment when there is a known, effective therapy,” Frame writes in *Ethical Concerns in Placebo-Controlled Supplementation Studies*. “This becomes less clear when talking about nutrition.”

Could it cause harm?

An individual may be found to have suboptimal or deficient stores of the nutrient in question. If they receive the therapy during the trial, their

nutritional status should improve at least, even if the dose is insufficient to bring their levels to those required for the effect in question.

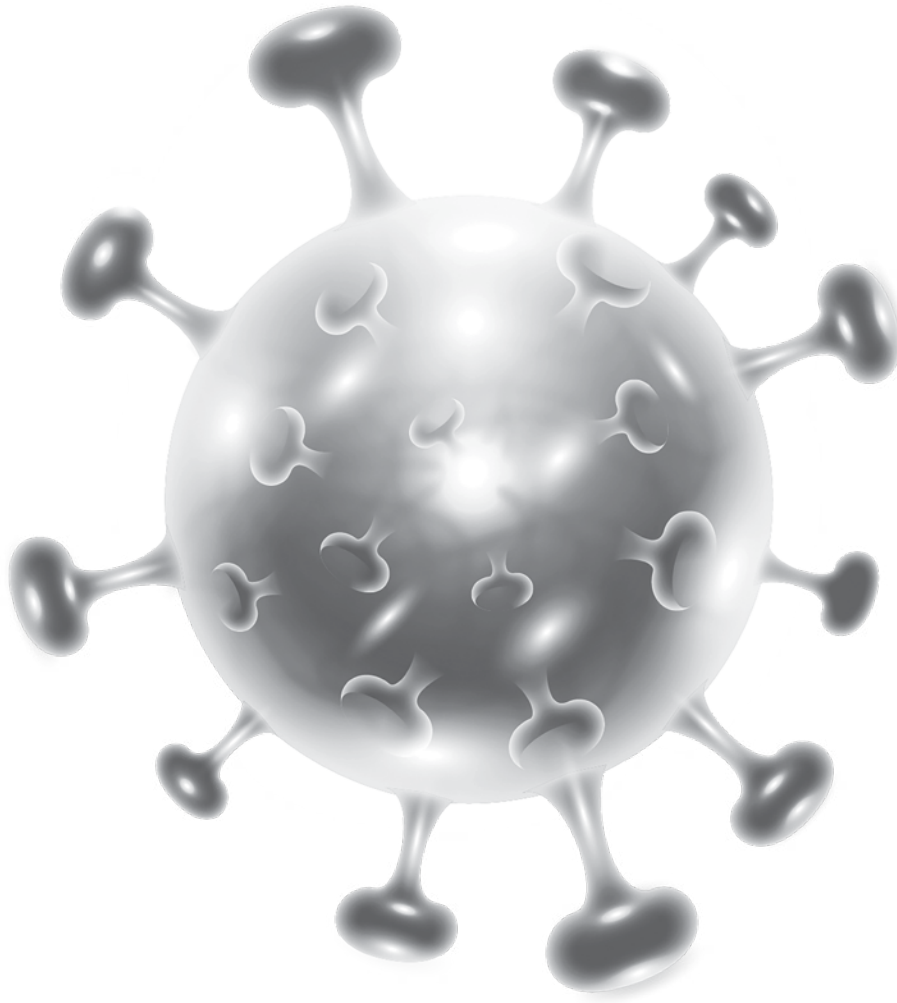
If they are unfortunate enough to be placed in the control group, their nutritional status will not improve and may even worsen over the course of their treatment. This is the crux of the ethical issue, Frame says.

“Are we doing harm to these participants? That answer depends on many factors, but to be ethical we must maximize the benefits to participants and minimize the harm. I recommend using the current Recommended Dietary Allowance (RDA) as the active control in nutrition studies, which is the minimum amount most people need each day to avoid disease, but not to optimize health.

“A low dose of vitamin D would minimize risk, improving the risk/benefit ratio. However, this may make detecting differences between the groups more difficult by reducing the difference in effect sizes between the groups, requiring a larger sample size and increasing the cost of the study.”

Above all, Frame advocates for weighing the risk/benefit ratio for each individual study during the study design process to optimize the potential for meaningful results from the study while protecting those participating: “As a member of the research study team, it is your duty to protect your study participants and to ensure that your research is conducted ethically.”

Frame's supplementation technique trial is still on hold. “We are hoping to start it very soon, as the risk of both contracting COVID-19 and the consequences of such infection have greatly decreased.” ●



WHAT WE KNOW ABOUT **LONG COVID**

Researchers are just beginning to unravel the mystery, but sex and vaccination history seem to matter

By: **Suzanne Condie Lambert**

GRAPHICS: Freepik , Abjad Design

Long COVID is a catch-all term for a wide range of symptoms that can include brain fog, fatigue and shortness of breath months or even years after a COVID-19 infection. But why do some people get it and others don't?

Definitions are fuzzy, with some organizations saying long COVID, also called post-COVID syndrome, is the presence of symptoms four weeks after infection and others defining it as symptoms seen after three or more months post-infection.

But researchers are beginning to peel back the layers to fully understand the phenomenon.

Women more affected

The U.S. government in August 2022 launched its National Research Action Plan on Long COVID to research the syndrome and support the people affected. And in October 2022 the U.S. Census Bureau and National Center for Health Statistics published a survey that illustrates the broad reach long COVID — defined in the survey as having symptoms three months or more after infection — can have.

Among the survey findings:

Women are more likely to get long COVID than men are, perhaps due to hormonal and immunological differences between men and women. They are also more likely to experience severe symptoms.

During the pandemic, 17 percent of U.S. women had long COVID, compared with 11 percent of U.S. men. Among all women, 2.4 percent had symptoms severe enough to significantly limit their daily activities. Of all men, 1.3 percent reported experiencing symptoms that reduced their ability to perform day-to-day activities, according to the survey. >>>

WHAT IS LONG COVID?

Experiencing COVID-19 symptoms for an extended period of time beyond the initial illness.

COMMON SYMPTOMS



SHORTNESS OF BREATH



FATIGUE



HEADACHE

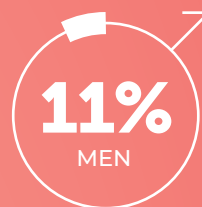
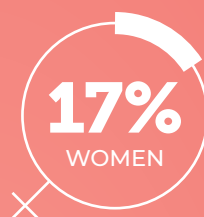


COUGH



1 out of 5 adults who previously had COVID-19 now report having symptoms of long COVID.

WOMEN ARE MORE SUSCEPTIBLE



17% of U.S. women had long COVID, compared with 11% of U.S. men.



Among all women, 2.4% had symptoms severe enough to significantly limit their daily activities, compared with 1.3% of men.

By early 2023, 15 percent of all U.S. adults had reported symptoms of long COVID; 6 percent reported current symptoms.

Are you vaxxed?

Meanwhile, a study published in October 2022 in *JAMA* finds that vaccination may reduce your chances of getting long COVID. But there are no points for half measures.

The study finds that completing the vaccination series before contracting the virus seems to reduce the risk of long COVID. Partial vaccination, however, such as taking one jab in a series of two, did not show any reduction in risk.

Claire J. Steves, one of the authors of a 2022 *Lancet* paper, tells *KUST Review* that one of the takeaways of her study is how important it is to get vaccinated.

“Back in October 2021 we showed how vaccination reduces the risk of long COVID. That’s mainly because still the strongest driver of risk of long COVID is the severity of initial illness. Vaccination really reduces this.”

In the *JAMA* study, fatigue is listed as the most common symptom, followed by loss of smell, “brain fog” and shortness of breath.

The frequency of symptoms was also associated with sex, with women being more likely to report loss of smell, cognitive symptoms, anxiety and sleep disruptions.

Researchers from Kings College London, who published their results in July 2022, found three groups in the long COVID cohort based on people who reported their symptoms via an app:

The largest group reported “brain fog,” headache and fatigue.

A second group reported symptoms most common in the early stage of the pandemic, before vaccinations were available. These were respiratory symptoms such as severe shortness of breath and chest pain.

And a smaller third group reported a range of symptoms including heart palpitations, changes in skin and hair and muscle pain.

The variant and severity of illness

The variant contracted and severity of initial illness also make a difference.

A study presented to the European Congress of Clinical Microbiology and Infectious Diseases in April reported that those who were infected

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The strongest driver of risk of long COVID is the severity of initial illness.

Claire J. Steves

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How Abu Dhabi became a vaccine hub

Receiving two doses of the COVID vaccination almost halved the odds of developing long COVID. But getting those vaccines to the people required an efficient distribution chain. The UAE became a hub of vaccine distribution, developing and deploying alternative approaches based on artificial intelligence models to store and ship vaccines at optimal temperatures to maximize their efficiency.

“The Hope Consortium, led by the Department of Health Abu Dhabi, Etihad Cargo, Abu Dhabi Ports Co., Rafed, part of ADQ, and SkyCell, set up cold and extreme cold

**41%
Decrease**

storage facilities on land as well as on board cargo planes and even on trucks and vans,” says Ernesto Damiani, the senior director of Khalifa University’s Robotics and Intelligent Systems Institute.

“Models based on simulation data were also used to forecast the needed supply according to geographical areas, population age groups and storage facilities to ensure seamless COVID-19 vaccine distribution.”

during the Omicron waves were as likely as people who'd never been infected with COVID-19 to experience lingering symptoms.

Those infected by the original variant were 67 percent more likely to experience lingering symptoms than those who never had a COVID infection.

And as Steves previously noted, the severity of initial illness is a factor.

So preventing a severe infection is important. Why? Again, still a mystery. But Mayoclinic.org suggests that inflammation and organ damage from a severe illness could be a driver of long COVID.

Other factors

As with many illnesses, it's complicated by many other factors.

A study published in *Nature Medicine* finds other risks for long COVID include ethnicity, socioeconomic deprivation, smoking, obesity and other comorbidities.

Previous studies had indicated that age was an issue, but in a February paper for *Gerontology & Geriatrics*, Columbia University's Ray Marks says there just isn't any evidence.

"Age alone cannot be a factor because the condition appears to randomly affect older as well as younger COVID survivors, regardless of vaccination or health status," he writes.

Mental health link

Long COVID might also have a link to mental health, although there is still some question about whether it is a cause or effect.

Patients with long COVID were about twice as likely to get a prescription for an antidepressant for the first time within 90 days of their initial

OMICRON VS "OG" VIRUS

A study by Dr. Carol Strahm
and Dr. Philipp Kohler

*Division of Infectious Diseases and Hospital Epidemiology
— Cantonal Hospital St. Gallen — Switzerland.*



SUBJECT

1,200

HEALTH CARE WORKERS
MOSTLY FEMALE NURSES

PREMISE



Regular
PCR testing
for COVID-19

DURATION

1. Original virus 2. Omicron wave
Feb 2020 — Jan 2021 Jan — Jun 2022

RESULT

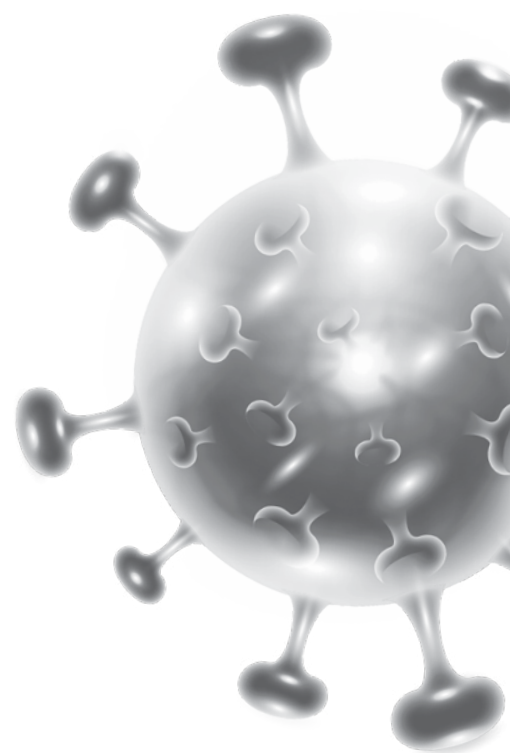
Both subject groups who tested positive for the original virus and the ones who tested positive for Omicron suffered similar symptoms of long COVID.

diagnosis, according to an analysis for Reuters conducted by health-data company Truveta.

Researchers are now asking whether changes in brain chemistry are causing the issue or if patients are experiencing distress as a result of a loss of function.

Things are looking up

The good news, however: The percentage of people who have had COVID and have long COVID symptoms has declined. It was 19 percent in June 2022 but was 11 percent in January 2023, according to the Kaiser Family Foundation. ●



INNOVATION

at the forefront

AI and ICT research
benefits business and
the community

By: **Nawaf Almoosa**

For the United Arab Emirates to continue to be the leader in information and communications technology (ICT), it needs to invest in developing home-grown technology and talent.

This is why in 2009 Khalifa University, with e& and BT Plc, created the Emirates ICT Innovation Center (EBTIC), one of the first and longest-running research centers in the UAE. EBTIC has since expanded nationally thanks to the support of the Telecommunication & Digital Government Authority's (TDRA) ICT Fund since 2014.

EBTIC is an international center of excellence for intelligent ICT systems research and innovation, driven by strong industry-academia and government partnership promoting world-class research, technology transfer, research training and open innovation.

EBTIC has strong capabilities in machine learning, optimization, natural language processing, cooperative intelligence and big data analytics, as well as

IMAGES: Freepik

network architectures and cybersecurity. These capabilities have been channeled to deliver more than 40 strategic projects annually to its partners and UAE government entities.

Recent projects provide intelligent building solutions, such as machinery-fault prediction, smart-metering analytics and Wi-Fi sensing. Also, power-usage forecasting and optimization helps companies significantly reduce their energy requirements.

One of the key technologies developed by EBTIC targets the automated design and planning of the telecommunications infrastructure, which has been adopted by e& to design its Fiber to the Home (FTTH) network. This technology has been shown to significantly reduce the capital costs and the design time of this nationally critical infrastructure.

EBTIC has collaborated with more than 15 UAE government entities to develop intelligent solutions. These include applying computer vision to improve transportation safety (Abu Dhabi Police), as well applying text analytics to improve learning outcomes (Ministry of Education). EBTIC has also delivered big data analytics, modeling and forecasting for national food imports and exports (the Abu Dhabi Agriculture and Food Safety Authority).

The success of the work with ADAFSA is illustrated by the continued growth of its partnership with EBTIC, as they have recently agreed to a multi-year set of projects that is EBTIC's biggest program yet. EBTIC also aims to commercially exploit the most promising of its research projects through the creation of start-ups.

Spearheaded by strong Emirati talent, these start-ups look to gain commercial success in the UAE and global markets. For example, EBTIC has spun out SPL Solutions, which uses advanced intelligence and software engineering innovations to automate the understanding of legacy software, which helps organizations turn their code into microservices to support strategic cloud migration initiatives commonplace in many organizations at the moment.

EBTIC is also working to exploit its portfolio of patents with regards to network synchronization. This work has developed an intelligent client-end network solution that allows for accurate time and frequency synchronization by using existing standards such as Precision Time Protocol (PTP).

Protected by 38 filed patents, of which 25 have been granted, this cost-effective solution achieves the highest levels of accuracy when measured against existing competitors.

Another start-up initiative in development is 10Folds, which will be the region's first machine-learning data-labeling solution provider for the Arabic language market. Due to the many Arabic dialects, current solutions struggle, but 10Folds will guarantee quality assurance of tagging, allowing for a more accurate machine-learning model to be trained.

EBTIC leveraged its capabilities in machine learning to support the response to the COVID pandemic through the development of COVID spread models driven by digital infrastructure data. Furthermore, it also applied accurate multilingual text analytics and natural language

processing (NLP) techniques to social media to gauge public sentiment about ensuing pandemic.

Recently honored as the UAEs most inventive center at the Department of Economic Development's Abu Dhabi Awards for Intellectual Property, EBTIC has more than 80 inventions patented or being filed, and 64 patents granted.

One major facet of EBTIC's success is in its knowledge-transfer ambitions. EBTIC has trained more than 400 UAE students, including supervising 50 Ph.D. or Master of Science students, and trained over 300 UAE-based professionals in big data-related competencies.

EBTIC colleagues have spoken at prestigious international conferences and exhibitions, won international competitions, published technical books and journal chapters, as well as appeared on TV, all of which has contributed to a growing global reputation for EBTIC and the UAE.

This mix of achieving scientific excellence; tackling national and societal challenges; and building core intelligent ICT skills in the UAE is central to EBTIC's mission, and there is much more to come. ●



Nawaf Almoosa is an EECS faculty member at Khalifa University with a joint appointment as the director of the Emirates ICT Innovate Center (EBTIC).



CYBER
SAFE

UAE's chief of cybersecurity has his eye on vulnerabilities caused by the pandemic as well as emerging threats

By: **Suzanne Condie Lambert**

PHOTOS: mockups-design, unsplash
GRAPHICS: Abjad Design

The coronavirus pandemic disrupted every aspect of life. Not the least among the disruptions: Businesses and governments scrambled to enable remote workforces. As a result of stretched networks and inadequate home security, they now face increases in cyberattacks.

We talked with His Excellency Dr. Mohamed Al Kuwaiti, head of cybersecurity for the UAE government, about these issues and more.



Dr. Mohamed Al Kuwaiti



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How were businesses made vulnerable by a rapid increase in remote workforces and what are some of the biggest issues companies face? How is this affected by the increase in remote shopping and other customer services?



Before the pandemic, most companies did not practice remote working. As such, the cybersecurity measures and practices put in place and implemented were not designed to protect the organization in the event of widespread remote access. In addition, employees were not trained and provided with the necessary best practices and guidelines on how to exercise proper cyber hygiene during remote working.

As such, when the pandemic occurred and a high ratio of employees started remote working, the organization's data were simply not protected adequately, resulting in security breaches and data exfiltration, both intentionally and unintentionally.

On the other hand, the increase in online shopping during the pandemic was not accompanied by adequate awareness on how to protect oneself from online fraud or proper hygiene on managing one's data in these kinds of scenarios.

This includes sensitive and private data, as well as personal identifiable information: credit card information or even more seriously one's online identity or credentials. Losing these data may result in identity theft. >>>

WHY ARE REMOTE WORKERS MORE PRODUCTIVE?



No Commute



More Exercise



Family Time

SOURCE www.apollotechnical.com



Type a message



**Dr. Mohamed Al Kuwaiti**

What are some of the most common scams and attacks you're seeing?



Phishing attacks, through emails as well as voice calls, remain a common threat today, because they are most easily executed and often used in conjunction with other methods in a blended attack on targeted users.

But on a bigger scale, system misconfiguration is another major concern, with one misconfiguration error happening to a major cloud provider recently. Allegedly, data from 65,000-plus entities in 111 countries were exposed and a series of other data leaks from the original related leakage affected 150,000 companies in 123 countries.

And not to mention that ransomware remains a very real problem. In the UAE, we are committed to leading efforts to fight against this threat. In fact, we were co-chair for information sharing at the recent Second International Counter-Ransomware Initiative held in the White House (in November 2022).

COMMON THREATS



Email



Voice call

EXPOSED DATA



65,000+ Entities



111 Countries



150,000+ Entities



123 Countries



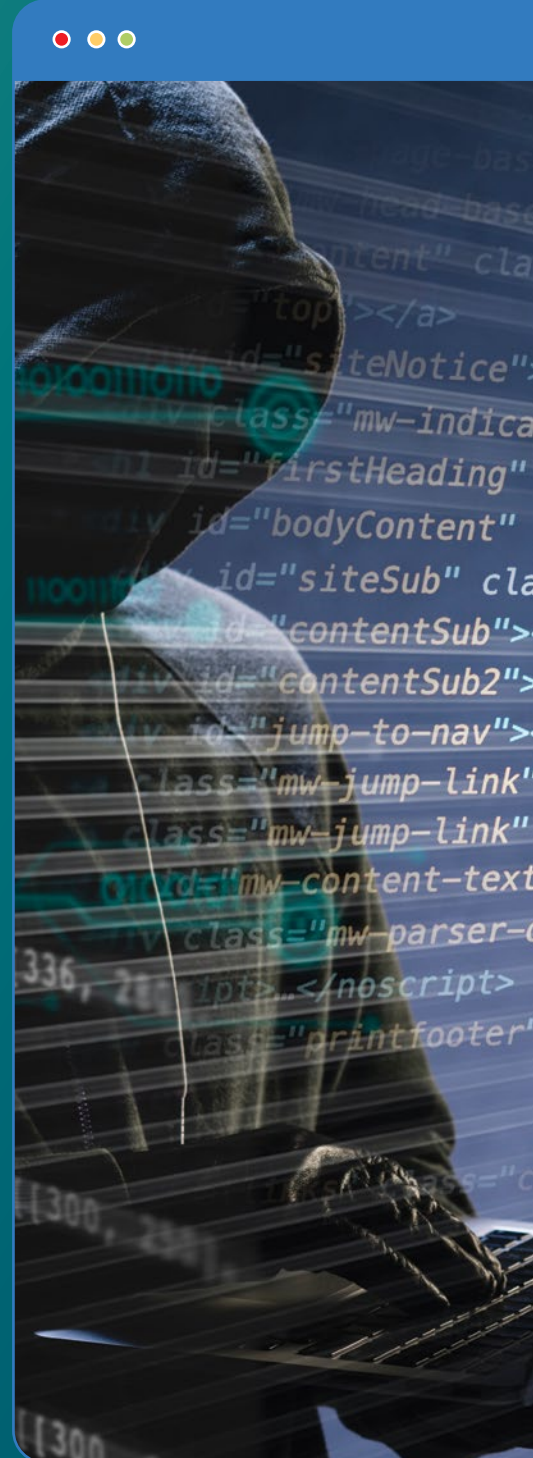
Cyberattacks threaten businesses with lost data, money, status and productivity. But does this kind of damage to private industry potentially affect national security? If so, how?



The financial sector has always been recognized as a vital part of any country's critical infrastructure because it is a backbone to sustain our economy. [Read more](#)

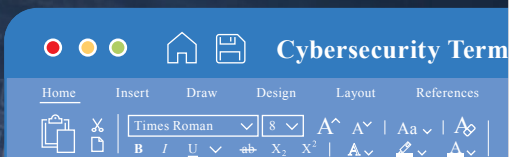


Type a message



Cyber Security Stats

Cybersecurity Risk.jpg



Cybersecurity Terms

Security Misconfiguration:

A type of security vulnerability that occurs when a system or application is not properly configured to protect against unauthorized access or data breaches. It can happen when security settings are not implemented, configured incorrectly or not updated to the latest version.

Phishing Scams

Phishing scams are a type of online fraud where scammers try to trick you into sharing your sensitive information, such as passwords, credit card numbers or other personal data. They usually do this by pretending to be a trustworthy entity, like a bank, a government agency or a popular website, and sending you fake emails, text messages or social media posts that look legitimate. The goal of these scams is to lure you into clicking on a link or downloading an attachment that contains malware or to fill out a form that asks for your personal information. Once scammers get access to your sensitive data, they can use it to steal your identity, empty your bank account or carry out other criminal activities.

Ransomware Attacks

Ransomware attacks are a type of malicious cyberattack in which an attacker gains access to a victim's computer or network and encrypts the victim's files or data, rendering them inaccessible. The attacker then demands a ransom payment from the victim in exchange for the decryption key that will unlock the files.

The ransom demand is usually accompanied by a threat to delete or publish the victim's data if the ransom is not paid within a certain time frame.



Dr. Mohamed Al Kuwaiti



The increased reliance on ICT in the financial sector, with online banking and trading, and also with the emergence of crypto currency, e-wallets and e-commerce today, shows that the availability, integrity and resiliency of the ICT infrastructure sustaining the financial sector is of the utmost importance to our very survival.

What should governments do better to support improvements in private-sector security and discourage cybercrime?
Are there any UAE initiatives you can discuss?

KU STR



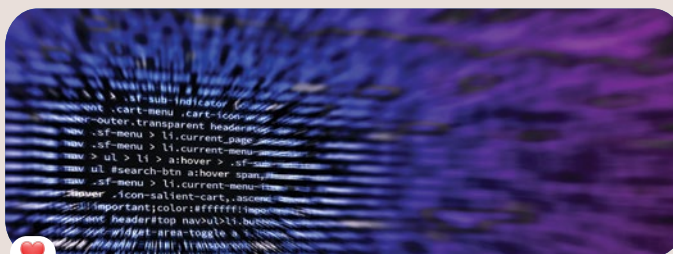
Our strategy is to engage the private sector directly by getting them to be part of the equation. As such, since last year I have been issuing a call for a public-private partnership ... to harness their expertise to solve our daily problems because they have the solutions while we have the problems. Besides the various (memorandums of understanding) that we have put in place with leading ICT companies, more recently we have started to engage the experts directly. For example, with the successful conclusion of the first CISO Circle gathering at GITEX Global 2022 that also saw the establishment of the (ISC)2 UAE Chapter in our country.

Aside from cybersecurity, what other emerging risks does your role monitor?

KU STR



Cybersecurity, data privacy, operational risks, governance and compliance — anything that leads towards data protection and the secure and safe usage of these data towards enabling business while protecting lives. This is what my role entails. >>>



Type a message





Dr. Mohamed Al Kuwaiti



What advice would you give to any new graduate considering a career in cybersecurity?

KU STR



Consider getting your hands dirty first and always be grounded in the basic fundamentals as these are the skill sets you will depend on when the going gets tough. Program them into your mind and body: There are no shortcuts, so roll up your sleeves first!

How should an organization go about assessing its critical infrastructure and securing its most vital assets?

KU STR



The organization should gather all their department heads, both businesses and platforms, and make them the risk owners of their own departments, so as to build a complete risk register of the business.

Apple or Microsoft? Why?

KU STR



Apple, because they are going to be a major cybersecurity player in the future. They are the leaders in consumer products. These consumer products or (internet of things) are going to be the biggest concerns moving into the future. They are not only providing the necessary information to your fingertips, but they are also going to be the largest group of devices collecting your information consciously or subconsciously. That may be the biggest cybersecurity crisis that we need to address in the future in order to protect one's data.

APPLE OR MICROSOFT?



MacBook Pro is frequently used by cybersecurity professionals.
SOURCE www.knowledgehut.com



Microsoft promises comprehensive security features.
SOURCE www.learn.microsoft.com



Type a message



Cybersecurity by the numbers.jpg

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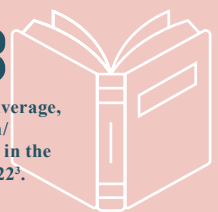
data records worldwide were exposed by data breaches in 2022¹.



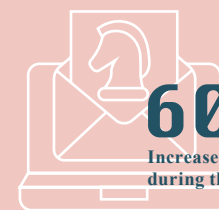
28%

increase in global attacks in the third quarter of 2022 compared to the same period in 2021².

2,148



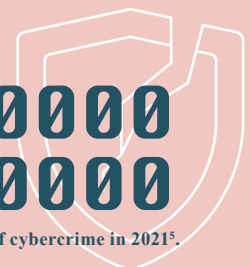
weekly attacks on average, targeting education/research industries in the third quarter of 2022³.



600%

Increase of malicious emails during the pandemic⁴.

\$6
0000000
0000000



Total cost of cybercrime in 2021⁵.

Cybersecurity by the Numbers: References

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Page 1 of 1 102 words

 **Dr. Mohamed Al Kuwaiti**   

Are we at risk when we use open-source programs, and what steps can we take to minimize risk? 

 There are always risks, whether we use open-source or proprietary software. The question should be: How can we build a risk-based program to address these risks, and build a multi-level defense system grounded in zero trust principle?

How do you see technology evolving in the next five to 10 years? 

 It is going to get more and more personal as we straddle between multiple worlds or realms in our journey to the realization of the future Metaverse.

What is the ethical response to ransomware? Does the government have a responsibility to protect businesses and citizens from ransomware attacks? If so, how? 

 We should never succumb to the threats of the perpetrators and pay the ransom. The buck should stop here as long as I am in charge. By paying the ransom, we are only going to see them get better and soon, beyond any reasonable means that we can respond to them in the future as we can only smell their smoke. So we shall not give them a chance at all. Do not pay them to leapfrog us in terms of technology (and innovation).

Is there anything we didn't ask that you'd like to talk about? 

 The sky is no longer the limit for us anymore; space is. And space security, that is a topic that we can explore the next time we speak. 🌌



  Type a message 



MODERN HERITAGE

Cellphones, robots, drones and more preserve the old ways for rural communities in UAE and beyond

By: Jade Sterling

Traditional ways often suffer after the introduction of technology. But Bedouins and other nomadic peoples are adapting modern tech to preserve the customs of their ancestors from herding and hunting to sailing and sports. Here are four ways tech is making an impact.

CELLPHONES AND MODERN COMMS

"Before I went to do research among the Egyptian Bedouin tribes, I had envisioned Bedouins as desert roamers living in tents and herding animals," Lila Abu-Lughod says about her time with Bedouin groups along the northern edge of the Egyptian Western Desert in 1984. "Instead, I found that these same people who touted the joys of the desert lived in houses, wore wristwatches and plastic shoes, listened to radios and cassette players, and travelled in Toyota pickup trucks."

Abu-Lughod is a professor of social science at Columbia University these days, but in 1984, she was working on her Ph.D. at Harvard University. She was living with the Awlad 'Ali tribe, documenting her experiences living with Bedouin women and researching their poetry and storytelling. The most visible changes in their mode of life, she says, do not signal the disintegration of their culture or society.

Thirty-nine years later, Fatma Al-Kalin visited Marsa Matrouh, Egypt, and came to a similar conclusion. The researcher from Girls' College Ain Shams University in Egypt noted most of the Bedouins she met had a cellphone and a social media account.

More than three-quarters of the population surveyed owned a cellphone and spent "a lot" of time using the internet. Compared with the mostly male ownership of the Toyotas seen by Abu-Lughod, cellphones were equally distributed among men and women. The proliferation of cheap communications technology has rapidly modernized the way of life for many Bedouin people, as have the cheap means to keep phones

charged without a fixed power station — thanks to the falling cost of solar panels.

Beyond "the internet," there are unique benefits to reap from the cellular revolution. Sharing information through informal social networks on the price of produce, weather patterns and grazing conditions helps families to maximize their production and profits while minimizing their risk, says Mark Hay, a freelance writer focusing on the culture and society of nomadic peoples.

"During a major drought in 2010, the Kenyan government itself took to using these networks to help nomadic Maasai tribes avoid

disaster," Hay explains. "Another Kenyan project gives mobile-phone holders access to hundreds of pro bono lawyers who can help nomads defend their land rights, using tools of a legal system that were once utterly inaccessible to most of them.

"In Mongolia, the solar panels brought in to charge phones have granted nomads access to cheap and reliable solar power in the countryside to light their homes, eliminating the need for candles to create light," Hay says. "This has reduced the risk of smoke-exposure-based diseases, extended the workday and freed up huge sums in family budgets to buy consumer goods. All from the proliferation of cellphones."





DHOWS

Symbolic of the golden age of exploration, pearl diving and fishing, the dhow is the traditionally romantic Arabian seacraft undergoing a dramatic revival. Dhows are an important part of the UAE's cultural heritage with many Emirati families tracing their history to sea-faring traditions.

While the dhows employed nowadays may look the same as the vessels that linked the countries of the Arabian Gulf to the rest of

the world through the centuries, advancements in materials mean they are now built of fiberglass instead of wood.

A modern fiberglass boat can be produced twice as quickly as the traditional teak boat and requires half the maintenance. While a wooden dhow needs dry-docking every three months to be treated, a fiberglass one can go much longer at sea.

Lamination has replaced shark-liver oil, and epoxy is used instead of cotton, while masts and booms

are made of carbon fiber. Sails are much lighter and stronger than they used to be, and radio and satellite navigation are standard accoutrements to the modern dhow sailor. >>>

☉ **ABOVE:** Dhows are traditional sailing boats used in the Red Sea, Arabian Peninsula and the seas of East Africa.

☉ **LEFT:** A Sudanese nomad checks his cell phone in the Sahara.

PHOTOS: Shutterstock, Alamy

ROBOT JOCKEYS

Across the Gulf, camel racing is a treasured sport. Controlling the camel as it thunders down the track is a remote-controlled robot jockey. Since 2005, camel racing in the UAE and Qatar has required the use of robot jockeys rather than humans. Robots are much lighter and can't be injured if they fall off. Development began in the early 2000s, with Swiss company K-Team first employed to design a mannequin-like robot that wouldn't spook the camels.

Beyond the visual aspect, the robots also needed to withstand high desert temperatures and cope with a fast-moving and uneven ride. These robots were introduced to the sport but they came with disadvantages: They were relatively heavy, weighing in at 16-18 kilograms, and expensive.

A team at the Qatar Scientific Club improved the design. Aluminum frames now protect the circuit box, reduced to the size of a large book. A rotor spins the jockey's arm, propelling the whip. The design is simple: It's basically a power drill, with the drill bit replaced with a riding crop. The jockey is controlled remotely by the handler.

The robots also provide feedback to the camel handlers, measuring and transmitting biological signals in real-time throughout the race. Esan Maruff was head of IT and robotics on the Robotics Academy of Qatar for Bright Inventions (RAQBI) in 2005. His team was also tasked with developing robotic jockeys but found that camel-racing technology didn't need to be complicated.

"Instead of full automation or a sleek design, the camel owners wanted a simple, streamlined robot. It didn't need to be intelligent or high-spec," Maruff says. The final RAQBI model miniaturized the K-Team design and repurposed car key fobs for remote controls. It also weighs just 2 kilograms.

"Any electronics technician can make this. Our methodology here was engineering rooted in simplification and an understanding of the local tradition. Within months, our design was being copied across the Gulf. It was amazing. We never expected that kind of reach."

Robot jockeys aren't the only technology helping improve camel racing. Enter Jamalytics or "camel Fitbit," a tracking and training

system using technology and data analytics to optimize the racing performance of camels and dogs.

"There are estimated to be 106,000 racing camels in the (UAE and Gulf) region," says Syed Tariq Ahmed, who mentors and trains the startup on entrepreneurship, business, market access and fundraising as part of his work at the Khalifa Innovation Center (KIC).

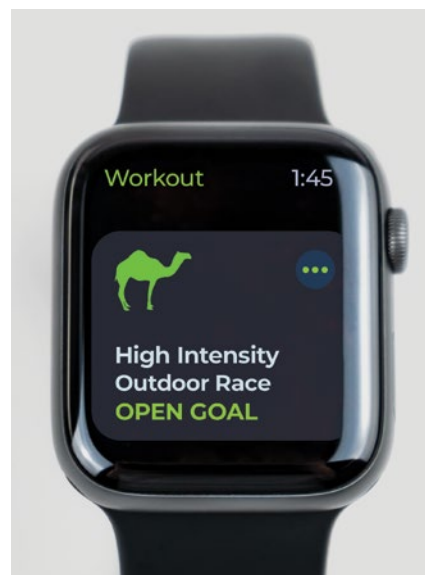
Khalifa University's KIC runs bootcamp and incubation programs.

"Jamalytics' training and tracking device will provide biological data to owners about their camels, enhancing owners' understanding of the health of their camels and enabling them to identify areas for improvement," he adds.

Ⓞ **BELOW:** Camel racing, a sport practiced at festivals and other social gatherings, can be traced back to the 7th century CE in the Arabian Peninsula. Jamalytics for camels is a much bigger version of the fitness trackers people wear.

Ⓞ **RIGHT:** Falconry is a form of hunting using birds of prey.

BELOW PHOTOS: Shutterstock, Unsplash
RIGHT PHOTO: Vowley Racing, United Kingdom



FALCONRY DRONES (AND NOT-DRONES)

For thousands of years, the Bedouin people across the Arabian Peninsula practiced falconry as an important form of hunting in a resource-scarce land. While resources are now plentiful for modern Emiratis, the sport remains popular.

Falcons require training to hunt in partnership with humans — they must be taught to fly high and swoop for prey, a challenge for a human floor-bound. For help, modern falconers have turned to the drone. Easy to fly and control thanks to advanced stabilization and GPS technology, modern drones are also sturdy enough to withstand the impact of a falcon seizing the lure.

The drone needs enough battery for practicing and stability for training under diverse wind conditions. Paul Posea tests drones for a living. As the designers of the robot jockey found, Posea recommends simplicity in a drone designed for falconry.

“Some manufacturers of UAVs exclusively used for falconry have too many gimmicks,” he said. “They try to adopt a more ‘bird-like’ appearance. Others use folding wings, V-twincopter designs, and others just don’t help with falconry. The best falconry drone should be able to mimic the bird’s speed and flight pattern. It should be versatile, not gimmicky.”

Nick Fox of Wingbeat Ltd. disagrees. Instead of training falcons to catch prey with assists from drones, Wingbeat creates drones that the falcon can catch — drones with a decidedly bird-like appearance. His design has had particular success in the Middle East, where prey suitable for the hunt is in short supply. The houbara bustard is the most



prestigious game bird in the region, but its population has nosedived.

“The end result is they haven’t got anything to hunt,” Fox says. “Our Robara model has been specifically designed as prey for hunting falcons. Through years of experiments, it was clear we needed a lure that looked the same as the real prey, behaved the same, had similar flight-performance characteristics, was controllable at all times, could fly high and freely in the sky, was safe to catch, could withstand repeated attacks, and could be mass-produced at an economical price.”

The Robara looks and flies like a houbara. Made from expanded polypropylene, the design resembles flapping wings, but it is much more resilient, with parts that can be easily replaced if broken. Although technically not a drone, more a remote-control helicopter since handlers fly it by eye, rather than videofeed from the drone cameras, the design is popular among falconers in the Middle East.

Peter Bergh went in a different direction. The Dubai-based falconer also wanted a drone that could push falcons to the limits of their speed and agility, and he also wanted his birds to be able to catch it. His

may not look like a bustard, but it’s definitely a drone. His BerghWing also enables falconers to analyze flight data, which can be used to find areas of improvement for their training.

Powered by a single motor resembling a desk fan atop a stealth bomber, the Berghwing has just three auto features: launch into wind, return to home, and loiter mode. Everything else is between trainer and falcon.

Technology isn’t just helping train falcons, however. Researchers at Khalifa University and the Abu Dhabi-based International Fund for Houbara Conservation are looking at using robotics to preserve houbara bustards, which are traditionally used to train falcons but have become endangered by habitat destruction and illegal hunting.

The idea is to use the technology to study the birds in the wild. “We will exploit the synergies between IFHC and KU to create a houbara robot that can travel freely in the houbara habitats, to perform behavior observations and interaction tasks related to houbara conservation,” Lakmal Seneviratne, director of the Center for Autonomous Robotic Systems, tells KUST Review. ●

DIGITIZING HISTORY

PHOTO: US Library of Congress

DESIGN: Anas Albounni, KUST Review

Bedouin traditions, dialects, stories and more stay alive for the next generation.

By: Jade Sterling



Bedouins are experiencing major shifts, transforming from a nomadic people into a population comfortable with modern technology and city living.

With this shift, however, comes the danger of forgetting the old ways entirely. If the people are no longer practicing, the heritage needs preserving in other ways. The UAE National Archives and Library has been collecting records about life in the region since 1968. Today, more than 5 million historical documents are stored at the National Archives, including 800 audio-visual recordings of Emirati storytellers and elders, preserving dialects, songs and folktales, as well as photographs, manuscripts and written histories.

Now, the challenge is to digitize everything for greater longevity. Digitization offers more than the safe storage of cultural content, however; it also offers wider availability. An ICT storage system needs to be more than a repository. It requires integrated search functions with well-organized metadata-tagging systems, interoperability with other IT systems to future-proof a collection, and easy access for archivists and curious laypeople alike.



ⓘ **ABOVE:** This Bedouin woman was photographed circa 1900-1920 in El Raha Plain, Egypt. **CREDIT:** US Library of Congress

Digitization is essential to manage heritage collections. The process can be as simple as photographing or scanning an extant document to be stored as a digital image, but it's the IT architecture that's the complicated part.

Additionally, meticulous planning is required for developing the metadata that will drive this architecture. If assets aren't tagged appropriately, the smartest search function in the world will struggle to return them.

Checking for bias in AI

Artificial intelligence can serve as a powerful tool in identifying and tagging digital-heritage assets, but it's important to consider how bias in AI systems can affect the data collected. Careful cultivation of "cultural intelligence" is vital to developing an AI to avoid bias in identifying images of certain demographic characteristics and ensure appropriate and sensible tags and captions are generated.

Athol Yates, associate professor of humanities and social sciences at Khalifa University, uses examples from World War Two archiving to explain: "During WWII, there were U.S. aircraft and a facility located in Sharjah, UAE, but this isn't a well-known fact. Confirmation bias was at play in the archive where I found a photo of an aircraft in Sharjah labeled as an aircraft in Egypt.

"Fortunately, this was found in the Australian War Memorial archive, which had a system to inform the archivist of the issue. There will be other examples of photos with an Arabic setting tagged as other areas of the Middle East, rather than Sharjah where it may actually have been."

Not to mention, all of this tagging and archiving needs to be scalable. Digital library systems need to be able to expand to accommodate additional assets. Beyond the sheer volume of items, the system should also be able to handle different types of content, the number of users accessing the system at a given time, and the different ways the content could be accessed. >>>

ⓘ **LEFT:** AI helped improve the quality of this image of a Bedouin man as well as all of the vintage photos used in this story.

The more complex they become, however, the more difficult to maintain, extend and reuse. The system needs to be flexible, not unwieldy. When asked how difficult it is to build an IT system that stores, archives and makes easily accessible and searchable hundreds of thousands of photos, Ibrahim Elfadel answers with just three words: “Use the cloud.”

Now professor of electrical engineering and computer science, Elfadel was a senior scientist at IBM before switching to academia. “The research on storing, archiving, indexing and searching digital media is quite old, but with the emergence of web services, early research work has become mainstream,” he says. “For instance, when we place our smartphone photos on the cloud, they get stored, indexed and retrieved according to methods based on that early research. AI is now playing a larger role in retrieving digital media based on complex user queries.”



“

Confirmation bias was at play in the archive where I found a photo of an aircraft in Sharjah labeled as an aircraft in Egypt. — Athol Yates

PHOTO: US Library of Congress

”

Region's libraries step up

Libraries across the region are rising to the challenge of digitizing their history. In 2021, Qatar Digital Library had a 2-million-page repository of culture, heritage and history. Each page highlights a historical report, letter, map, photograph or sound recording, with an explanation in both English and Arabic.

Art Jameel is a project preserving heritage and supporting creative enterprises rooted in local heritage in AlUla, Saudi Arabia. It trains photographers in advanced photogrammetry, a technique used to document objects in 3D, and is leading efforts to record and preserve the rich archaeological heritage of the region, especially

the rock art. Art Jameel has also operated abroad, using digital-documentation techniques to record evidence of Yazidi cultural heritage in Iraq.

Working in the Sinjar region, the Art Jameel team used aerial photography and photogrammetry to construct 3D models of sites destroyed by conflict.

In Oman, an online training program seeks to turn young Omanis into keen digital-heritage curators, providing students and recent graduates from all disciplines with the digital skills and tools needed to conserve their history. The National Library of Israel

received a donation of more than 50 years of documentation of the Bedouin community living in the Sinai Peninsula.

The donation is the work of Clinton Bailey, author and researcher of Middle Eastern and Islamic history, who spent his life recording and collecting materials from the last Bedouin generation to grow up in the pre-modern period to capture an orally transmitted ancient heritage.

He conducted research throughout the deserts of Sinai and the Negev, speaking with the Bedouin people to collect their knowledge, memories and history.

Collaboration with UAE

The archivists involved in curating the Clinton Bailey Archive of Bedouin Culture are now working with archivists in the UAE to transcribe more than 350 hours of interviews in the various Arabic dialects spoken by the Bedouin people.

Samuel Thrope, curator of the Islam and Middle East collection at the National Library of Israel, explained that while the storage and cataloguing of these recordings were the technical challenges, they were simple compared with the careful transcription of the

content: “We have all the recordings digitized and catalogued. They’re fully searchable with rich descriptions of the topics discussed and full names and tribal affiliations of the interviewees. “The next stage is transcribing them. Robust cataloging — that’s not new.

“That wasn’t the challenge. The challenge was how to make the transcriptions available and searchable — and accurate. All these dialects, they’re difficult to transcribe and translate.

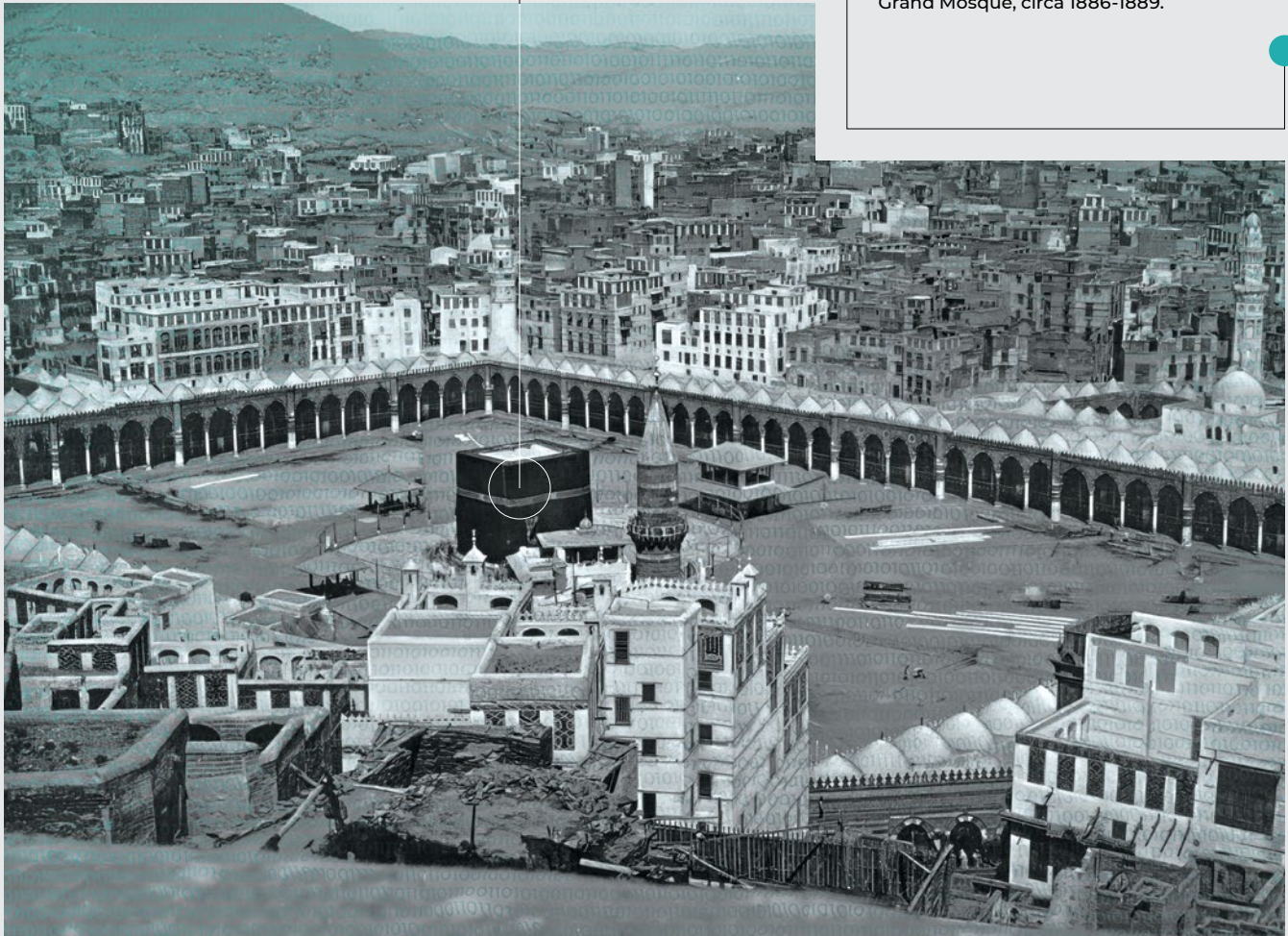
“Working with the professionals at the National Library and Archives in the UAE has been so helpful in

solving this. We can learn from their experiences, from the work they’ve done in archiving rare and precious recordings of the Arabic language.”

As for the other side of archiving — the accessibility and democratization of knowledge, as Thrope puts it — the library is forward-thinking: “All the vast collections we have are open and accessible to everyone everywhere.

“Maybe we don’t know why people want to access the information and it’s OK that we don’t know. We’re collecting not just for the present, but for the future. We know we have to preserve, protect, record.” ●

PHOTO: Al Sayyid Abd Al Ghaffar/Qatar Digital Library



● **BELOW:** The Kaaba and Sanctuary at Mecca were photographed from an elevated position due east of the Masjid al-Haram, or Grand Mosque, circa 1886-1889.



Preparing the Future-Ready Doctor

Experiential co-curricular programs in medical education add value

By: **Abiola Senok, Nerissa Naidoo and Farah Otaki**

Abiola Senok is chair of Basic Medical Sciences and professor of microbiology and infectious diseases, College of Medicine, Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU), Dubai, UAE.

Nerissa Naidoo is assistant professor of anatomy at MBRU College of Medicine.

Farah Otaki is senior specialist at MBRU Strategy and Institutional Excellence.

GRAPHICS: Freepik, Abjad Design

Experiential-learning opportunities can contribute toward molding a holistic 21st century physician.

Accordingly, Mohammed Bin Rashid University of Medicine and Health Sciences in Dubai, United Arab Emirates, has since 2016 operated a co-curricular program for Bachelor of Medicine, Bachelor of Surgery (MBBS) students called the MBRU-Summer Scholars Program (MBRU-SSP).

The key objective of this program is to provide students with a platform beyond the classroom setting that helps them acquire and integrate competences in research, clinical practice, community service, health systems and/or arts-and-culture.

Although the program is not integrated into curriculum, it is highly associated with and complementary to the curriculum, and hence referred to as co-curricular (as opposed to extracurricular).

The program's annual cycle entails three phases: preparation, implementation and evaluation.

Throughout the cycle, there is substantial engagement of all stakeholders.

This builds on the strengths and resources within the MBRU community and facilitates collaborative partnerships.

The voluntary program is unique as it is anchored in theories of experiential-learning.

It upholds the institutional goals and is characteristically diverse. Learners select from an extensive array of offerings.

This sets the MBRU-SSP apart from other experiential-learning opportunities that tend to focus on single domains.

To date, the MBRU-SSP has enabled student placements spanning »»

one to six weeks at collaborating centers across 12 countries.

A multi-phased study, conducted at the end of the Academic Year 2018- 2019, investigated the program's effectiveness.

The study's first aim was to innovatively evaluate the quality of the experiential education and the value it offers. Secondly, this study explored, from a holistic social-constructionism perspective, the added value of the MBRU-SSP.

The first phase of this study relied on a sequential explanatory mixed-methods design, which systematically analyzed quantitative and qualitative data from program organizers, participating students and onsite mentors.

The second phase involved carrying out focus-group sessions with randomly selected MBRU-SSP student participants. The collected data was then thematically analyzed. The results of the quantitative component of the first phase of the study revealed that program organizers perceived the MBRU-SSP to be effective.

Also, most participating students rated the overall quality of experience as excellent, and most onsite mentors rated students' attendance as excellent.

Through the qualitative analysis, we generated the novel "Global Citizenship" framework. This framework comprises nine themes, reflective of the fruits reaped from the program: unique encounters; enriching experiences; core knowledge, skills and competences; thinking skills; interpersonal skills; facilitation of transitions;

novel realizations; institutional connectivity; and impact on others.

The second phase of the study identified that the program yielded benefits at the individual-student and community-at-large levels. At the individual-student level, interlinked benefits were related to personal, academic and professional development.

- "It helps you figure out what you actually want and test if you really like what you think you like. During the semester, we are under a lot of pressure, there is no time to sit and reflect on matters and figure things out. During the placement, there is little to zero pressure, so you are kind of just enjoying learning and reflecting at your own pace." — A second-year learner, after her second placement.

- "It is so beneficial to reach the clinics with that much of knowledge and experience — it is so enriching." — A third-year learner, after her fifth placement.

Benefits identified at the community-at-large level were institutional advancement, contribution to host centers and giving back to the community.

- "Students from other universities are surprised by the worthwhile exposure that we get early on in our educational path. It provides exposure to diverse opportunities." — A third-year learner, after his third placement.

- "The MBRU-SSP provides an opportunity to give back to the community, to serve others." — A third-year learner, after his third placement.



It is so beneficial to reach the clinics with that much of knowledge and experience ... it is so enriching.

— A third-year learner, after her fifth placement



Designing co-curricular programs in line with holistic learning theories, which foster learning as participation in the social world, can nurture holistic, humane, millennial physicians.

It is important to systemically evaluate such co-curricular programs to effectively capture the value that they offer.

The MBRU-SSP global-citizenship framework represents a unique model that can guide the development of similar worthwhile co-curricular programs in higher education. ●

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Exploration of the solar system and beyond
is heating up among governments and
the private sector.

GIVE US SOME SPACE

In the **next issue of *KUST Review***, we look at the 2D materials that may make space exploration possible, explore why mushrooms might be the secret to protecting astronauts from cosmic radiation and share stunning photos from some of the Middle East's best astrophotographers.

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