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## The Biggest Whales Are Yet to Come

*A study of whale feeding habits found that food is the main limit to the size of ocean giants*

By [Riley Black](#)

There's never been an animal as large as the blue whale. While we can certainly quibble that some sauropod dinosaurs were longer, and that life in the water allows whales to get away with body masses that would cause collapse on land, if we're crunching the numbers there really isn't a contest. The blue whale can reach over 100 feet long and weigh about 100 tons, and there's never been a more massive animal on Earth.

But might whales evolve to be [larger still](#)?

Up until recently, it seemed that our current surfeit of suspension-feeding giants – not just the blue whale, but others like the fin and sei whales – was a recent development. The biggest modern whales seemed to be far larger than their prehistoric counterparts, hinting that baleen whales have been ballooning (despite the fact that the marks of modern human whaling still marks the world's oceans). But a paper published earlier this year documented a 1.5 million-year-old blue whale that stretched [about 85 feet in life](#), hinting that the cetacean size boom has deep roots. And, coming at the question from another direction, marine biologist Jeremy Goldbogen and colleagues have [outlined](#) what might keep whales from getting larger. Namely, how much food they can sift from the seas.

There are definite upsides to being big. It's often easier to travel long distances, for example, and big animals can subsist on large amounts of low-quality food instead of having to search out the most energy-efficient morsels. Not to mention that baleen whales have enormous, specialized mouths that allow them to sift huge quantities of food from the sea. While available food may be found only in patches, and may require long migrations to reach feeding

grounds, baleen whales are so huge because they can consume truly enormous quantities of food by focusing on dense patches of small organisms instead of trying to catch larger prey one by one.

What Goldbogen and colleagues found by calculating the foraging efficiency of whales – in short, how much return they got for their energetic investments seeking and capturing prey – is that the upper limits of cetacean size may rely on food availability. So far as biologists are aware, whales haven't hit any kind of biomechanical or physical upper boundary. It's not as if they're so big their nerves can't conduct messages or their bones simply can't support their frames. Instead, it seems that the main factor keeping big whales from becoming bigger is how much food there is to eat. If the seas suddenly boasted even more krill, copepods, and other baleen whale snacks, the biggest baleen whales might be able to achieve even bigger sizes. It comes down to physiological math, with organisms on the bottom of the food web setting the limits for those near the top.

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### Want to turn back time? Try running a marathon

*New marathon runners reduced blood pressure, arterial stiffness equivalent to a 4-year reduction in vascular age*

The new year means it's time to set resolutions for 2020 and [new research from the Journal of the American College of Cardiology](#) suggests running a marathon for the first time could have several health benefits. The study found that for first-time marathon runners, training and completion of the marathon was associated with reductions in blood pressure and aortic stiffening in healthy participants that were equivalent to a four-year reduction in vascular age, with the greatest benefits seen in older, slower male marathon runners with higher baseline blood pressure.

"As clinicians are meeting with patients in the new year, making a goal-oriented exercise training recommendation--such as signing up

for a marathon or fun-run--may be a good motivator for our patients to keep active," said senior author Charlotte H. Manisty, MD, of the Institute of Cardiovascular Science at University College London and Barts Heart Centre in London. "Our study highlights the importance of lifestyle modifications to slow the risks associated with aging, especially as it appears to never be too late as evidenced by our older, slower runners."

Arterial stiffening is a normal part of aging, but it also increases cardiovascular risk in otherwise healthy individuals by contributing to increased pulse pressure and ventricular overload, which are associated with dementia and cardiovascular and kidney diseases, even in the absence of plaque in the arteries. While blood pressure medication can modify arterial stiffness in established heart disease, more cardiovascular events occur in individuals without diagnosed high blood pressure.

Regular aerobic exercise is a lifestyle modification that has real-world implications, particularly with the growth in mass participation running as an increasingly popular form of non-prescribed exercise. The researchers used a cohort of 138 healthy, first-time marathon runners from the 2016 and 2017 London Marathon. They examined the participants before training and after marathon completion to determine if age-related aortic stiffening would be reversible with real-world exercise training.

Participants had no significant past medical or cardiac history and were not running for more than two hours per week at baseline. On average, participants were 37 years old and 49% were male. Exclusion criteria included pre-existing heart disease during the preliminary investigations or contraindication on a cardiovascular magnetic resonance imaging scan.

The researchers conducted all measurements before training started six months prior to the marathon and repeated them all within three weeks of completing the London Marathon, but no earlier than one

week after the marathon to avoid any acute effects of exercise. Assessments included blood pressure measurements and measurements of aortic stiffness by cardiovascular magnetic resonance imaging. Biological aortic age was determined from the relationship between the participant's age and aortic stiffness at three levels of the aorta.

All participants were recommended to follow the "Beginner's Training Plan" provided by the marathon, which consists of approximately three runs per week that increase in difficulty for a 17-week period prior to the marathon. However, the researchers did not discourage participants who wished to use alternative training plans. The average marathon running time was 5.4 hours for women and 4.5 hours for men. When compared to training data and marathon completion times from 27,000 runners, these times were found to be consistent with a training schedule of six to 13 miles per week.

Training decreased systolic and diastolic blood pressure by 4 and 3 mmHg, respectively. Overall, aortic stiffness reduced with training and was most pronounced in the distal aorta with increases in distensibility--the capacity to swell with pressure--of 9%. This amounted to the equivalent of an almost four-year reduction in 'aortic age.' Older patients had greater changes with exercise training, with males and those running slower marathon times deriving greatest benefit.

"Our study shows it is possible to reverse the consequences of aging on our blood vessels with real-world exercise in just six months. These benefits were observed in overall healthy individuals across a broad age range and their marathon times are suggestive of achievable exercise training in novice participants," Manisty said.

Although the study only recruited healthy participants, those with hypertension and stiffer arteries might be expected to have an even greater cardiovascular response to exercise training.

In an accompanying editorial, Julio A. Chirinos, MD, PhD, from the Division of Cardiovascular Medicine at the Hospital of the University of Pennsylvania, said "Despite some limitations, including its observational nature, the study adds to the body of evidence supporting beneficial effects of exercise on multiple aging phenotypes. Given the profound implications of arterial stiffness for human health, this study is important and should stimulate further research to identify potential molecular mechanisms by which exercise reduces aortic stiffness. In addition, training for marathons usually involves various concomitant approaches such as better sleep and dietary patterns, and in some instances, over-the-counter supplements, that may confound or interact with exercise training per se. More research to identify optimal integrated training regimens is needed."

<http://bit.ly/36F2N8U>

### **Half of women with heart failure get the wrong treatment**

*As many as 50 per cent of women suffering from cardiac arrest are given insufficient treatment, because the heart failure was not caused by a heart attack*

More women than men die of heart failure. The reason is that only 50 per cent of the heart failure cases among women are caused by having a heart attack, which can be treated with modern methods.

For the other 50 per cent of women experiencing heart failure the cause is generally related to having untreated high blood pressure levels over time, which leads to progressive stiffening of the heart. There is no effective treatment for this kind of heart failure yet.

"Men and women have different biologies and this results in different types of the same heart diseases. It is about time to recognise these differences," says Professor Eva Gerdt, Department of Clinical Science, University of Bergen.

"Another important point concerning how to avoid heart disease is to ask about what the national health service is doing on this issue. Heart disease remains among the most common cause of death and reduced quality of life in women. Medically speaking, we still do not know what the best treatment for heart- attack or -failure is in many women. It is an unacceptable situation," Gerdt claims.

Gerdt has recently [published an invited review paper in Nature](#) together with Professor Vera Regitz-Zagrosek ved Charité Universitätsmedizin.

The researchers have compared common risk factors for heart disease and how these affect men and women differently. They have, among other things, focused on the sex differences in the effect of obesity, high blood pressure and diabetes.

### **Women gain more weight**

According to The World Health Organization (WHO) 11 per cent women and 15 per cent men are obese (BMI over 30 kg/ m<sup>2</sup>) globally. In Norway one in five adults are obese.

"If we see this from a life span perspective, we can see that obesity increases with age, and that this trend is greater for women than men. Obesity increases the risk of having high blood pressure by a factor of three. This, in turn, increases the risk of heart disease," Gerdt points out.

According to Gerdt, obesity also increases the risk of diabetes 2. A woman with diabetes has a much higher relative risk of heart complications and death than a man.

"We know that women with diabetes 2 are usually obese and some of this fat is stored in the heart, which makes it more vulnerable for disease."

### **Oestrogen influence heart risk**

Gerdt explains that many of the differences between woman and men when it comes to heart disease are connected to the sex hormone, oestrogen. The hormone prevents the formation of

connective tissue in the heart, which makes it harder for the heart to pump. In men the effects are the opposite.

"We see that obese men store oestrogen in their fat cells in the abdomen, which has a bad effect on the heart."

After menopause, women lose the oestrogen advantage. Their arteries becomes stiffer and more vulnerable for disease. We see this in the fact that for persons under 60, high blood pressure is most common amongst men. For persons over 60, it is the opposite.

"We think that this is part of the explanation for why high blood pressure seems to indicate higher risk of heart disease amongst women."

### **Women smoke more**

In addition, smoking is also a part of the risk scenario for women. During the past decades, more women have started smoking than men. "Many women start smoking to reduce their appetite and to control their weight. However, this is not a good choice from a health perspective."

"For women, the effects of risk factors such as smoking, obesity and high blood pressure increase after menopause," says Eva Gerdts.

<http://bit.ly/2Nfwi9A>

### **JUUL delivers substantially more nicotine than previous generation e-cigs and cigarettes**

#### ***JUUL also impairs blood vessel function similar to cigarette smoke, UCSF researchers find***

JUUL delivers substantially more nicotine to the blood per puff than cigarettes or previous-generation e-cigarettes (e-cigs) and impairs blood vessel function comparable to cigarette smoke, according to a new study by researchers at UC San Francisco.

The study, which appears online Jan.

4, 2020, in [Tobacco Regulatory Science](#), found that nicotine concentrations were five to eight times higher in rodents that were exposed to JUUL versus other tobacco products.

The work also supports an earlier finding by the same researchers of harm to blood vessels from brief exposures to both direct and secondhand smoke from cigarettes, little cigars and combustible marijuana, and to aerosol from IQOS "heat-not-burn" tobacco products.

JUUL and earlier generation e-cigs are promoted as being less hazardous than cigarettes.

Since 2016, there has been a dramatic increase in youth e-cig use, with JUUL devices particularly effective at recruiting teenagers to begin nicotine usage.

A recent study found 27.5 percent of high school students and 10.5 percent of eighth graders currently use e-cigs, with more than half of both groups using JUUL as their preferred choice.

A caveat of this study is that it measured the impact of equal numbers of puffs of all products, whereas adult former cigarette smokers may stop their vaping session when they reach the level of nicotine they normally ingest, said senior author Matthew Springer, PhD, professor of cardiology at UCSF and member of the [UCSF Center for Tobacco Research and Education](#).

"However, adolescent non-smokers who are not familiar with the effects of nicotine may be more likely to chase higher levels of the drug's effects," Springer said.

"The ease of over-consuming nicotine with JUUL makes this likely, especially in light of reports of teenagers binging on JUUL to the point of rapid addiction and behavioral consequences."

As with earlier-generation e-cigs, the liquid in JUUL pods is composed of vegetable glycerin and propylene glycol, along with flavors and nicotine.

But while the freebase nicotine used in earlier generations limits the amount comfortably inhaled, JUUL has introduced acidified nicotine salts, which are easier to inhale and deliver nicotine at substantially higher concentrations.

In the *Tobacco Regulatory Science* study, eight rats were exposed to 10 cycles of two-second inhalation over a five-minute period, with one of four different substances: JUUL, an e-cigarette with freebase nicotine e-liquid, cigarettes or clean air.

The researchers collected blood samples 20 minutes after exposure and measured blood vessel impact through a process known as flow mediated dilation.

This approach, which is a validated measurement of human cardiovascular health, has been shown in rodents to yield pharmacological and biophysical effects similar to humans, Springer said.

The research found that blood nicotine concentrations in the JUUL group (136.4 ng/ml) were eight times higher than e-cigs group (17.1 ng/ml) and 5.2 times higher than cigarettes (26.1 ng/ml).

However, while Springer and his colleagues found that aerosol or smoke from JUUL caused greater blood vessel impairment than either of the other nicotine sources, the differences in the extent of impairment between the sources themselves was deemed statistically insignificant.

"The comparison of cardiovascular health effects of JUUL use with those of previous generation e-cigs and of combusted cigarettes is an important issue for policymakers, including the FDA and comparable bodies outside the United States," Springer said.

"Our findings show that the adverse effect of cigarettes on vascular endothelial function, which has been a known consequence of cigarette smoking since the 1990s, is not prevented by using JUUL."

*Other study contributors were lead author Poonam Rao and Jiangtao Liu, of UCSF. Financial support was provided by National Institutes of Health National Heart, Lung, and Blood Institute grants R01HL120062 and U54HL147127, U.S. Food and Drug Administration Center for Tobacco Products, and a donation from the Elfenworks Foundation in memory of Deb O'Keefe. The authors report no conflicts of interest.*

<http://bit.ly/2R1Sq1a>

## Vaping lung injury symptoms have been reported online for at least seven years

### *UC Riverside research used internet data mining to monitor health effects reported by electronic cigarette users over time*

RIVERSIDE, Calif. -- A team of researchers at the University of California, Riverside, used automated computer methods to mine a large online discussion forum for electronic cigarette users and found this group reported numerous adverse health effects for at least seven years.

The [research](#), published in the *Journal of Medical Internet Research*, shows health problems associated with e-cigarettes existed well before summer 2019 when vaping-associated pulmonary illness, or VAPI, was recognized by the medical community. This development suggests many more e-cigarette users may have serious symptoms.

Recently, the [Centers for Disease Control and Prevention, or CDC, linked VAPI to vitamin E](#). A number of VAPI cases are not, however, linked to the vitamin. VAPI is also referred to as [EVALI](#), or e-cigarette or vaping product use-associated lung injury.

"The sudden uptick in symptoms and conditions related to VAPI comes at least 10 years after e-cigarette products gained widespread popularity in the United States, including the rise in popularity of JUUL and marijuana vape products," said [Prue Talbot](#), a professor of cell biology in the [Department of Molecular, Cell, and Systems Biology](#), who led the research. "Our data, which shows many of the symptoms characterizing the current patients have been reported online for at least seven years, suggests cases similar to those in the current VAPI epidemic have existed previously and been unreported or simply not linked to vaping."

The researchers collected data posted between January 2008 and July 2015 on a large e-cigarette online discussion forum. They



designed a web crawler in Java to extract and parse information on symptoms and disorders from the forum. The crawler, programmed to focus on only those posts that belonged to seven health subforums, browsed through more than 41,000 posts, of which 45% were negative in sentiment, 38% were neutral, and 17% were positive.

The top five symptoms in the database were headache, coughing, pain in throat, itching, and malaise. The top five disorders in the dataset were dehydration, asthma, pharyngitis, common cold, and [aptyalism](#).

E-cigarette research has shown some flavor chemicals can dilate blood vessels and cause headache, nausea, and fatigue. Prolonged inhalation of some flavor chemicals can cause headaches, dizziness, and/or respiratory symptoms. Metals identified in e-cigarette aerosols have been linked to neurological and respiratory symptoms. Nicotine, a major component in most e-cigarette fluids, can affect neurological, respiratory, digestive, mouth/throat, and circulatory systems. Nicotine inhalation can cause headaches, nausea, mouth/throat pain, cough, and heartburn.

"Our data underscore the idea that e-cigarette use is not free of adverse health effects and suggest that the epidemic we are seeing now will continue to grow given the many reports in the forum of symptoms characteristic of VAPI," said [My Hua](#), a graduate student in [Talbot's lab](#) and first author of the research paper. "It is important that vigilant reporting of cases, tracking symptoms, and engaging in research on the health effects related to e-cigarette use be continued and expanded to understand and contain VAPI."

The study is the first to use automated methods to analyze online posts uploaded over a seven-year period on an e-cigarette website and to identify the symptoms and disorders most frequently reported online by e-cigarette users.

"We used a modified version of the MetaMap medical information extraction tool, which has been shown to have high accuracy in extracting medical concepts like symptoms or disorders," said [Vagelis Hristidis](#), a professor of [computer science and engineering](#) and a co-author of the study. "It is possible that some posts mention a disorder in the wrong context, for example, making a joke about it, but from our manual screening of thousands of posts, this number of posts would be very small to meaningfully affect the results."

Hristidis, an expert on data mining, explained the crawler mines data from each discussion thread in the e-cigarette forum and stores its content locally. A parsing tool then extracts the individual posts from the thread. Finally, a medical information extraction tool analyzes each post's text and identifies mentions of symptoms or disorders.

As of December 27, 2019, more than 2,500 hospitalized EVALI cases or deaths have been [reported to the CDC](#) from 50 states, the District of Columbia, and two U.S. territories; 27 states and the District of Columbia have confirmed 55 deaths associated with vaping. "The symptoms and disorders we report in our study may be of interest to physicians and health care providers treating patients who use e-cigarettes," Talbot said.

Talbot and Hua are working with a health clinic at UC Riverside to include vaping-related questions in medical history questionnaires filled out by patients. They have also provided an e-cigarette fact sheet to the UCR clinic for distribution to patients; the plan is to provide the fact sheet to all clinics in the UC system.

*Talbot, Hua, and Hristidis were joined in the [study](#) by graduate student [Shouq Sadah](#), who works with Hristidis. The [research](#) was supported by grants to Talbot from the National Institute of Drug Addiction, National Institute of Environmental Health Sciences, and the U.S. Food and Drug Administration Center for Tobacco Products. Hristidis was supported by the National Science Foundation. Hua was supported in part by a Cornelius Hopper Fellowship and a predoctoral dissertation fellowship from the University of California Tobacco-Related Disease Research Program. The funding agencies played no role in designing the study or advising on how the data was collected and analyzed.*

<https://nyti.ms/2Rh5fw7>

## A.I. Comes to the Operating Room

*Images made by lasers and read by computers can help speed up the diagnosis of brain tumors during surgery.*

By [Denise Grady](#)

Brain surgeons are bringing artificial intelligence and new imaging techniques into the operating room, to diagnose tumors as accurately as pathologists, and much faster, according to a [report in the journal Nature Medicine](#).

The new approach streamlines the standard practice of analyzing tissue samples while the patient is still on the operating table, to help guide brain surgery and later treatment.



***Using laser imaging and artificial intelligence, researchers were able to diagnose brain tumors in under 150 seconds. The dark ovals are tumor cells, among nerve fibers that appear as white streaks, indicating a malignant tumor called a diffuse glioma. Credit...Michigan Medicine***

The traditional method, which requires sending the tissue to a lab, freezing and staining it, then peering at it through a microscope, takes 20 to 30 minutes or longer. The new technique takes two and a half minutes. Like the old method, it requires that tissue be removed from the brain, but uses lasers to create images and a computer to read them in the operating room.

“Although we often have clues based on preoperative M.R.I., establishing diagnosis is a primary goal of almost all brain tumor operations, whether we’re removing a tumor or just taking a biopsy,” said Dr. Daniel A. Orringer, a neurosurgeon at N.Y.U. Langone Health and the senior author of the report.

In addition to speeding up the process, the new technique can also detect some details that traditional methods may miss, like the spread of a tumor along nerve fibers, he said. And unlike the usual method, the new one does not destroy the sample, so the tissue can be used again for further testing.

The new process may also help in other procedures where doctors need to analyze tissue while they are still operating, such as head and neck, breast, skin and gynecologic surgery, the report said. It also noted that there is a shortage of neuropathologists, and suggested that the new technology might help fill the gap in medical centers that lack the specialty.

Algorithms are also being developed to help [detect lung cancers on CT scans](#), diagnose eye disease in people with diabetes and find cancer on microscope slides. The new report brings artificial intelligence — so-called deep neural networks — a step closer to patients and their treatment.

The study involved brain tissue from 278 patients, analyzed while the surgery was still going on. Each sample was split, with half going to A.I. and half to a neuropathologist. The diagnoses were later judged right or wrong based on whether they agreed with the findings of lengthier and more extensive tests performed after the surgery. The result was a draw: humans, 93.9 percent correct; A.I., 94.6 percent.

The study was paid for by the National Cancer Institute, the University of Michigan and private foundations. Dr. Orringer owns stock in the company that made the imaging system, as do several co-authors, who are company employees. He conducted the research at the University of Michigan, before moving to New York. “Having an accurate intra-operative diagnosis is going to be very useful,” said Dr. Joshua Bederson, the chairman of neurosurgery for the Mount Sinai Health System, who was not involved in the study. He added, “I think they understated the significance of this.”

He said the traditional method of examining tissue during brain surgery, called a frozen section, often took much longer than 30 minutes, and was often far less accurate than it was in the study. At some centers, he said, brain surgeons do not even order frozen sections because they do not trust them and prefer to wait for tissue processing after the surgery, which may take weeks to complete.

“The neuropathologists I work with are outstanding,” Dr. Bederson said. “They hate frozen sections. They don’t want us to make life-altering decisions based on something that’s not so reliable.”

Dr. Bederson said that the study authors had set a very high bar for their new technique by pitting it against experts at three medical centers renowned for excellence in neurosurgery and neuropathology: Columbia University in New York, the University of Miami and the University of Michigan, Ann Arbor.

“I think that what happened with this study is that because they wanted to do a good comparison, they had the best of the best of the traditional method, which I think far exceeds what’s available in most cases,” Dr. Bederson said.

The key to the study was the use of lasers to scan tissue samples with certain wavelengths of light, a technique called stimulated Raman histology. Different types of tissue scatter the light in distinctive ways. The light hits a detector, which emits a signal that a computer can process to reconstruct the image and identify the tissue. The system also generates virtual images similar to traditional slides that humans can examine.

The researchers used images from tissue from 415 brain surgery patients to train an artificial intelligence system to identify the 10 most common types of brain tumor.

Some types of brain tumor are so rare that there is not enough data on them to train an A.I. system, so the system in the study was designed to essentially toss out samples it could not identify.

Over all, the system did make mistakes: It misdiagnosed 14 cases that the humans got right. And the doctors missed 17 cases that the computer got right.

“I couldn’t have hoped for a better result,” Dr. Orringer said. “It’s exciting. It says the combination of an algorithm plus human intuition improves our ability to predict diagnosis.”

In his own practice, Dr. Orringer said that he often used the system to determine quickly whether he had removed as much of a brain tumor as possible, or should keep cutting.

“If I have six questions during an operation, I can get them answered without having six times 30 or 40 minutes,” he said. “I didn’t do this before. It’s a lot of burden to the patient to be under anesthesia for that long.”

Dr. Bederson said that he had participated in a pilot study of a system similar to the one in the study and wanted to use it, and that his hospital was considering acquiring the technology.

“It won’t change brain surgery,” he said, “but it’s going to add a significant new tool, more significant than they’ve stated.”

<http://bit.ly/39YUnLC>

## **Data suggest water is common but scarce in exoplanets** *Astronomers study chemical patterns in extra-terrestrial worlds.*

**By Richard A Lovett**

Exoplanet atmospheres appear to be unexpectedly low in water vapour scientists say, suggesting these planets may not have formed in the same manner as worlds in our own Solar System.

The discovery came from the first-ever tabulation of exoplanet atmospheres — a type of research that has only now become possible, says Nikku Madhusudhan, an astrophysicist at the University of Cambridge, UK.

It was only five years ago, he says, that his team was able to obtain good enough spectroscopic data from the Hubble Space Telescope to be able make the first detection of water in an exoplanet



atmosphere. Now, he says, 19 exoplanets have been found to show signs of water in their atmospheres, with 14 having sufficiently good data to reveal the amount.

That's enough, he says, to show a clear trend: by Solar System standards, exoplanets simply do not have enough water. "It's not a one-off effect. All are depleted compared to what we see in the Solar System."

Not that any of these planets is earthlike. So far, only giant planets like Jupiter, Saturn, Uranus and Neptune can be studied well enough across interstellar distances for astronomers to find signatures of water vapour in their atmospheres.

But the low levels of water in those that have been measured holds for a wide range of planets, Madhusudhan says, from "mini-Neptunes" 10 times the size of the Earth, to "super-Jupiters" more than 600 times more massive than our home world.

Not that the finding is entirely about water, important as it is on our own planet. Water is important as a detectable carrier of oxygen — the third most abundant element in the Universe. And it is the oxygen that is important from an astrophysical point of view.

In the Solar System, oxygen (in the form of water) appears to be substantially more plentiful in the atmospheres of the giant planets than in the Sun. But it's not similarly plentiful in exoplanets, even when compared to the oxygen content of their own stars.

"The water abundances are significantly lower," Madhusudhan says. What this means, he adds, is "that the picture we have of planets forming with a substantial accretion of water ice and dust is incomplete. These planets are finding a way to form without accreting 'enough' water ice."

One possibility, he says, is that the planets in his study formed far out from their stars, where water ice — and oxygen — were scarce, then migrated inward. Or, it's possible that estimates of the amount of water vapour in our own giant planets are overstated.

One of the ironies of the field, Madhusudhan says, is that it's currently easier to measure water vapour in exoplanet atmospheres than in our own giant planets.

"Ours are too cold," he says. (The planets in his study all lie close enough to their stars to have temperatures at least as warm as the Earth, and in some cases, substantially hotter.)

One of the main goals of NASA's Jupiter-orbiting Juno mission, Madhusudhan adds, has been to measure Jupiter's water content but, so far, that's not succeeded. Meanwhile, he says, the focus is on continuing to study exoplanet atmospheres. "We look forward to increasing the size of our sample." The [research](#) was reported in *Astrophysical Journal Letters*.

<http://bit.ly/39Wazxl>

**Ditching coal in the US is saving lives, helping crops  
Near shuttered plants, deaths drop and crop productivity rises.**

[John Timmer](#)

A lot of the discussions about switching sources of electricity focus on costs, specifically whether going renewable will cost more than fossil fuels. But the costs of fossil fuels go well beyond simply the costs of supplying the fuel. Fossil fuels create costs by harming human health and the environment—these costs aren't priced into electricity produced. Instead, they wind up being paid by society at large—and that's before pricing in the inevitable costs of climate change.

In fact, in the United States, the rationale for Obama-era climate rules included the idea that the regulations would save money by avoiding these costs. That claim was controversial, however, and the Trump administration's rollback of these rules also claimed to provide economic benefits.

What's been lacking is a clear measure of the impact of pollution from fossil fuels. In an attempt to rectify that, Jennifer Burney of the University of California, San Diego, took advantage of a natural

experiment that the US has been undertaking: shuttering older coal plants and replacing them with natural gas, which produce far less pollution. Using data from a decade of vanishing coal plants, Burney found that tens of thousands of deaths had been avoided by replacing coal plants. As an added bonus, the productivity of nearby farms increased as well.

### **Tracking the unmeasurable**

Burning fossil fuels produces a huge variety of pollutants. There's carbon dioxide, which alters the climate, and sulfates that form aerosols and lead to acid rain. Ozone can form from some of the other pollutants released, and particulate matter causes additional health risks. Finally, coal contains mercury and other metals that can have a variety of toxic effects. For some of these, we have good estimates of the health effects, and generating facilities are required to track their release of pollutants. But other pollutants aren't tracked at all, leaving gaps that make it difficult to estimate the contributions of individual power plants.

So rather than figuring out what's being produced while a plant operates, Burney decided to track what changes when a plant shuts down. The plants' locations are well documented and could be correlated with data on human health and agricultural productivity that are broken down by county, which provides a sense of the local impacts. Satellite data could also track the presence of materials like aerosols and ozone in the regions affected by plant closures.

Working with data from the decade 2005-2016, Burney identified when plants (almost entirely coal) shut down and when new ones (both coal and natural gas) came online. She then tracked changes to the measures of human and agricultural well-being from the surrounding area. While there are undoubtedly other factors that influenced these measures in each area, these should largely average out over the hundreds of plants that changed status over this period. It's also not clear how widespread to expect the effects

to be relative to the location of the plant. Burney did both a conservative measure, checking for impacts within 25km of the power plant, and a more expansive one that examined a 200km radius.

One of the interesting things she found was that the opening of new plants wasn't correlated with any statistically significant changes. She suggests that this is likely the result of the fact that the newer plants adopt the latest pollution-control technology and therefore have a lower impact on the surrounding communities. This might indicate that, in the decades to come, we'll see diminishing returns as coal plants close.

### **Big losses**

But for the plants that closed in the decade she examined, the results were dramatic. The decommissioning of coal plants was associated with drops in ozone and aerosols formed by sulfur dioxide and nitrogen dioxide. For the latter two chemicals, the decrease faded as a simple matter of distance from the closed plant. (Ozone dynamics were a bit more complicated.)

Burney found that "these lower aerosol and ozone concentrations conferred near-immediate benefits to health and crop productivity." All-cause mortality in the counties closest to the closed plant dropped by a percent, with the elderly being the largest beneficiaries. All told, the data suggests that about 27,000 premature deaths were avoided between 2005 and 2016. The confidence intervals are wide, ranging from 2,700 to 50,000, but the numbers go up if a wider radius around the plant is used. The effects on crops were even more dramatic. Nearby corn and soybean yields went up by over five percent; wheat yields rose by four percent.

Translating those numbers to apply to the remaining coal plants, Burney found that even for the conservative 25km estimate, they caused about 330,000 premature deaths and a loss of 10 billion

bushels of crops over the decade she studied. For reference, she notes that the crop loss is roughly equivalent to a half-year's production; it's also equivalent to five percent of the total US harvests over that decade.

The news isn't all good when it comes to climate, though. The aerosols produced by these plants reflect sunlight and have a net cooling effect that outweighs the often black particulate matter they also produce. But as they close, the reflective aerosols they produce rapidly decline, leading to a shift from a net cooling to a net warming, at least locally. Collectively, the closure of hundreds of plants could lead to a localized warming.

As noted above, the results of plants closing may change as the poor economics of coal will eventually start hitting some of the newer plants that have more effective pollution controls. Which implies that the payoffs from closing plants will gradually decline. But Burney also notes that her analysis doesn't include things like lost productivity and medical costs; it simply looks at mortality. If those costs are considered, then the payoffs from switching away from coal may remain considerable.

*Nature Sustainability*, 2020. DOI: [10.1038/s41893-019-0453-5](https://doi.org/10.1038/s41893-019-0453-5) ([About DOIs](#)).

<http://bit.ly/2FDhq9v>

## **Single dose of antibodies can knock out HIV in newborns**

***Study: Combination of 2 antibodies taken 30 hours after virus exposure prevents infection in baby monkeys***

A single dose of an antibody-based treatment can prevent HIV transmission from mother to baby, new nonhuman primate research suggests for the first time. The findings are being published in the journal *Nature Communications*.

When that single dose is given is key, however. The study found rhesus macaque newborns did not develop the monkey form of HIV,

called SHIV, when they received a combination of two antibodies 30 hours after being exposed to the virus.

Delaying treatment until 48 hours, on the other hand, resulted in half of the baby macaques developing SHIV when they were given four smaller doses of the same antibody cocktail. In comparison, the study found macaques that received the current standard HIV treatment - antiretroviral drugs - remained SHIV-free when they started a three-week regimen of that therapy 48 hours after exposure.

"These promising findings could mean babies born to HIV-positive mothers can still beat HIV with less treatment," said the study's corresponding's author, Nancy Haigwood, Ph.D., a professor of pathobiology and immunology in the Oregon Health & Science University School of Medicine, as well as the director at the Oregon National Primate Research Center at OHSU.

This is the first time a single dose of broadly neutralizing antibodies given after viral exposure has been found to prevent SHIV infection in nonhuman primate newborns. Previous research by Haigwood, Ann Hessel, Ph.D., and others showed four doses of antibodies started 24 hours after exposure prevented SHIV infection, with all 10 of the baby primates in that study not having any SHIV virus for six months. Both studies used a combination of two antibodies called PGT121 and VRC07-523.

The new study also suggests a much shorter course of antiretroviral therapy given after virus exposure could prevent HIV transmission to newborns. Human babies born from HIV-positive mothers typically take the drug cocktail - a personalized regimen of multiple drugs taken daily - for about six weeks before being re-tested. If the tests are then positive, they likely need to take HIV drugs for the rest of their lives. But this study showed nonhuman primate newborns didn't have SHIV after undergoing antiretroviral therapy for just three weeks starting 48 hours after exposure.

HIV-positive women typically take antiretroviral therapy drugs during pregnancy for their own health, as well as to prevent passing the virus onto their developing child. But mother-to-baby transmission sometimes still happens. Children born to HIV-positive mothers also are given antiretroviral therapy to further prevent infection. However, this drug cocktail can have many negative side effects, involves making special liquid formulations for newborns, and researchers worry about antiretroviral therapy's long-term consequences for development.

Antibodies, however, aren't toxic and can be modified to last a long time in the body, which reduces treatment frequency. This has led researchers to explore their potential to replace or supplement antiretroviral therapy for newborns with HIV-positive mothers as well as for HIV-positive adults.

Next, Haigwood and colleagues plan to see if different antibodies, or a combination of antibodies and antiretroviral therapy, could be even more effective. They also want to determine if the antibodies they evaluate actually eliminate HIV, or only prevent it from replicating.

The research team has regularly shared their primate research findings with the scientific community, including those involved in the International Maternal Pediatric Adolescent AIDS Clinical Trials Network, which is currently leading two trials evaluating a single antibody to treat HIV-exposed newborns.

*This research was supported by the National Institutes of Health (grants R01 HD080459, U42 OD023038, U42 OD010426, P51 OD011092, T32 AI007472) and the intramural research program at the NIH's Vaccine Research Center.*

*REFERENCE: Mariya B. Shapiro, Tracy Cheever, Delphine C. Malherbe, Shilpi Pandey, Jason Reed, Eun Sung Yang, Keyun Wang, Amarendra Pegu, Xuejun Chen, Don Siess, David Burke, Heidi Henderson, Rebecca Lewinsohn, Miranda Fischer, Jeffrey J. Stanton, Michael K. Axthelm, Christoph Kahl, Byung Park, Anne D. Lewis, Jonah B. Sacha, John R. Mascola, Ann J. Hessell, Nancy L. Haigwood, Single-dose bNAb cocktail or abbreviated ART post-exposure regimens achieve tight SHIV control without adaptive immunity, Nature Communications, Jan. 7, 2019, DOI: 10.1038/s41467-019-13972-y, <https://www.nature.com/articles/s41467-019-13972-y>.*

<http://bit.ly/2QDVwRq>

## **Famous black hole has jet pushing cosmic speed limit**

### *Sections of the jet are moving at nearly the speed of light*

by [Chandra X-ray Center](#)

The Event Horizon Telescope Collaboration released the first image of a black hole with observations of the massive, dark object at the center of Messier 87, or M87, last April. This black hole has a mass of about 6.5 billion times that of the sun and is located about 55 million light years from Earth. The black hole has been called M87\* by astronomers and has recently been given the Hawaiian name of "Powehi."

For years, astronomers have observed radiation from a jet of high energy particles—powered by the black hole—blasting out of the center of M87. They have studied the jet in radio, optical, and X-ray [light](#), including with Chandra. And now by using Chandra observations, researchers have seen that sections of the jet are moving at nearly the speed of light.

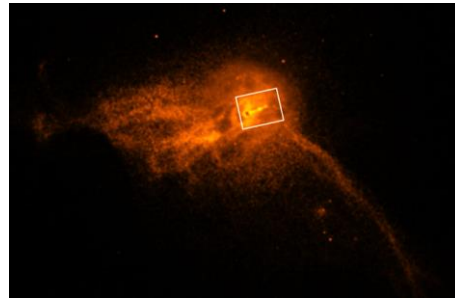
"This is the first time such extreme speeds by a black hole's jet have been recorded using X-ray data," said Ralph Kraft of the Center of Astrophysics | Harvard & Smithsonian (CfA) in Cambridge, Mass., who presented the study at the American Astronomical Society meeting in Honolulu, Hawaii. "We needed the sharp X-ray vision of Chandra to make these measurements."

When matter gets close enough to a black hole, it enters into a swirling pattern called an accretion disk. Some material from the inner part of the accretion disk falls onto the black hole and some of it is redirected away from the black hole in the form of narrow beams, or jets, of material along magnetic field lines. Because this infall process is irregular, the jets are made of clumps or knots that can sometimes be identified with Chandra and other telescopes.

The researchers used Chandra observations from 2012 and 2017 to track the motion of two X-ray knots located within the jet about 900

and 2,500 [light years](#) away from the black hole. The X-ray data show motion with apparent speeds of 6.3 times the speed of light for the X-ray knot closer to the black hole and 2.4 times the speed of light for the other.

"One of the unbreakable laws of physics is that nothing can move faster than the speed of light," said co-author Brad Snios, also of the CfA. "We haven't broken physics, but we have found an example of an amazing phenomenon called superluminal motion."



*Chandra Wide-field View of M87; box shows the approximate location of the wide-field jet image above. Credit: NASA/CXC*

Superluminal motion occurs when objects are traveling close to the speed of light along a direction that is close to our line of sight. The jet travels almost as quickly towards us as the light it generates, giving the illusion that the jet's motion is much more rapid than the speed of light. In the case of M87\*, the jet is pointing close to our direction, resulting in these exotic apparent speeds.

Astronomers have previously seen such motion in M87\*'s jet at radio and optical wavelengths, but they have not been able to definitively show that matter in the jet is moving at very close to the speed of light. For example, the moving features could be a wave or a shock, similar to a sonic boom from a supersonic plane, rather than tracing the motions of matter.

This latest result shows the ability of X-rays to act as an accurate cosmic speed gun. The team observed that the feature moving with an apparent speed of 6.3 times the [speed of light](#) also faded by over 70% between 2012 and 2017. This fading was likely caused by particles' loss of energy due to the radiation produced as they spiral around a magnetic field. For this to occur the team must be seeing

X-rays from the same particles at both times, and not a moving wave. "Our work gives the strongest evidence yet that particles in M87\*'s jet are actually traveling at close to the cosmic [speed limit](#)", said Snios.

The Chandra data are an excellent complement to the EHT data. The size of the ring around the black hole seen with the Event Horizon Telescope is about a hundred million times smaller than the size of the jet seen with Chandra.

Another difference is that the EHT observed M87 over six days in April 2017, giving a recent snapshot of the black hole. The Chandra observations investigate ejected material within the jet that was launched from the black hole hundreds and thousands of years earlier.

"It's like the Event Horizon Telescope is giving a close-up view of a rocket launcher," said the CfA's Paul Nulsen, another co-author of the study, "and Chandra is showing us the rockets in flight."

In addition to being presented at the AAS meeting, these results are also described in a paper in *The Astrophysical Journal* led by Brad Snios that is [available online](#).

**More information:** Bradford Snios et al. *Detection of Superluminal Motion in the X-Ray Jet of M87*, *The Astrophysical Journal* (2019). [DOI: 10.3847/1538-4357/ab2119](https://doi.org/10.3847/1538-4357/ab2119)

**Journal information:** [Astrophysical Journal](#)

Provided by [Chandra X-ray Center](#)

<http://bit.ly/2QG80I3>

**Rape-kit testing shows that rapists also commit other serious, invasive crimes, according to new research**  
**Rapists don't exclusively commit rape; they're often the most aggressive types of criminals**

by Colin McEwen

Larry McGowan is a sexual-assault offender, identified through the DNA testing of thousands of rape kits in Cleveland. [He's been linked to raping six women](#)—killing one of them—during a 15-year span and is serving a 25-years-to-life sentence.



Between rapes, McGowan was in and out of prison for stealing cars, felonious assault, arson, burglary, theft and robbery. He's also a suspect in another murder. But until thousands of previously untested [rape](#) kits in Cuyahoga County were tested, including those connected to McGowan, he had never been arrested or convicted of rape.

McGowan represents what researchers at Case Western Reserve University have concluded after analyzing the rape kits: that [sexual offenders](#) also tend toward committing other serious felonies—not just rape.

Most existing research about sexual offenders is limited because offenders must either be caught or self-disclose their crimes, said Rachel Lovell, research assistant professor at the university's Begun Center for Violence Prevention Research and Education at the Jack, Joseph and Morton Mandel School of Applied Social Sciences.

"New data on undetected sexual offenders—those who were never prosecuted for their crimes—connected to newly tested rape kits tells us that not only is repeated sexual offending more common than previously expected, but also about all the other crimes they commit," she said.

In other words, rapists don't exclusively commit rape; they're often the most aggressive types of criminals.

With access granted by the Cuyahoga County Prosecutor's Office, the researchers have studied [data from Northeast Ohio](#)'s nearly 7,000 untested rape kits, an effort that has resulted in hundreds of convictions.

The research findings, published in the journal *Criminal Justice and Behavior*, show that sexual offenders have very high "serial criminality rates." Criminality is measured by offenders who have multiple arrests for serious crimes.

In addition:

- **7% have at least one arrest for murder;**

- **While one in five are rapists who primarily commit rape ("specialists"), 40% are committing lots of varying crimes ("generalists");**

- **Only a third had a rape arrest in their history. "Like McGowan, just because he didn't have a rape arrest, didn't mean that there weren't previous rapes," said Lovell.**

Journal information: [Criminal Justice and Behavior](#)

Provided by [Case Western Reserve University](#)

<http://bit.ly/2FFSQMy>

## **US\$1 dollar increase in minimum wage linked to 3.5-6% fall in suicide rate**

**Effects seem to be strongest during periods of high unemployment, shows 26-year study**

A US\$1 increase in the minimum wage is linked to a fall in the suicide rate of between 3.5 and 6% among people with high school education or less, reveals a 26-year study, published online in the *Journal of Epidemiology & Community Health*.

The effect seems to be strongest during periods of high unemployment, the findings indicate.

In 2017, there were more than 47,000 preventable suicide deaths in the USA, with suicides accounting for nearly one in five (19%) deaths among those aged 18-24. Between 1999 and 2017, suicide rates increased by more than 30% in half of US states.

Suicide risk is often associated with financial stressors, but less is known about the potential impact of economic interventions, such as minimum wage policies, on suicide rates.

To try and find out, the researchers looked at the difference between the effective state and federal minimum hourly wage for all 50 states and Washington DC and state unemployment and suicide rates among 18 to 64-year olds, for every month between 1990 and 2015.

Between 1990 and 2015, there were 478 changes in state minimum wages across US states. The average difference in wages between the states at and above the federal minimum wage was US\$ 2200/year for a full time worker.

In 1990, 36 states had a minimum wage equal to the federal rate; by 2015, this had fallen to 21 states.

Between 1990 and 2015, 399,206 people with high school education or less took their own lives compared with 140,176 people with a college degree or higher.

The researchers estimated a 3.5-6% reduction in suicides for every dollar increase in the minimum wage among 18-64 year-olds with high school education or less. No such effect was apparent among those who were educated to college level or higher.

The association between minimum wage and suicide rates differed by state-level unemployment rate during the 26-year timeframe.

When this was high (above 6.5%), progressively higher minimum wages were associated with lower suicide rates; when unemployment was low, on the other hand, the association with the minimum wage weakened.

Based on these estimates, the researchers calculated that after the 2009 peak in unemployment following the financial crash, 13,800 suicides could have been prevented between 2009 and 2015 among less well educated 18-64 year-olds if a US\$1 dollar increase had been added to the minimum wage. A US\$2 increase could have prevented 25,900 suicides, they calculated.

Over the entire 26-year period, the researchers estimated that a US\$1 increase in state minimum wage could have staved off 27,550 suicides in this group of workers, while a US\$2 increase could have staved off 57,350 suicides.

This is an observational study, and as such, can't establish cause. But, conclude the researchers: "Our findings are consistent with the notion that policies designed to improve the livelihoods of

individuals with less education, who are more likely to work at lower wages and at higher risk for adverse mental health outcomes, can reduce the suicide risk in this group."

They add: "Our findings also suggest that the potential protective effects of a higher minimum wage are more important during times of high unemployment."

<http://bit.ly/2QH3yZF>

### **Cases of mysterious shrew-transmitted disease double Researchers have identified eight more people who died from the Borna virus**

By [Kai Kupferschmidt](#)

Researchers have identified eight more people who died from the Borna virus, a known pathogen in several animals that was only recently shown to cause disease in humans. Scientists had been skeptical that the virus could infect people, but the new work suggests Borna has been killing humans for decades.

"It's a nice, clear study," says Thomas Briese, a molecular virologist at Columbia University who was not involved with the work. The research, he says, adds important data on a human disease that scientists are just beginning to explore.



***The bicolored white-toothed shrew is the natural host species of Borna virus.***  
Tierbild Okapia/Science Source

For more than 300 years, people in central Europe have known of an equine "disease of the head" that leads horses to go blind, lose coordination, and die. The infectious agent responsible, Borna disease virus 1—named for an outbreak in military horses in the German city of Borna in the 19th century—causes encephalitis, an inflammation in the brain. The pathogen also infects sheep, ostriches, and other animals.

Experts have debated whether it afflicts humans for decades. Some scientists have suggested the virus infects many people around the world, causing depression and other psychiatric disorders. But the data were questionable and the field was plagued with contamination problems, Briese says.

In the past few years, a different story has emerged. Scientists identified the bicolored white-toothed shrew (*Crocidura leucodon*) as a natural reservoir of the virus: The animals carry it with no apparent illness. And they found a handful of people in Germany with severe encephalitis caused by the virus.

In the new study, researchers screened brain tissue from 56 encephalitis patients over the past 25 years that had been stored at the University Hospital in Regensburg, Germany. For 28 patients, the cause of the encephalitis was known—cancer or autoimmune disease, for example—and none of these control tissue samples was positive for Borna virus. But of the 28 patients for whom no cause of the encephalitis could be found, [seven carried the virus in their brain](#), the researchers report today in *The Lancet Infectious Diseases*.

The scientists identified two further cases in other medical centers in southern Germany. For seven of these eight new patients (one of the Regensburg patients had been previously reported), the researchers managed to sequence the genome of the virus. The viruses taken from each patient closely resemble genomes isolated from animals in the area where the patients lived. But they differ from each other enough that each infection occurred independently from wildlife, instead of the pathogen being transmitted between people, the team concludes.

How exactly the virus makes it into a person is still unclear. “This is now one of the big questions we need to answer,” says study author Martin Beer, a virologist at Germany’s Federal Research Institute for Animal Health. Five of the eight patients owned cats,

he notes, and at least two of the felines reportedly brought home small mammals, including shrews.

“People might dispose of the animals with their bare hands and then rub their eyes,” says Norbert Nowotny, a virologist at the University of Vienna, who has studied Borna virus for decades but who was not involved with the current work. Identifying more cases could help resolve how the virus is transmitted, he says.

As testing for the virus becomes more common in the affected regions, scientists are discovering more cases. In October 2019, an 11-year-old girl in Bavaria died of encephalitis, and a postmortem exam found Borna virus in her brain. The absolute number of cases is likely to remain low, Beer says. But the virus may account for a significant number of unexplained, fatal encephalitis cases in the parts of Germany, Austria, and Switzerland, where the pathogen is endemic.

Identifying more cases could also give a better estimate of how often the infection is fatal, Nowotny says. Of the 14 cases reported in the scientific literature so far, 11 have died. “I imagine that as we identify more cases we will also find more mild cases.”

<http://bit.ly/2TeNUqb>

**Automobile law in Japan has improved air quality**  
*Evidence that the intervention reduced emissions, contributing to air quality improvements in metropolitan regions*

by [Wiley](#)

A law passed in Japan in 1992 aimed to improve urban air quality by banning vehicles that violated certain emission standards from being registered in designated areas. A new study published in *Contemporary Economic Policy* provides evidence that the intervention reduced emissions, contributing to air quality improvements in metropolitan regions.

The law has been controversial because of its expense to owners of non-compliant vehicles and because of its unclear benefit. The

study suggests that the law led to a 3% to 6% reduction in the monthly average ambient concentration of nitrogen dioxide over more than two decades, yielding benefits equal to about US \$104 million as a result of reduced mortality from [asthma](#).

"Japan's automobile law seems to work well, but to formally evaluate the validity of the law, full cost-benefit analyses would need to be undertaken," said corresponding author Shuhei Nishitatano, Ph.D., of Kwansai Gakuin University.

*More information:* Shuhei Nishitatano et al, HAVE VEHICLE REGISTRATION RESTRICTIONS IMPROVED URBAN AIR QUALITY IN JAPAN?, *Contemporary Economic Policy* (2020). DOI: [10.1111/coep.12457](https://doi.org/10.1111/coep.12457)

<http://bit.ly/36LMXtn>

## Early humans revealed to have engineered optimized stone tools at Olduvai Gorge

### *Early Stone Age populations engineered their stone tools in complex ways to make optimised cutting tools*

Early Stone Age populations living between 1.8 - 1.2 million years ago engineered their stone tools in complex ways to make optimised cutting tools, according to a new study by University of Kent and UCL.

The research, published in the *Journal of Royal Society Interface*, shows that Palaeolithic hominins selected different raw materials for different stone tools based on how sharp, durable and efficient those materials were.

They made these decisions in conjunction with information about the length of time the tools would be used for and the force with which they could be applied. This reveals previously unseen complexity in the design and production of [stone tools](#) during this period.

The research was led by Dr. Alastair Key, from Kent's School of Anthropology and Conservation, and is based on evidence from mechanical testing of the raw materials and artefacts found at

Olduvai Gorge in Tanzania—one of the world's most important sites for human origins research.

Dr. Key collaborated with Dr. Tomos Proffitt, from UCL Institute of Archaeology, and Professor Ignacio de la Torre of the CSIC-Centro de Ciencias Humanas y Sociales in Madrid, for the study.

Their research, which employed experimental methods more commonly used in modern engineering research, shows that hominins preferentially selected quartzite, the sharpest but least durable stone type at Olduvai for flake tools; a technology thought to have been used for expedient, short-lived cutting activities.

Chert, which was identified as being highly durable and nearly as sharp as quartzite, was only available to hominins for a short 200,000 year period. Whenever it was available, chert was favoured for a variety of stone [tool](#) types due to its ability to maximise cutting performance over extended tool-use durations.

Other stone types, including highly durable lavas, were available at Olduvai, however their use varied according to factors such as how long a tool was intended to be used for, a tool's potential to create high cutting forces, and the distance hominins had to travel to raw material sources.

The study reveals a level of complexity and flexibility in stone tool production previously unseen at this time. Earlier research had demonstrated Early Stone Age populations in Kenya to select highly durable stone types for tools, but this is the first time cutting edge sharpness has been able to be considered. By selecting the material best suited to specific functional needs, hominins optimised the performance of their tools and ensured a tool's efficiency and 'ease-of-use' was maximised.

Dr. Key said: 'Why Olduvai populations preferentially chose one raw material over another has puzzled archaeologists for more than 60 years. This has been made all the more intriguing given that



some stone types, including lavas and quartzite, were always available.

'What we've been able to demonstrate is that our ancestors were making quite complex decisions about which raw materials to use, and were doing so in a way that produced tools optimised for specific circumstances. Although we knew that later [hominin](#) species, including our own, were capable of such decisions, it's amazing to think that populations 1.8—1.2 million years ago were also doing so.'

Dr. Proffitt added: 'Early hominins during the Oldowan were probably using stone flakes for a variety of tasks. Mostly for butchering animals whilst scavenging, but also probably for cutting various plants and possibly even shaping wood. A durable cutting edge would have been an important factor when using these tools.'

'There are many modern analytical techniques used in material sciences and engineering that can be used to interrogate the archaeological record, and may provide new insights into the mechanical properties of such tools and artefacts. By understanding the way that these tools work and their functional limits it allows archaeologists to build up a greater understanding of the capabilities of our earliest ancestors at the dawn of technology.'

The team now hopes that researchers at other archaeological sites will want to apply similar mechanical tests and techniques to help understand the behaviour of Stone Age populations.

'Raw material optimisation and [stone](#) tool engineering in the Early Stone Age of Olduvai Gorge (Tanzania)' has been published in the *Journal of the Royal Society Interface*.

**More information:** Alastair Key et al, Raw material optimization and stone tool engineering in the Early Stone Age of Olduvai Gorge (Tanzania), *Journal of The Royal Society Interface* (2020). [DOI: 10.1098/rsif.2019.0377](https://doi.org/10.1098/rsif.2019.0377)

<http://bit.ly/36L0ukF>

## Russian journals retract more than 800 papers after 'bombshell' investigation

**Report "will reinforce the suspicions and fears of many—that their country is not going down the right path in science and that it's damaging its own reputation"**

By [Dalmeet Singh Chawla](#)

Academic journals in Russia are retracting more than 800 papers following a probe into unethical publication practices by a commission appointed by the Russian Academy of Sciences (RAS). The moves come in the wake of several other queries suggesting the vast Russian scientific literature is riddled with plagiarism, self-plagiarism, and so-called gift authorship, in which academics become a co-author without having contributed any work.

The RAS commission's preliminary [report documenting the problems and journals' responses to them](#) is "a bombshell," says Gerson Sher, a former staffer at the U.S. National Science Foundation and the author of a [recent book on U.S.-Russia science cooperation](#). The report, released yesterday, "will reinforce the suspicions and fears of many—that their country is not going down the right path in science and that it's damaging its own reputation," says Sher, who applauds RAS for commissioning the investigation. Russia's roughly 6000 academic journals, the vast majority published in Russian, are popular among the country's academics. A 2019 study found that Russian authors publish far more in domestic journals than, for instance, their counterparts in Poland, Germany, or Indonesia. But standards are often low. In March 2018, for instance, [Dissernet](#), a network aimed at cleaning up the Russian literature, identified more than 4000 cases of plagiarism and questionable authorship among 150,000 papers in about 1500 journals.



And Russian authors frequently republish their own work, says Yury Chekhovich, CEO of [AntiPlagiat](#), a plagiarism detection company. In September 2019, after sifting through 4.3 million Russian-language studies, AntiPlagiat found that more than 70,000 were published at least twice; a few were published as many as 17 times. Chekhovich believes most instances are due to self-plagiarism. Meanwhile, the website 123mi.ru claims to have brokered authorships for more than 10,000 researchers by selling slots on manuscripts written by others that were already accepted by journals.

The RAS commission, formally known as the Commission for Counteracting the Falsification of Scientific Research, investigated the problem independently. It has experienced fraud busters on board. Dissernet co-founder Andrew Zayakin, a physicist at the Institute for Theoretical and Experimental Physics, is the commission's secretary; it also includes several other "academic activists," Zayakin says, including representatives of the Society for Evidence-Based Medicine, the Russian Association of Scientific Editors and Publishers (RASEP), and Russia's Scientific Electronic Library (eLibrary). The commission used software to search hundreds of Russian-language journals—ranging from natural sciences, agronomy, psychology, and medicine to economics and law—for text overlap. Suspicious papers were checked manually to verify that they counted as plagiarism or self-plagiarism. By comparing the author lists of papers that had been published twice or more, the commission also identified apparent cases of "obscure authorship"—academics who were an author on one version of the paper but not the other.

Last summer, the commission asked 541 journals to retract a total of 2528 papers. In its interim report, the commission writes that 390 journals have so far responded to the inquiry, 263 of which have agreed to retract all suspicious papers; others agreed to retract some

of the highlighted papers but not others, or gave legitimate reasons why the papers shouldn't be pulled.

Eight journals explicitly refused to address the problems; the report urges that five of them be removed from the Russian Science Citation Index, a database run by eLibrary. (Because publication in indexed journals is often a prerequisite for promotions and funding in Russia, delisted journals are thought to be less attractive to authors.) Victor Glukhov, eLibrary's deputy director, says the group's own expert council will look into the matter, but is likely to agree. Zayakin emphasizes that the exercise is a work in progress; he hopes the threat of being delisted will persuade journals that haven't yet responded—or have refused to pull papers on flimsy grounds—to take the commission's findings seriously.

The same RAS commission caused a stir in September 2019, when it recommended not voting for 56 candidates—out of a total of more than 1800—during the academy's membership elections, because of their alleged involvement in plagiarism and other types of misbehavior. That "caused a lot of tension over how the commission is organized and who pulls the strings in it," says Dmitry Malkov, a science communication scholar at ITMO University in St. Petersburg. (The academy had about 200 new memberships available; only a few of the 56 were elected.)

The new investigation "caused tension and conflict" as well, says commission member Anna Kuleshova, chair of RASEP's Council on the Ethics of Scientific Publications. Kuleshova says some Russian journals were unaware of internationally accepted standards around ethical publishing and retractions. "I hope that our work will not only reduce scientometric distortions, and help us to get rid of garbage publications," she says, "but will also draw attention to issues related to the management of science."

*\*Correction, 10 January, 10:45 a.m.: The web address for 123mi.ru has been corrected.*

<http://bit.ly/2QJDe14>

## The Influence of Soil on Immune Health

*Recent work in humans and mice highlights how exposure to environmental microbes helps protect against allergies and other inflammatory diseases.*

Jef Akst

People living along the border between Finland and Russia are yielding valuable data that could shed light on people's relationship with nature—particularly when it comes to the link between environmental exposure and immune health. During the Second World War, Finland ceded a large swath of territory to the Soviet Union. In the second half of the 20th century, the Finnish side became modernized, while people on the Soviet side maintained a traditional lifestyle. And by the 21st century, according to a study carried out by researchers at the University of Helsinki, the prevalence of allergies on Finland's side of the border region known as Karelia was [significantly higher](#) than that of people living on the Russian side.

Immunologist [Nanna Fyhrquist](#), who joined the University of Helsinki team in 2011 and helped carry out the research, wanted to know why. The group suspected that the differences in allergy incidence between the two sides of the Finnish-Russian border might have something to do with exposure to environmental microbes. The late ecologist [Ilkka Hanski](#) of the University of Helsinki along with Helsinki University Central Hospital researchers [Tari Haahtela](#) and [Leena von Hertzen](#) had recently formalized the [biodiversity hypothesis](#), arguing that the total biodiversity—and correspondingly, microbial diversity—of people's living environments influences human health via changes to the composition of the microbiome. A global loss of biodiversity, they reasoned, was to blame for the dysregulation of the human

immune system and thus the increase in allergic and inflammatory diseases observed in developed nations around the world.

The idea is an extension of the decades-old hygiene hypothesis, developed in the late 1980s and '90s as researchers came to realize that living in a modernized world where bacterial exposure is limited was linked with hay fever and other disorders characterized by immune dysfunction. Later, University College London microbiologist and immunologist [Graham Rook](#) took a similar view with his [“old friends” hypothesis](#), which posits that humans—and specifically their immune systems—have become [dependent](#) on the microbes they coevolved with for tens of thousands of years or more. “The immune system [is] a learning system,” Rook tells *The Scientist*. “Unless you put the data in, it can't function correctly.”

The team in Finland has since been exploring mechanisms by which environmental microbes might influence the human immune system. One way could be through the shaping of humans' resident microbiota, which has been linked to the [development of allergies](#). The idea is already somewhat supported by data from the Karelia study. In the Finnish skin swab samples, “we saw children living in the countryside surround by forest and green area were much less allergic [than Finnish children in more-urban environments], and they also had a much richer skin microbiota,” says Fyhrquist.

Specifically, the country kids had more, and more-diverse, [bacteria on their skin](#), with a particularly high abundance of *Acinetobacter*—a genus of microbes in the *Proteobacteria* phylum that are commonly found on plants. The researchers further found that children with more *Acinetobacter* on their skin had more leukocytes in their bloodstream and that these cells were much more capable of producing the anti-inflammatory cytokine IL-10 compared with the leukocytes of urban kids. “This led us to think that this particular group of microbes derived from nature might be able to somehow contribute training or calibration of the immune

system,” says Fyhrquist. Samples from the less-developed Russian side of the border [supported that idea](#), containing a higher abundance of *Acinetobacter* than the samples from the Finnish side regardless of the specific living environment. “The Russian lifestyle being so profoundly different from the Finnish, it appears to override possible effects of rural versus urban living environments,” she says.

But to know if exposure to soil microbes was causing the microbiome differences linked to the Russian population’s relatively low rates of allergies, the team needed to do an experiment. Last year, Fyhrquist, now at the Karolinska Institute in Sweden, and her collaborators used a mouse model of asthma, a disease triggered by the same type 2 helper T cell (Th2) immune response that underlies allergic reactions. They housed some female animals on clean bedding while their sisters’ cages were sprinkled with potting soil and kept in a stable that housed other animals such as sheep.

After six weeks, mice that had lived on clean bedding were [more susceptible](#) to developing lung inflammation in response to an asthma-triggering allergen than were the mice in contact with soil. The team also found that, in agreement with some [previous research](#), the guts of soil-exposed mice contained more bacteria in the *Bacteroidetes* phylum than in the *Firmicutes* phylum—the opposite of the microbial signature usually associated with asthma and inflammation in general in both mice and humans. Soil-exposed animals also had higher levels of anti-inflammatory proteins that keep the immune system in check, including an enzyme called A20 that has previously been shown to be protective in mouse models of asthma. “It was quite amazing to see so many different levels of modification and induction of tolerance in the mice,” says Fyhrquist. The Finnish team’s mice were in prolonged physical contact with microbe-filled soil, but other work suggests that even trace amounts

of airborne soil—along the lines of what a person might experience by spending time in nature—could have effects on mouse health. In work published this month, restoration ecologist [Martin Breed](#) of Flinders University in Adelaide, Australia, and his colleagues placed small amounts of soil with varying levels of biodiversity in a tray outside a mouse cage, and ran a fan over it for two hours a day to create “a very light wafting” towards the animals, Breed describes. The soil load amounted to a 100 to 1,000 times lower dose than that used in other studies, he says.

Nevertheless, after seven weeks of this sort of exposure to soil with high microbial diversity, the animals showed [changes in their microbiomes](#), and scored lower on standard stress tests. “By the end of the experiment, the feces of the mice in the high biodiversity enclosures were more like the high diversity soils than they were at the start,” Breed says. “There was direct colonization into the gut . . . from the soil. . . . I was floored by the fact that we could pick up mouse poo differences based on such tiny levels of exposure.”

The field is using results such as these to begin making the case that exposure to diverse bacteria in the environment is one mechanism underlying the wide-ranging health benefits of spending [time in nature](#). “I think there is more and more evidence to back up this statement that there is a direct contribution of the soil to human health,” says [Sophie Zechmeister-Boltenstern](#), head of the Institute of Soil Research at the University of Natural Resources and Life Sciences Vienna (BOKU). “If there is more biodiversity,” she adds, “then there is more resilience and resistance against pathogens.”

But this conclusion comes with a problem: biodiversity in the world’s soils is dwindling, says Zechmeister-Boltenstern, meaning that even people who do spend time in nature are getting exposed to fewer types of bugs now than they were in the past. She and her colleagues recently reported that the diversity of the human gut

microbiome is [decreasing](#) right alongside this loss of biodiversity in the environment.

“People are not so much aware of this immense biodiversity which is harbored in the soil,” says Zechmeister-Boltenstern, “but soil is actually the most diverse habitat on Earth.”

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<http://bit.ly/2QKN6Ym>

## Tea drinkers live longer

### *Drinking tea at least three times a week is linked with a longer and healthier life*

Sophia Antipolis Drinking tea at least three times a week is linked with a longer and healthier life, according to a study [published today in the European Journal of Preventive Cardiology](#), a journal of the European Society of Cardiology (ESC).<sup>1</sup>

"Habitual tea consumption is associated with lower risks of cardiovascular disease and all-cause death," said first author Dr. Xinyan Wang, Chinese Academy of Medical Sciences, Beijing, China. "The favourable health effects are the most robust for green tea and for long-term habitual tea drinkers."

The analysis included 100,902 participants of the China-PAR project<sup>2</sup> with no history of heart attack, stroke, or cancer. Participants were classified into two groups: habitual tea drinkers (three or more times a week) and never or non-habitual tea drinkers (less than three times a week) and followed-up for a median of 7.3 years.

Habitual tea consumption was associated with more healthy years of life and longer life expectancy. For example, the analyses estimated that 50-year-old habitual tea drinkers would develop coronary heart disease and stroke 1.41 years later and live 1.26 years longer than those who never or seldom drank tea.

Compared with never or non-habitual tea drinkers, habitual tea consumers had a 20% lower risk of incident heart disease and

stroke, 22% lower risk of fatal heart disease and stroke, and 15% decreased risk of all-cause death.

The potential influence of changes in tea drinking behaviour were analysed in a subset of 14,081 participants with assessments at two time points. The average duration between the two surveys was 8.2 years, and the median follow-up after the second survey was 5.3 years.

Habitual tea drinkers who maintained their habit in both surveys had a 39% lower risk of incident heart disease and stroke, 56% lower risk of fatal heart disease and stroke, and 29% decreased risk of all-cause death compared to consistent never or non-habitual tea drinkers.

Senior author Dr. Dongfeng Gu, Chinese Academy of Medical Sciences, said: "The protective effects of tea were most pronounced among the consistent habitual tea drinking group. Mechanism studies have suggested that the main bioactive compounds in tea, namely polyphenols, are not stored in the body long-term. Thus, frequent tea intake over an extended period may be necessary for the cardioprotective effect."

In a subanalysis by type of tea, drinking green tea was linked with approximately 25% lower risks for incident heart disease and stroke, fatal heart disease and stroke, and all-cause death. However, no significant associations were observed for black tea.

Dr. Gu noted that a preference for green tea is unique to East Asia. "In our study population, 49% of habitual tea drinkers consumed green tea most frequently, while only 8% preferred black tea. The small proportion of habitual black tea drinkers might make it more difficult to observe robust associations, but our findings hint at a differential effect between tea types."

Two factors may be at play. First, green tea is a rich source of polyphenols which protect against cardiovascular disease and its risk factors including high blood pressure and dyslipidaemia. Black



tea is fully fermented and during this process polyphenols are oxidised into pigments and may lose their antioxidant effects. Second, black tea is often served with milk, which previous research has shown may counteract the favourable health effects of tea on vascular function.

Gender-specific analyses showed that the protective effects of habitual tea consumption were pronounced and robust across different outcomes for men, but only modest for women. Dr. Wang said: "One reason might be that 48% of men were habitual tea consumers compared to just 20% of women. Secondly, women had much lower incidence of, and mortality from, heart disease and stroke. These differences made it more likely to find statistically significant results among men."

She added: "The China-PAR project is ongoing, and with more person-years of follow-up among women the associations may become more pronounced." The authors concluded that randomised trials are warranted to confirm the findings and provide evidence for dietary guidelines and lifestyle recommendations.

*Funding: Chinese Academy of Medical Sciences (CAMS) Innovation Fund for Medical Sciences (2017-I2M-1-004); National Key R&D Program of China (2017YFC0211700 and 2018YFC1311703). Disclosures: None.*

**References** <sup>1</sup>Wang X, Liu F, Li J, et al. Tea consumption and the risk of atherosclerotic cardiovascular disease and all-cause mortality: The China-PAR project. *Eur J Prev Cardiol.* 2019. doi:10.1177/2047487319894685.

<sup>2</sup>China-PAR: Prediction for ASCVD Risk in China project.

<http://bit.ly/2RfrOku>

## Roman Emperors Were More Likely Than Gladiators to Die Gruesome Deaths

*The emperors' chances of dying were the greatest during the first year of their reigns.*

By [Mindy Weisberger - Senior Writer](#)

Emperors of ancient Rome tended to die bloody, violent deaths. In fact, a Roman gladiator had better odds of surviving a brutal fight

in the arena than an emperor had of dying peacefully of natural causes, according to a new study.

From A.D. 14 to A.D. 395, 43 of the 69 Roman rulers (62%) [died violently](#), meaning they were killed in battle or at the hands of assassins. But those numbers tell only part of the story.

At his day job, study author Joseph Saleh, an associate professor with the Center for Space Technology and Research at Georgia Tech in Atlanta, researches aerospace engineering. But his work evaluating spacecraft reliability and failure — coupled with a longtime fascination with Roman history — led him to question if it might be possible to use the same statistical models to calculate the inherent risk in the prestigious job of Roman emperor.

"That it was a risky business was known, at least qualitatively," Saleh told Live Science. What had never been explored was how an emperor's chances of dying from violence might change over time — their "time to failure," Saleh said.

**Commodus reigned as emperor of Rome from A.D. 177 until his death in 192, when he was strangled in a bathtub by a wrestler.** (Image: © PD-US)

Some of those "failures" were quite gruesome. Publius Septimius Geta, who died in A.D. 211, was slaughtered in his mother's arms when he was only 21 years old, on the orders of his older brother Caracalla. Caracalla was then murdered in A.D. 217, allegedly while defecating by the side of a road, [wrote](#) Michael Meckler, a scholar of Roman history at The Ohio State University.

The emperor Marcus Aurelius Commodus Antoninus, who reigned from A.D. 177 to 192, also suffered a grisly fate. After a failed poisoning attempt, a wrestler sent by disgruntled Roman senators strangled the emperor while he was in the bath, [according to Dennis Quinn](#), a historian and associate professor at California State Polytechnic University.





Overall, the new analysis found that a Roman emperor's chances of survival were roughly equivalent to those of someone playing a game of Russian roulette with four bullets in the revolver instead of just one, Saleh said in the study.

Saleh used a statistical method typically performed by engineers to see how long it takes equipment to fail. Many devices, when analyzed this way, fall into a pattern known as a bathtub curve. There are multiple failures when the device first hits the market. Then, failures taper off for a while. After devices have been around long enough to start wearing out, failures spike again, Saleh explained.

### "Wear-out failures"

He discovered that Roman emperors followed a similar pattern. Their [risk of death](#) was the highest during the first year in power. But if a ruler managed to survive his first year and stayed alive for the next seven years, his odds of dying declined significantly. However, that grace period lasted only four years. Once an emperor reached his 12th year in power, his odds of dying soared again, Saleh reported.

For example, Emperor Geta died during the first year of his reign. Caracalla died during his seventh year in power, and Commodus met his bloody end during his 16th year as emperor.

Like devices that fail early, emperors who died in the first years of their reigns did so because they demonstrated fatal "design flaws," undermining confidence in their ability to rule, Saleh said. Emperors who died after 12 years in power were more like devices suffering from "wear-out failures": They were vulnerable to societal changes, the rise of new enemies or new attacks from old enemies that had regrouped, Saleh wrote.

"It's very interesting that something so haphazard as the assassination of a Roman emperor has an underlying structure to it," Saleh said.

The findings were published online Dec. 23 in the journal [Palgrave Communications](#).

<https://go.nature.com/2RaTmrl>

### **Parrots give each other gifts without promise of reward** *African grey parrots show a type of insightful generosity recorded in only humans, orangutans and a few other species.*

Humans and some other apes are known for helping unrelated members of their own species.

Now, the first non-mammal, the African grey parrot (*Psittacus erithacus*), joins the ranks of animals that provide help after gauging the beneficiary's needs.

Désirée Brucks and Auguste von Bayern at the Max Planck Institute for Ornithology in Seewiesen, Germany, trained zoo parrots in an enclosure to pass tokens through an 'exchange hole' to a researcher, who then handed over walnuts, a beloved snack.

The scientists next placed two parrots in adjacent enclosures with a 'transfer hole' between them.

One bird had tokens, but a blocked exchange hole. The other had access to the researcher and the walnuts, but no tokens.

In the very first session, seven of eight parrots with tokens spontaneously transferred them to their partner, even though they would receive no benefit for doing so.

These parrots generally didn't bother passing over tokens when no parrot was next door, or when the other parrot couldn't make an exchange for food, suggesting that they understood the import of their actions.

When partners switched roles, parrots that had benefited from a partner's generosity returned the favour, hinting at their motivation for helping. [Curr. Biol. \(2020\)](#)

<http://bit.ly/2QNzED2>

## Copper-based nanomaterials can kill cancer cells in mice

### *Success in permanently killing tumour cells in mice using nano-sized copper compounds*

An interdisciplinary team of scientists from KU Leuven, the University of Bremen, the Leibniz Institute of Materials Engineering, and the University of Ioannina has succeeded in killing tumour cells in mice using nano-sized copper compounds together with immunotherapy. After the therapy, the cancer did not return.

Recent advances in [cancer](#) therapy use one's own immunity to fight the cancer. However, in some cases, immunotherapy has proven unsuccessful. The team of biomedical researchers, physicists, and chemical engineers found that tumours are sensitive to copper oxide nanoparticles—a compound composed of copper and oxygen. Once inside a living organism, these nanoparticles dissolve and become toxic. By creating the nanoparticles using iron oxide, the researchers were able to control this process to eliminate [cancer cells](#), while healthy cells were not affected.

"Any material that you create at a nanoscale has slightly different characteristics than its normal-sized counterpart," explain Professor Stefaan Soenen and Dr. Bella B. Manshian from the Department of Imaging and Pathology, who worked together on the study. "If we would ingest [metal oxides](#) in large quantities, they can be dangerous, but at a nanoscale and at controlled, safe, concentrations, they can actually be beneficial."

As the researchers expected, the cancer returned after treating with only the nanoparticles. Therefore, they combined the nanoparticles with immunotherapy. "We noticed that the copper compounds not only could kill the tumour cells directly, they also could assist those

cells in the [immune system](#) that fight foreign substances, like tumours," says Dr. Manshian.

The combination of the nanoparticles and immunotherapy made the tumours disappear entirely and, as a result, works as a vaccine for lung and colon cancer—the two types that were investigated in the study. To confirm their finding, the researchers injected tumour cells back into the mice. These cells were immediately eliminated by the immune system, which was on the lookout for any new, similar, cells invading the body.

The authors state that the novel technique can be used for about sixty percent of all cancers, given that the cancer cells stem from a mutation in the p53 gene. Examples include lung, breast, ovarian, and colon cancer.

A [crucial element](#) is that the tumours disappeared without the use of chemotherapy, which typically comes with major side-effects. Chemotherapeutic drugs not only attack cancer cells, they often damage healthy cells along the way. For example, some of these drugs wipe out white blood cells, abolishing the immune system.

"As far as I'm aware, this is the first time that metal oxides are used to efficiently fight cancer [cells](#) with long-lasting immune effects in live models," Professor Soenen says. "As a next step, we want to create other metal [nanoparticles](#), and identify which particles affect which types of cancer. This should result in a comprehensive database."

The team also plans to test [tumour cells](#) derived from cancer patient tissue. If the results remain the same, Professor Soenen plans to set up a clinical trial. For that to happen, however, there are still some hurdles along the way. He explains: "Nanomedicine is on the rise in the U.S. and Asia, but Europe is lagging behind. It's a challenge to advance in this field, because doctors and engineers often speak a different language. We need more [interdisciplinary collaboration](#),

so that we can understand each other better and build upon each other's knowledge."

**More information:** Hendrik Naatz *et al*, *Model-Based Nanoengineered Pharmacokinetics of Iron-Doped Copper Oxide for Nanomedical Applications*, *Angewandte Chemie International Edition* (2019). DOI: [10.1002/anie.201912312](https://doi.org/10.1002/anie.201912312)

<http://bit.ly/35QjYTM>

## **New Coronavirus Identified in Central China Pneumonia Outbreak**

***The virus, which has sickened at least 59 people, does not appear to transmit easily between humans.***

**Shawna Williams**

A mysterious new type of pneumonia linked to a seafood market in Wuhan, China, is caused by a novel coronavirus, Chinese state media reported today (January 9). The reports come a day after the World Health Organization (WHO) stated that multiple known viruses had been ruled out as a cause of the outbreak, and that a coronavirus was the likely cause. The virus had sickened at least 59 people in China as of Sunday, and according to the [Associated Press](#), one suspected case—a woman who fell ill after returning from China—has been identified in South Korea.

[Xinhua](#) reports that the virus was identified by the Chinese Academy of Engineering's Xu Jianguo based on tests of samples from 15 patients with the illness. Known coronaviruses include some that cause a cold, as well as the pathogens behind severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS).

"Preliminary identification of a novel virus in a short period of time is a notable achievement and demonstrates China's increased capacity to manage new outbreaks," the WHO's Gauden Galea says in a statement quoted by multiple news outlets.

"If the Chinese truly have sequenced the virus and they've demonstrated that it's present in other patients, [that] means there's

a PCR diagnostic test available. And the Chinese need to make that available to the rest of the world immediately," Ralph Baric, a coronavirus expert at the University of North Carolina, tells [STAT](#). He explains that coronaviruses could be transmitted to people from bats, or through a different animal species that had been infected by a bat.

"I am stunned by the timeline and speed of this isolation and characterization, if it's all true," says Matthew Frieman, a coronavirus expert at the University of Maryland School of Medicine, in remarks to *STAT*. He expressed skepticism about Chinese authorities' claim that the virus can't be transmitted between humans, saying, "I don't know how you know that at all." Given the number of reported cases, he says, it's not likely that animal-to-human transmission is the only way the virus can spread. David Hui, an emerging infections expert at the Chinese University of Hong Kong, shares a similar take with [The New York Times](#). "So, there are still a lot of question marks," he says. "It's premature to say that there's no human-to-human transmission."

<https://bbc.in/2NArwUD>

## **Mystery Chinese virus: How worried should we be? A mystery virus - previously unknown to science - is causing severe lung disease in the Chinese city of Wuhan.**

**By James Gallagher Health and science correspondent**

More than 50 people have been infected. Seven are currently in a critical condition.

A new virus arriving on the scene, leaving patients with pneumonia, is always a worry and health officials around the world are on high alert.

But is this a brief here-today-gone-tomorrow outbreak or the first sign of something far more dangerous?

**What is this virus?**

Viral samples have been taken from patients and analysed in the laboratory. And officials in China and [the World Health Organization](#) have concluded the infection is a coronavirus.

Coronaviruses are a broad family of viruses, [but only six](#) (the new one would make it seven) are known to infect people.

Severe acute respiratory syndrome (Sars), which is caused by a coronavirus, killed 774 of the 8,098 people infected in an outbreak that started in China in 2002. "There is a strong memory of Sars, that's where a lot of fear comes from, but we're a lot more prepared to deal with those types of diseases," says Dr Josie Golding, from the Wellcome Trust.

### **Is it serious?**

Coronaviruses can cause symptoms ranging from a mild cold all the way through to death. This new virus appears to be somewhere in the middle. "When we see a new coronavirus, we want to know how severe are the symptoms - this is more than cold-like symptoms and that is a concern but it is not as severe as Sars," says Prof Mark Woolhouse, from the University of Edinburgh.

### **Where has it come from?**

New viruses are detected all the time. They jump from one species, where they went unnoticed, into humans.

"If we think about outbreaks in the past, if it is a new coronavirus, it will have come from an animal reservoir," says Prof Jonathan Ball, a virologist at the University of Nottingham. Sars jumped from the civet cat into humans.

And Middle East respiratory syndrome (Mers), which has killed 858 out of the 2,494 recorded cases [since it emerged in 2012](#), regularly makes the jump from the dromedary camel.

### **Which animal?**

Once the animal reservoir where the virus normally camps out is detected, the problem becomes much easier to deal with. The cases have been linked to the South China Seafood Wholesale Market, in

Wuhan. But while some sea-going mammals can carry coronaviruses ([such as the Beluga whale](#)), the market also has live wild animals, including chickens, bats, rabbits, snakes, which are more likely to be the source.

### **Why China?**

Prof Woolhouse says it is because of the size and density of the population and close contact with animals harbouring viruses.

"No-one is surprised the next outbreak is in China or that part of the world," he says.

### **How easily does it spread?**

Perhaps the single most reassuring fact about this outbreak is that the new virus does not appear to spread from one person to another.

This is a major concern with new viruses that infect the lungs, as coughs and sneezes are a highly effective way for a virus to spread.

If it was going person-to-person, then you would expect cases in healthcare workers as they come into close contact with sick patients.

Chinese officials say that has not happened.

However, some experts have cautioned it may be too soon to know whether there is human-to-human transmission.

Prof Ball says: "There would have to be 59 animal-to-human transmission events in a short amount of time, intuitively that does seem quite high, it is still an open question."

Prof Woolhouse says: "I'm cautious rather than sceptical, it is early too tell - most coronaviruses are actually transmissible and that would be my initial concern."

### **How fast is it spreading?**

So far, not very. All the 59 patients had symptoms start between 12 December and 29 December 2019. And there have been no further cases reported. "It's positive that we've not seen an expansion in cases," Dr Golding says. "China is taking it seriously and it could be contained, we have to wait and see."

Concerns remain, however, that the virus could be spread by the hundreds of millions of people travelling for Chinese New Year later this month.

### **How have Chinese authorities responded?**

Infected people have been treated in isolation to minimise the risk of the bug spreading. More than 150 people who have had contact with infected patients are being monitored for signs of the disease.

Extra checks such as temperature scans have been put in place to screen travellers. And the seafood market was closed for cleaning and disinfection.

### **How worried are the experts?**

Dr Golding says: "At the moment, until we have more information, it's really hard to know how worried we should be. "Until we have confirmation of the source, that's always going to make us uneasy."

Prof Ball says: "We should be worried about any virus that explores humans for the first time, because it's overcome the first major barrier.

"Once inside a [human] cell and replicating, it can start to generate mutations that could allow it to spread more efficiently and become more dangerous. "You don't want to give the virus the opportunity."

<https://bitly.is/2uKwqHZ>

## **Women with transplanted uterus gives birth to 'miracle' baby**

***A woman who gave birth to a boy she carried inside a transplanted womb said Thursday that the experimental procedure delivered a "miracle."***

NEW YORK – Jennifer Gobrecht and her husband, Drew Gobrecht, appeared Thursday at a news conference in Philadelphia. Their child, Benjamin, was the first baby born as part of Penn Medicine's 2-year-old uterine transplant trial, and the eighth baby in the United States to be born to the recipient of a uterus transplant, according to Penn.

Jennifer Gobrecht, 33, who was born without a uterus, underwent a 10-hour transplant procedure in 2018. The uterus came from a deceased donor.

"This journey has not been easy, but every time I look at Benjamin's face, I know it was worth it," she said. "Benjamin is truly a miracle, and we feel beyond lucky to have him."

There have been about 70 uterus transplants performed worldwide. Penn Medicine said its trial is one of the few to accept donations from both living and deceased donors, an approach it said that could pay dividends in the form of an expanded pool of donor organs. Most transplant programs accept only from living donors, according to Penn.

Some medical ethicists and transplant experts have expressed concerns about uterine transplants, questioning whether the benefit justifies the risk.

But Dr. Kathleen O'Neill, one of the lead trial investigators at Penn, said uterine transplantation could give couples like the Gobrechts another option besides adoption and the use of a gestational carrier.

"Uterus transplant is the only path to parenthood that will actually allow these women to carry their own pregnancies," she said.

Penn said trial participants will be followed for five to 10 years, from in vitro fertilization through long-term follow-up after delivery. Because of the risk of rejection, women with transplanted uteruses have hysterectomies after giving birth.

Gobrecht has Mayer-Rokitansky-Kuster-Hauser syndrome, a congenital condition that occurs in 1 of every 4,500 females. She learned at age 17 she wouldn't be able to carry a child.

"That was a very difficult thing to hear as a teenage girl who had dreams of being a loving mother," Gobrecht said. "Like many young girls, I dreamed of how it would feel to grow a baby in my womb, to feel them kick inside me, and those dreams disappeared."



Years later, she and her husband, both of suburban Ridley Park, Pennsylvania, underwent fertility treatments that produced several embryos. They were exploring a gestational carrier when Jennifer Gobrecht learned of the Penn trial.

Benjamin was born via Cesarean section in November.

“Two years ago, if you had told me I would be sitting here not only a mother but one who got to bear her own child, I simply would have not believe you,” Gobrecht said. “But here I am.”

<http://bit.ly/35OI7Ky>

### **Deadly fungus became resistant to all existing drugs in 3 unlinked US patients**

*It was considered an urgent threat before this.*

[Beth Mole](#) - 1/10/2020, 11:21 AM

A deadly fungal pathogen developed the ability to resist all existing antifungal drugs on three separate occasions in the United States, [according to a new report](#).

The fungus, *Candida auris*, was already classified as an "urgent threat" by the Centers for Disease Control and Prevention. But the emergence of so-called "pan-resistant" strains raises additional concern, according to the report's authors, who are infectious disease specialists at the CDC and the New York State Department of Health. They published their findings Thursday in the CDC's publication Morbidity and Mortality Weekly Report.

*C. auris* was first identified in 2009 in Japan and has since popped up in [nearly 40 countries](#). (It arrived in the US by 2013, and New York City, Chicago, and New Jersey have been hit the hardest.) [The insidious germ](#) is known for creeping around healthcare facilities and infecting vulnerable patients, causing invasive infections marked by nondescript fever and chills.

Somewhere between 30 percent and 60 percent of patients die from the infection. (Determining the exact fatality rate is tricky because

the fungus often preys upon patients already suffering from life-threatening conditions.)

Part of what makes *C. auris* strains so dangerous is that they seem to develop resistance to antifungal drugs relatively easily. Only three classes of antifungal drugs are used to treat *C. auris* infections: triazole, polyene, and echinocandins classes. And many strains are already resistant to one or two of those.

A survey of strains found in New York discovered that over 99 percent could withstand triazole drugs, while over 60 percent were resistant to polyene drugs. So far, resistance to echinocandins has been rare in the US and, as such, that class has been [the standard first-line treatment](#).

But, in the new MMWR report, the infectious-disease researchers describe just how easily that can change.

#### **Fortified fungi**

Surveillance of strains collected in the latter half of 2019 turned up three patients with pan-resistant *C. auris*, the report says. The patients were all in different medical facilities and had no contact or connection with each other.

In all three cases, the patients' *C. auris* infections started out with strains that were susceptible to echinocandins, and each was treated for prolonged periods with an echinocandin drug.

After months on the drugs, subsequent testing showed that their once echinocandin-susceptible infections had developed additional resistance, making them able to withstand all classes of drugs available.

Two of the patients died within weeks of investigators isolating their pan-resistant strains in 2019. Both had multiple underlying health conditions, were dependent on ventilators, and were colonized by multi-drug resistant bacteria. Thus, "the role of *C. auris* in their deaths is unclear," the infectious disease researchers report.

After those two patients were identified, investigators looked back at older samples from other patients. That's when they found the third case of pan-resistant *C. auris*, which was in a rectal swab taken from a patient in 2017.

In that case, the antifungal treatment had cleared the patient's initial drug-susceptible infection. But subsequent monitoring found the pan-resistant strain colonizing the patient, i.e., skulking around the patient's body without causing an infection. The patient died 10 months after the pan-resistant strain was isolated.

The researchers report that:

Although extensive investigations failed to document transmission of pan-resistant isolates from the three patients to other patients or the environment, the emergence of pan-resistance is concerning. The occurrence of these cases underscores the public health importance of surveillance for *C. auris*, the need for prudent antifungal prescribing, and the importance of conducting susceptibility testing on all clinical isolates, including serial isolates from individual patients, especially those treated with echinocandin medications.

### **Tenacious foe**

This isn't the first time that pan-resistant *C. auris* has been identified, the researchers note. Countries where *C. auris* arrived before reaching the United States have already reported increased resistance to echinocandin and their own pan-resistant strains.

Still, in an email to Ars, the New York State Department of Health added that "we cannot predict if pan resistance will develop again" here. The agency added that the measures outlined by the researchers in the MMRW report can "reduce the likelihood of development of pan resistance in the future."

In addition to trying to keep the menacing microbe from becoming more resistant, researchers are also working on trying to scrub it out

of healthcare facilities where it poses the most threat—which is extremely difficult.

Recent studies suggest that copious amounts of fungal cells can drip from infected or colonized patients, drenching their surroundings in infectious, drug-resistant germs. On plastic surfaces, those fungal cells can form steely clumps that can survive for weeks. Rigorous bleaching and disinfection measures can sometimes fail to kill off lurking fungi.

In the event that pan-resistant *C. auris* does show up again in the US, there may be some treatment options, the New York health department says.

Infectious-disease specialists should be called in and can make recommendations on a case-by-case basis. They might consider removing potentially contaminated medical devices or draining areas such as abscesses that might harbor *C. auris*. They could also try combination therapies or turn to experimental antifungal medications in development.

<https://bbc.in/2FKfLq5>

### **Languages affected differently by brain disease**

*There are differences in the way English and Italian speakers are affected by dementia-related language problems, a small study suggests.*

While English speakers had trouble pronouncing words, Italian speakers came out with shorter, simpler sentences.

The findings could help ensure accurate diagnoses for people from different cultures, the researchers said.

Diagnostic criteria are often based on English-speaking patients.

In the University of California study of 20 English-speaking patients and 18 Italian-speaking patients, all had primary progressive aphasia - a neuro-degenerative disease which affects areas of the brain linked to language.

It is a feature of Alzheimer's disease and other dementia disorders.

Brain scans and tests showed similar levels of cognitive function in people in both language groups.

But when the researchers asked participants to complete a number of linguistic tests, they picked up obvious differences between the two groups in the challenges they faced.

### 'Easier to pronounce'

"We think this is specifically because the consonant clusters that are so common in English pose a challenge for a degenerating speech-planning system," said study author Maria Luisa Gorno-Tempini, professor of neurology and psychiatry.

"In contrast, Italian is easier to pronounce, but has much more complex grammar, and this is how Italian speakers with [primary progressive aphasia] tend to run into trouble."

As a result, the English speakers tended to speak less while the Italian speakers had fewer pronunciation problems, but simplified what they did say.

English is a Germanic language while Italian is a Romance language, derived from Latin along with French, Spanish and Portuguese.

The researchers, [writing in Neurology](#), are concerned that many non-native English speakers may not be getting the right diagnosis "because their symptoms don't match what is described in clinical manuals based on studies of native English speakers".

The San Francisco research team says it now wants to repeat the research in larger groups of patients, and look for differences between speakers of other languages, such as Chinese and Arabic.

"We hope that such studies will advance our understanding of the brain science underlying language and language disorders, raise awareness of health disparities in dementia treatment, and ultimately improve care for all patients," said Prof Gorno-Tempini.

<http://bit.ly/2NkpgAy>

## Hikikomori: New definition helps identify, treat extreme social isolation

### *Modern tools to improve interpersonal communication may be having the opposite effect*

Experts in the Japanese phenomena of hikikomori say the condition of extreme social isolation is more widespread than previously acknowledged, and it deserves a clear and consistent definition to improve treatment across the globe. In an article [published in the February issue of the journal World Psychiatry](#), experts cite a lack of broad clinical understanding of the condition.

Although hikikomori is typically associated with young adults in Japan, the researchers say many of the same criteria of extended social isolation apply to people around the world, including among older adults and stay-at-home parents. A simplified and clear definition will improve the recognition and subsequent treatment for people who suffer from the condition, the authors write.

The article highlights four key aspects of the newly proposed definition of hikikomori:

*\* Confined at home: The proposed definition clarifies the frequency of time spent outside the home, while still meeting the definition of "marked social isolation."*

*\* Avoiding people: Some people choose to avoid social situations and interaction not because they're anxious but because it meets their comfort level. The newly suggested definition therefore removes the avoidance of social situations as a criteria.*

*\* Better defining distress: Many people diagnosed with hikikomori report that they feel content in their social withdrawal. However, as the duration of social withdrawal gets longer, their distress and feelings of loneliness increases.*

*\* Other disorders: Co-occurring mental health conditions such as depression should not exclude patients from also being assessed for and diagnosed with hikikomori.*

"In our view, the frequency of co-occurring conditions increases the importance of addressing social withdrawal as a health issue," they write.

Senior author Alan Teo, M.D., associate professor of psychiatry in Oregon Health & Science University School of Medicine and a researcher and psychiatrist in the VA Portland Health Care System, said the medical profession hasn't traditionally recognized social isolation as a health issue.

"There is a cultural issue within the house of medicine whereby we don't pay attention to it and don't think it is in our lane to deal with," he said. "These are shared problems, whether it's an 80-year-old Portlander who's a meals-on-wheels recipient living by herself or an 18-year-old with hikikomori in Japan." Ironically, modern tools to improve communication may be having the opposite effect.

"With advances in digital and communications technologies that provide alternatives to in-person social interaction, hikikomori may become an increasingly relevant concern," the authors write.

Spending time online can be damaging when it substitutes for interacting with people face to face, Teo said. Those person-to-person social relationships are a critical aspect of mental health.

"Your social life is critical to your quality of life - yet in health care, we often forget to think about that," Teo said. "A person's day-to-day social life is really what brings them meaning and value."

In addition to Teo, the other authors included Takahiro A. Kato, M.D., Ph.D., and Shigenobu Kanba, M.D., Ph.D., of Kyushu University in Japan.

The recommendations published online today in *World Psychiatry* represent an outgrowth of earlier collaboration between the three authors, including a perspective published in the journal *Psychiatry and Clinical Neurosciences* in 2019.

*Teo's work is supported by a Career Development Award (CDA 14-428) from the U.S. Veterans Health Administration Health Service Research and Development and the HSR&D Center to Improve Veteran Involvement in Care. The views expressed in the*

*paper are those of the authors and do not necessarily reflect the position nor policy of the U.S. Department of Veterans Affairs of the U.S. government.*

<http://bit.ly/35OBh7R>

## California considers selling its own generic prescription drugs

**"The cost of healthcare is just too damn high," California governor says.**

**[Beth Mole](#) - 1/11/2020, 1:45 AM**

California could become the first state to introduce its own brand of generic prescription drugs in an effort to drag down stratospheric healthcare costs.

The plan for state-branded drugs is part of California Gov. Gavin Newsom's budget proposal, which he is expected to unveil Friday, January 10.

"A trip to the doctor's office, pharmacy or hospital shouldn't cost a month's pay," Newsom said in a statement. "The cost of healthcare is just too damn high, and California is fighting back."

A plan for California to sell its own drugs would "[take the power out of the hands of greedy pharmaceutical companies](#)," Newsom said, according to the Associated Press.

Under the plan, the state would contract with one or more generic drug companies, which would manufacture select prescription drugs under a state-owned label, according to [an overview of the plan](#) reported by the Los Angeles Times. Those state generics would presumably be offered to Californians at a [lower price than current generics](#), which could spark [more competitive pricing](#) in the market overall.

So far, much of the plan's details are unclear, though, including which drugs might be sold and how much money they could save residents and the state.

The conceptual plan so far has garnered both praise and skepticism from health industry experts.



Anthony Wright, executive director of the advocacy group Health Access California, told the Associated Press that “Consumers would directly benefit if California contracted on its own to manufacture much-needed generic medications like insulin—a drug that has been around for a century yet the price has gone up over tenfold in the last few decades.”

Geoffrey Joyce, who heads the USC Schaeffer Center for Health Policy and Economics, meanwhile, [speculated to the Times](#) that the state might end up focusing on drugs that currently have little competition—which may mean manufacturing drugs that are less commonly used. “In terms of savings to a typical family, it would be very modest,” he predicted.

Industry lobbying group Pharmaceutical Research and Manufacturers of America (PhRMA) told reporters that it was withholding comment until more details about the plan were available.

If the plan moves forward, California would be the first state to have its own drug label. But it’s not the first to try to thwart the current drug market. As the Times notes, over 1,000 hospitals in 46 states banded together in 2018 with philanthropies to form a nonprofit drug-making venture called Civica Rx. The company manufactures generic injectable drugs used in hospitals, offering lower prices and stable supplies.

In October, it delivered its first generic drug, the antibiotic Vancomycin Hydrochloride, which had been subject to shortages. “This first delivery demonstrates the Civica model in action and is a dream come true,” Martin VanTrieste, president and CEO of Civica Rx, said [in a statement at the time](#). “We thank our founding philanthropies for prioritizing accessible and affordable healthcare.” The company has since [shipped several other essential medicines](#), including the blood thinner heparin and the opioid overdose rescue drug, naloxone.

<http://bit.ly/35TdUdq>

## Has the Average Human Body Temperature Always Been the Same?

*Evidence suggests that modern humans may be cooler than our 19th-century ancestors.*

By [Nicoletta Lanese - Staff Writer](#)

98.6. Why does that number ring a bell?

For years, the figure has held an important place in hospital rooms and physiology textbooks: 98.6 degrees Fahrenheit (37 degrees Celsius) is widely considered to be the “normal” average human body temperature.

But is this temperature still accurate? New research suggests the average American body temperature has dropped, and researchers think they know why.

A German physician named Carl Reinhold August Wunderlich [was the first to crunch the 98.6 degrees number](#) in 1851 after collecting millions of temperatures from about 2,500 patients in the city of Leipzig. “He took temperatures of everybody he could find, whether they were healthy ... sick, and he wrote a large book on temperature variation with illness,” said study senior researcher Dr. Julie Parsonnet, a professor of medicine and of health research and policy at Stanford University. Wunderlich's work also highlighted temperature variations between people of different sexes, ages, weights and heights.

“Almost everything he said was correct,” Parsonnet told Live Science. “He must have been sitting there with a pen, paper and pencil for an awful long time with all those temperatures.”

Since Wunderlich's pioneering efforts, doctors still use [body temperature](#) as a key vital sign to help determine a person's health status. We now know that body temperature fluctuates as much as 0.5 F (0.2 C) throughout the day; that young people generally stay warmer than elderly people; and that women tend to maintain a



higher temperature than men, depending on where they are in their menstrual cycles, according to a 2019 report in the journal [Open Forum Infectious Diseases](#). Our body temperature also varies with the weather, our level of physical activity and whether we've eaten recently.

But why is it that, in general, the human body tends to hover around 98.6 degrees?

Evidence suggests that the body maintains a relatively stable temperature in order to keep its many organs and chemical reactions running smoothly, and potentially [keep fungal infections at bay](#). But, according to the new study, published Jan. 7 in the journal [eLife](#), the ideal body temperature may no longer be 98.6 F.

Rather, the average body temperature among Americans has dropped about 0.05 F (0.02 C) every decade since the early 1800s, the researchers found. American men born in the 2000s measure an average 1.06 F (0.58 C) cooler than men born in the early 1800s. Women born in the 2000s measure about 0.58 F (0.32 C) cooler than women born in the 1890s. The big question is, why?

### Hot and cold

As an infectious disease researcher, Parsonnet has spent many years studying a [bacterial](#) disease caused by the [microorganism](#) *Helicobacter*. The bug causes open sores called ulcers in the esophagus, stomach and small intestine and raises affected people's risk of developing gastric cancers. Over the years, though, *Helicobacter* infections have become less common in the U.S.

"I became aware, because I worked on it for 30 years, that that organism is disappearing from populations in the United States," Parsonnet said. The change reflects a larger trend; compared with our 19-century relatives, modern humans catch far fewer infectious diseases. People who lived through the 1800s were plagued with recurrent [malaria](#), chronic wounds, [tuberculosis](#), never-ending dental disease and bouts of dysentery, Parsonnet said.

Today, we don't have all these bugs swimming through our bodies and revving our [immune systems](#) into overdrive. Parsonnet wondered how the loss of these microorganisms has altered human physiology through time.

To find out, Parsonnet and her co-authors dug through the data, including data sets from the American Civil War, the 1970s and the early 2000s. With these data sets combined, the researchers accrued more than 677,000 temperature measurements to examine.

The team spotted a steady drop in average human body temperature through the years. To rule out the possibility that improved thermometer technology had skewed the data, the researchers also looked for trends within each individual data set. Sure enough, the cooling trend appeared in each, regardless of the thermometer used by each historical group.

"We as human beings [have evolved over time](#) — physiologically changed," Parsonnet said. "We've changed from who we were in the 19th century, and who we were in the 1960s, to a different human today that's colder."

### Why does it matter?

The findings echo the results of a [2017 study](#) conducted in England that analyzed about 250,000 temperature measurements from more than 35,000 patients. The average temperature among the British patients measured about 97.88 F (36.6 C), down a significant fraction from the "normal" average temperature of 98.6 F (37 C). Although humankind seems to be growing cooler by the decade, what does this actually mean for our physiology?

It's still a mystery, Parsonnet said. "We don't really understand what this cooling means in humans, what it means to our health, what it means to our longevity," she said.

Perhaps our decreased body temperature likely reflects the historical decline in infectious disease rates — a trend that reduced excess inflammation in the human body to a significant degree, the

researchers wrote in the study. Inflammation produces proteins called cytokines that ramp up the body's metabolic rate, thus generating heat.

Additionally, unlike our ancestors, many people now live in a largely temperature-controlled world. "We don't have to work very hard to maintain our body temperature; it's always 70 F (21.1 C) in our houses," Parsonnet said.

Of course, it may be that people living in regions beyond the U.K. and the U.S. maintain entirely different body temperatures. For example, a [2008 study](#) determined that the average body temperature in Pakistan still hovers around 98.6 F. However, these slight temperature differences between populations likely don't alter how our bodies function, physiologically, Parsonnet said.

"It might affect how microbes function, [but] I don't think we know the answers to those questions at all," she said. On the level of individuals, only extreme temperature changes signal worrisome health issues, such as fever or hypothermia. On a grand scale, though, average body temperatures may continue to fall as medicine advances and life expectancy increases, Parsonnet added.

Body temperature is "a marker of inflammatory state. And if you can take the temperature of a population, you might be able to predict their life expectancy," she noted. Parsonnet added that, someday, both life expectancy and body temperature will likely level off and remain consistent into the future.