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"Game-changing" procedure shown to discontinue insulin treatment in type 2 diabetics

A revolutionary endoscopic therapeutic procedure may lead to the discontinuation of insulin treatment in a significant number of people with type 2 diabetes, new research presented today at UEG Week 2020 Virtual has shown

Vienna - A revolutionary endoscopic therapeutic procedure may lead to the discontinuation of insulin treatment in a significant number of people with type 2 diabetes, new research presented today at UEG Week 2020 Virtual has shown.

Researchers from the Netherlands tested a novel, minimally-invasive ablation procedure, which rejuvenates the lining of the duodenum, in combination with daily doses of glucose lowering drugs called glucagon-like peptide agonists (GLP-1 RAs) and mild lifestyle counselling.

The study found that 75% of previously insulin-dependent people with type 2 diabetes treated with the ablation technique did not need insulin six months later, with HbA1c (a long-term parameter of glucose control) readings of 7.5% or below. HbA1c readings also fell to 6.7% at 12 months.

Patients who responded to the treatment also saw significant reductions in their body mass index (BMI), which was down from an average of 29.8 kg/m2 at the beginning of the research to 25.5 kg/m2 after 12 months. The percentage of fat in their livers also decreased from 8.1% to 4.6% at 6 months. Obesity and fatty liver are both important risk factors in the development of metabolic syndrome, a term that encompasses diabetes, high blood pressure (hypertension), obesity, and high triglycerides.

In the non-responder patients, who still needed insulin, the median insulin dose they required fell by more than half (from 35 units per day at study entry to 17 units per day at 12 months).

The minimally-invasive technique, called Duodenal Mucosal Resurfacing (DMR), is performed in an outpatient setting and is delivered via an integrated over-the-wire catheter attached to a custom console that performs a synchronized lifting of the duodenal mucosa and then ablation of the treatment area.

Although the process is not yet fully understood, mucosal cells are believed to undergo alterations in a response to unhealthy diets, high in fat and sugar. This leads to changes in the production and signalling of key hormones that impact insulin resistance and diabetes. Resurfacing the lining appears to rejuvenate and reset this process.

The pilot study, undertaken in 16 patients, was led by Dr Suzanne Meiring, Dr. Annieke van Baar, and Professor Jacques Bergman from the Amsterdam University Medical Center in the Netherlands.

Dr Meiring explained: "This could be a game-changing approach in the treatment of metabolic syndrome. A single endoscopic DMR ablation with GLP-1 drugs and lifestyle counselling can lead to discontinuation of insulin therapy in a subset of patients with type 2 diabetes, while improving their blood glucose control and overall metabolic health. Many patients with type 2 diabetes are very happy to be able to discontinue insulin therapy, since insulin therapy comes with weight gain and hypoglycaemic events. Our earlier study, (Revita-1) with patients that used only oral medication for their diabetes type 2, showed that the effect of a single DMR was comparable to adding one glucose lowering drug."

There are about 60 million people in Europe with diabetes and the vast majority (around 90%) of cases are type 2. As well as age and a family history of the condition, high blood pressure and being overweight are major risk factors for type 2 diabetes.

"Based on the results of this study, a large international randomised controlled trial, called Revita T2Di Pivotal, will soon start to further investigate its effectiveness in greater numbers", added Dr Meiring.

References:
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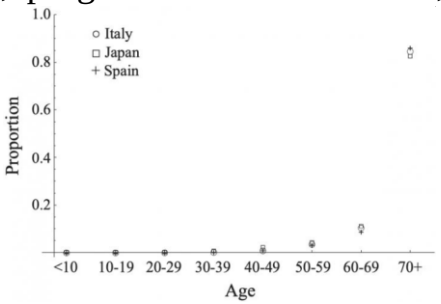
https://bit.ly/3dBLlXh

Age does not contribute to COVID-19 susceptibility

Scientists have estimated that the age of an individual does not indicate how likely they are to be infected by SARS-CoV-2.

However, development of symptoms, progression of the disease, and mortality are age-dependent.

There have been a large number of deaths due to the ongoing COVID-19 pandemic, and it has been shown that elderly individuals disproportionately develop severe symptoms and show higher mortality.



The age distribution of mortality by COVID-19 was similar in Italy (reported on 13th May 2020), Japan (reported on 7th May 2020), and Spain (reported on 12th May 2020). **Credit: Ryosuke Omori, Ryota Matsuyama, Yukihiko Nakata, Scientific Reports, October 6, 2020**

A team of scientists, including Associate Professor Ryosuke Omori from the Research Center for Zoonoses Control at Hokkaido University, have modeled available data from Japan, Spain and Italy to show that susceptibility to COVID-19 is independent of age, while occurrence of symptomatic COVID-19, severity and mortality is likely dependent on age. Their results were published in the journal *Scientific Reports* on October 6, 2020.

Causes of mortality in elderly individuals may be due to two factors: how likely they are to be infected due to their advanced age (age-dependent susceptibility), which is reflected in the number of cases; and, how likely they will be affected by a severe form of the disease due to their advanced age (age-dependent severity), which is reflected in the mortality rate. These factors are not fully understood for COVID-19.

The scientists chose to analyse data from Italy, Spain and Japan to determine if any relationship between age, susceptibility and severity.

These three countries were chosen as they have well recorded, publicly available data. As of May 2020, the mortality rate (number of deaths per 100,000) was 382.3 for Italy, 507.2 for Spain and 13.2 for Japan.

However, despite the wide disparity in mortality rates, the age distribution of mortality (the proportional number of deaths per age group) was similar for these countries.

The scientists developed a mathematical model to calculate susceptibility in each age group under different conditions. They also factored in the estimated human-to-human contact level in each age group, as well as varying restriction levels for outside-home activities in the three countries.

The model showed that the susceptibility has to be unrealistically different between age groups if they assume age does not influence severity and mortality.

On the other hand, the model indicated the age should not influence susceptibility but should negatively influence severity and mortality, to explain the fact that the age distribution of mortality is similar between the three countries.

Ryosuke Omori, from the Research Center for Zoonoses Control at Hokkaido University, specializes in epidemiological modelling: the use of mathematics and statistics to understand and predict the spread of diseases.

Since the outbreak of COVID-19, he has turned his efforts to ascertaining the true extent of the spread of the pandemic in Japan and abroad.

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Panic at the pump: Researcher explores role of gas stations in horror films

The gas station is often viewed as a harmless, benign stop for commuters and travelers. Looking back at a few classic horror films, however, these mainstays of the American landscape take on much deeper meanings.

by Mike Emery

University of Houston-Downtown researcher Dr. Chuck Jackson recently focused on three iconic horror films and the memorable (and frightening) scenes featuring gas stations. "Invasion of the Body Snatchers" (1956), "The Birds" (1962) and "Night of the Living Dead" (1968) all have pivotal moments centered around gas stations or gas pumps. During these respective eras, the gas station often served as a gateway to weekend escapes, day trips, vacations or other optimistic ventures. These films, however, juxtapose horrific situations with these otherwise benign and everyday environments.

He explores these scenes and deeper reflections on America's dependence on oil and gas in the article "Petrification and Petroleum: Affect, the Gas Pump and US Horror Films (1956–73)," which was recently published in the journal Film Studies.

"Starting in 1956, but throughout the 1960s, some of the most popular American horror films include a scene that takes place at a gas pump that goes terrifyingly wrong," said Jackson, Associate Professor of English and Coordinator of UHD's Film Studies Minor. "Each film destroys the presumed pleasures of getting gas to fuel a car as it heads to its next destination. Instead of a full tank, the films bring monstrosity and death."

The scenes Jackson explores include a menacing alien shape-shifting seed placed in a car's trunk by a dubious service attendant in "Body Snatchers"; an explosion caused by blood-thirsty fowl and a cigarette smoking citizen in "The Birds"; and a blinding explosion ignited by torch-wielding escapees from a zombie horde in "Living Dead." The characters' reactions to these events are what Jackson describes as "petrification meets petroleum."

As Jackson states at the onset of his article, these films "imbue scenes that take place at a gas pump with a horror so intense, it petrifies." Indeed, the reaction of protagonists to the events that take place at these service stations reflect paralyzing dread.

"The films uniquely join petroleum with petrification, or oil and the body's experience of terror—characters 'turn to stone' as they apprehend the horror of oil as an out of control and deadly force," he said.

He added that these fearful moments within these films counter the popularity of open highways and car culture found not just in films, but across the country.

"My argument is that the films index an alternative affect to what other scholars have termed the 'exuberance' of oil for Americans," he said. "The scenes elicit a feeling that is radically at odds with Big Oil's 1950s and 60s advertising and marketing campaigns and the seemingly progressive federal funding of our current national highway system—a project that guarantees private travel in individually owned cars will be the expectation for us all in the decades to come."

Jackson, also a Fellow in UHD's Center for Critical Race Studies, is a film scholar who frequently focuses his scholarly work on race and the horror genre. He previously explored the relationship between oil and gas and horror in the article "Blood for Oil: Crude Metonymies and Tobe Hooper's Texas Chain Saw Massacre (1974)" published in the journal Gothic Studies.

The horror genre, he said, provides deeper insights into human nature, culture and the environment than many audiences realize. His insights on the aforementioned films and the oil and gas

industries reveal much about ourselves and our reliance on these resources.

"As scholars have made clear, the horror genre asks viewers to take pleasure in what we would otherwise find unbearable—fear and disgust—and often this includes forms of oppressive power," he said. "These case studies have a pedagogical value as they teach us to feel differently about the stranglehold that oil culture has on the world, which only came into being as such an intense fashion less than 100 years ago."

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COVID-19 recovery at home possible for most patients

Cedars-Sinai emergency department researchers confirm the safety of home discharge for low-risk patients with COVID-19

LOS ANGELES -- A new study shows that the vast majority of patients who visited the Ruth and Harry Roman Emergency Department at Cedars-Sinai with suspected COVID-19 (novel coronavirus) symptoms, and who were treated and sent home to recuperate, recovered within a week.

The study, published by the *Journal of the American College of Emergency Physicians Open*, showed that none of those patients died from the virus and fewer than 1% required intensive care.

"When the pandemic began there was minimal evidence to guide us as to who should be hospitalized and who could be sent home," said Sam Torbati, MD, co-chair and medical director of the Ruth and Harry Roman Emergency Department at Cedars-Sinai. "In real time, we began developing our criteria for who needed hospitalization for monitoring, intensive care, and who could recover at home. And this study shows our patients received the appropriate level of care."

In the retrospective study, researchers looked at the outcomes of 452 patients who sought care at the Emergency Department for COVID-19 symptoms between March 12 and April 6, 2020.

The study showed that the patients, with a median age of 38, had experienced flu-like symptoms two to three days before they went to the Emergency Department. After being given a comprehensive care plan and then discharged home, it took an average of between five and seven days for patients to recover at home.

"What we learned from the study is that outpatient management is safe for most COVID-19 patients who have normal vital signs and no comorbidities," said first author Carl Berdahl, MD. "However, patients should be instructed to return to the Emergency Department for worsening symptoms, including labored breathing."

The study, which showed that no patients died, also found:

- ***Sixty-one percent of the patients in the sample had no comorbidities.***
- ***Thirteen percent of patients who were sent home came back to the Emergency Department for additional care.***
- ***The inpatient admission rate at 30 days was 4%, with fewer than 1% of patients requiring intensive care.***

"The takeaway for the public is that emergency clinicians can safely and readily identify patients with COVID-19 who are safe for outpatient monitoring," said Torbati. "Those who meet criteria for discharge are at very low risk of getting worse and requiring hospitalization."

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Stopping lethal lung damage from the flu with a natural human protein

Animal study shows treatment blocks inflammation and protects lungs without killing the flu virus

Columbus, Ohio - The raging lung inflammation that can contribute to death from the flu can be stopped in its tracks by a drug derived from a naturally occurring human protein, a new animal study suggests.

In mouse studies, all untreated animals given a lethal dose of

influenza died within days. All but one of the infected mice treated with the experimental therapy not only survived, but remained energetic and kept weight on - despite having high levels of the flu virus in their lungs.

The experimental treatment is a heavy dose of MG53, part of a family of proteins that plays an essential role in cell membrane repair. Already identified as a potential therapy for conditions ranging from Alzheimer's disease to persistent skin wounds, MG53 was found in this study to prevent death from a lethal flu infection by blocking excessive inflammation - without having any effect on the virus itself.

The researchers are currently testing the effects of the therapy in mice infected with SARS-CoV-2, the coronavirus that causes COVID-19.

"I haven't ever seen anything like this before," said Jacob Yount, associate professor of microbial infection and immunity at The Ohio State University and co-lead author of the study. "Even though these mice had the same viral load as the untreated mice, they didn't get very sick - with the lethal dose of the flu."

Yount, whose lab studies the immune response against viral infections, co-led the work with Jianjie Ma, professor of cardiac surgery at Ohio State, who discovered MG53 and its role in cell repair and has been developing the protein as a therapeutic agent.

The paper was published online Oct. 8 in the *American Journal of Respiratory and Critical Care Medicine*, and will appear in a future print issue.

The collaboration on this work grew out of a proposal by Matthew Sermersheim, a graduate student in Ma's lab, to expand on the investigation of MG53's links to inflammation. In the July 17 issue of Nature Communications, Sermersheim was the first author of a study showing that the lungs of mice lacking the MG53 gene and infected with flu responded with extensive inflammation compared to normal mice - indicating that MG53 has a protective role in the immune response.

For this new work, the scientists put MG53 to the test against influenza, which, along with other respiratory viruses, is a top-10 cause of death worldwide.

The researchers infected mice with a dose of an H1N1 strain of influenza and treated half with a placebo. Using recombinant human MG53, a molecule Ma's lab has been developing as a drug, the researchers treated the other half of mice with seven daily injections beginning 24 hours after infection. The untreated mice showed an aggressive loss of weight and died within nine days, but 92% of the treated mice lost very little weight, remained active and returned to their normal weight by two weeks after infection.

"The protein has a way to recognize tissue that's been injured and it can go there directly," Ma said. "We are basically enhancing a natural anti-inflammatory mechanism in the body so that when you face the crisis of an aggressive virus infection, the body can better defend itself."

Despite the strikingly different outcomes, the viral loads in both sets of mice were similar - meaning an MG53-based agent is not an anti-viral drug. Even teeming with the flu virus, the airways of treated mice showed little tissue damage.

Though the team is still working to fully identify how this protection occurs, the researchers determined that MG53 stops an immune response mishap called a "cytokine storm," which leads to tissue damage. The research also showed that MG53 mitigates an infection-related cell-death process called pyroptosis, which also promotes inflammation and lung dysfunction.

"A lot of the lung damage with the flu virus is actually caused by excessive inflammation from our own immune response," Yount said. "If you can dampen that hyperactive immune response, you'll have less tissue damage, even though the virus is still replicating at

really high levels."

Lung tissue damaged by inflammation is deadly because it allows fluid and cells to build up in airways, preventing the lungs from absorbing oxygen.

Ma's previous work in animal models suggests driving up levels of MG53 in the body for therapeutic purposes is safe: Mice his lab has genetically engineered to over-produce the protein live longer and healthier lives than normal mice. Though the scientists envision MG53 as part of a cocktail of drugs targeting deadly viral infections, they caution that much more research is needed before a therapy is available for humans.

"We need better anti-inflammatory tissue repair therapies," Ma said. "We don't have COVID-19 data yet, but even with influenza, which hits us on a seasonal basis, this application could make quite a bit of difference."

This work was supported by grants from the National Institutes of Health and the Department of Defense, and an Ohio State University Presidential Fellowship. Additional co-authors, all from Ohio State, include Adam Kenney, Zhongguang Li, Zehua Bian, Xinyu Zhou, Haichang Li, Bryan Whitson, Tao Tan and Chuanxi Cai. Ma and Tan have an equity interest in TRIM-edicine, Inc., which develops MG53 for treatment of human diseases. Patents on the use of MG53 are held by Ohio State and Rutgers University.

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Researchers have reversed Parkinson's disease in mice

Infecting astrocytes with a virus made them develop into neurons

Ellie Tanimura

Parkinson's Disease is a movement disorder caused by the progressive loss of dopamine neurons in a brain-region called the substantia nigra (SN). Current treatments only relieve symptoms temporarily because they don't reverse what causes them: the loss of neurons.

In a study recently published in *Nature*, researchers demonstrated that it is possible to reverse neuronal loss by converting astrocytes (helper brain cells) into neurons. They did so by injecting an astrocyte-targeting virus into the brains of mice. The simple virus suppressed the production of a protein called PTB, which blocks astrocytes from making neuronal proteins.

With lower levels of PTB, these infected astrocytes could produce neuronal proteins, and became increasingly similar to neurons. Eventually, the former astrocytes were structurally and functionally indistinguishable from their neuronal counterparts! Following this conversion, researchers not only saw a significant restoration of dopamine neurons in the SN, but a full correction of movement symptoms in the mice.

As bizarre as growing back a part of your brain sounds, the discovery of this new technique has transformed the idea of reversing Parkinson's disease from a fantasy to a potential reality.

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Statins may reduce cancer risk through mechanisms separate to cholesterol

New findings suggest the potential use of statins for cancer prevention should be "urgently evaluated"

Cholesterol-lowering drugs called statins may reduce cancer risk in humans through a pathway unrelated to cholesterol, says a study published today in *eLife*.

Statins reduce levels of LDL-cholesterol, the so-called 'bad' cholesterol, by inhibiting an enzyme called HMG-CoA-reductase (HMGCR). Clinical trials have previously demonstrated convincing evidence that statins reduce the risk of heart attacks and other cardiovascular diseases. But evidence for the potential effect of statins to reduce the risk of cancer is less clear.

"Previous laboratory studies have suggested that lipids including cholesterol play a role in the development of cancer, and that statins inhibit cancer development," explains lead author Paul Carter, Cardiology Academic Clinical Fellow at the Department of Health and Primary Care, University of Cambridge, UK. "However, no

trials have been designed to assess the role of statins for cancer prevention in clinical practice. We decided to assess the potential effect of statin therapy on cancer risk using evidence from human genetics."

To do this, Carter and the team studied genetic variants that mimic the effect of statins using a technique known as Mendelian randomization in UK Biobank, a large study of UK residents that tracks the diagnosis and treatment of many serious illnesses. Mendelian randomization assesses associations between genetically predicted levels of a risk factor and a disease outcome, in order to predict the extent to which that risk factor causes the outcome. For example, it can compare the risk of cancer in patients who inherit a genetic predisposition to high or low levels of cholesterol, in order to predict whether lowering cholesterol levels will reduce the risk of cancer. This study is the first Mendelian randomization analysis of lipid subtypes for a range of cancers across the human body.

The team obtained associations of lipid-related genetic variants with the risk of overall cancer and 22 cancer types for 367,703 individuals in UK Biobank. In total, 75,037 of these individuals had a cancer event.

Their analysis revealed that variants in the HMGCR gene region, which represent proxies for statin treatment, were associated with overall cancer risk, suggesting that statins could lower overall cancer risk. Interestingly, variants in gene regions that represent other cholesterol-lowering treatments that work differently to statins were not associated with cancer risk, and genetically predicted LDL-cholesterol was not associated with overall cancer risk.

"Taken together, these results suggest that inhibiting HMGCR with statins may help reduce cancer risk though non-lipid lowering mechanisms, and that this role may apply across cancer sites," Carter says. "This effect may operate through other properties of statins, including dampening down inflammation or reducing other chemicals produced by the same cellular machinery which synthesises cholesterol."

Despite the large sample size of more than 360,000 participants and the broad set of outcomes analysed in this study, the team adds that there are a number of limitations to this work. For example, for many cancer types, there were not enough outcome events needed in the analysis to rule out the possibility of moderate causal effects.

"While there is evidence to support our assumption that genetic variants in relevant gene regions can be used as proxies for pharmacological interventions, our findings should be considered with caution until they are confirmed in clinical trials. However, our work highlights that the effectiveness of statins must be urgently evaluated by large clinical trials for potential use in cancer prevention," says senior author Stephen Burgess, Group Leader at the Medical Research Council Biostatistics Unit, part of the University of Cambridge. "While statins do have some adverse effects, our findings further weight the balance in favour of these drugs reducing the risk of major disease."

Reference

The paper 'Predicting the effect of statins on cancer risk using genetic variants from a Mendelian randomization study in UK Biobank' can be freely accessed online at https://doi.org/10.7554/eLife.57191. Contents, including text, figures and data, are free to reuse under a CC BY 4.0 license.

This study was originally posted on medRxiv at https://www.medrxiv.org/content/10.1101/2020.02.28.20028902v1.

https://bit.ly/3kjTstS

Research offers path to end world hunger within decade

The world's small-scale farmers now can see a path to solving global hunger over the next 10 years

The world's small-scale farmers now can see a path to solving global hunger over the next decade, with solutions—such as

adopting climate-resilient crops through improving extension services—all culled rapidly via artificial intelligence from more than 500,000 scientific research articles.

The results are synthesized in 10 new research papers—authored by 77 scientists, researchers and librarians in 23 countries—as part of Ceres2030: Sustainable Solutions to End Hunger. The project is headquartered at Cornell University, with partners from the International Food Policy Research Institute (IFPRI) and the International Institute for Sustainable Development (IISD).

The papers were published concurrently on Oct. 12 in four journals—*Nature Plants*, *Nature Sustainability*, *Nature Machine Intelligence* and *Nature Food*—and assembled in a comprehensive package online: Sustainable Solutions to End Hunger.

Ceres2030 employed machine learning, librarian savvy and research synthesis methods to quickly scan a trove of thousands of scientific journals for ideas and websites from more than 60 agencies that can help eradicate world hunger.

"We're all bombarded with new research information and the question we must be asking is how do we make decisions from all of that information," said Ceres2030 principal investigator and co-director Jaron Porciello.

The United Nations' Sustainable Development Goal No. 2, known as SDG2, calls for ridding the world of hunger by 2030. Currently, more than 690 million people—about 8.9% of the world's population—are food-insecure, according to the United Nation's Food and Agriculture Organization (FAO). Due to the COVID-19 pandemic, that global statistic could easily rise by 10 million people a year from now, and by nearly 60 million people in five years.

"We're trying something new that hasn't been done before," Porciello said. "We know the tools weren't there, the methods weren't there and the teams weren't in place. Now, we've created some staircases to make science and world reality connect a little bit more. This approach could be replicated to build a scientific evidence base for many of the world's most complex policy problems"

More information: *Sustainable Solutions to End Hunger: www.nature.com/collections/dhiggjeagd*

https://wb.md/2IF5Tml

Recall Widens for Diabetes Drug Metformin

The recall of extended-release metformin continues this month as 76 more lots have been flagged for a possible cancer-causing ingredient.

Aaron Gould Sheinin

The FDA announced the latest recall, involving Marksans Pharma Limited and Sun Pharmaceutical Industries products, on Oct. 5. It involves the 500mg and 700mg tablets. More than 175 different drug combinations have been recalled since late May.

Consumers can see all the recalled metformin products at this FDA website. The agency says that immediate-release metformin does not appear to have the same contamination problem.

The FDA has been investigating the presence of nitrosamines, known to be a possible carcinogen, in the popular diabetes medications since December, when it was first discovered in drugs in other countries. The agency said this month they still do not know the source of nitrosamines in the medications.

The investigation, and subsequent recalls, follows similar ones for contamination of popular heartburn and blood pressure drugs, also for nitrosamines, such as N-Nitrosodimethylamine (NDMA).

The FDA says patients taking metformin products that have been recalled should continue taking the medication until a doctor or pharmacist gives them a replacement or a different treatment option. It could be dangerous for patients with type 2 diabetes to stop taking the medication without first talking to their doctor.

The agency has asked drug manufacturers to test products before

batches are released into the market. The companies must tell the FDA if any product shows levels of nitrosamines above the acceptable limit.

The risks from nitrosamines is not clear. The FDA says they may increase the risk of cancer in people who are exposed to high levels over a long period of time, "but we do not anticipate that shorter term exposure at levels above the acceptable intake limit would lead to an increase in the risk of cancer."

Sources

FDA.gov: "Questions and Answers: NDMA impurities in metformin products," "FDA Updates and Press Announcements on NDMA in Metformin," "Marksans Pharma Limited Issues Expansion of Voluntary Nationwide Recall of Metformin Hydrochloride Extended-Release Tablets, USP 500mg & 750mg, Due to the Detection of N-Nitrosodimethylamine (NDMA)."

https://bit.ly/31leMrw

COVID-19 lockdowns averted tens of thousands of premature deaths related to air pollution

Averted tens of thousands of deaths in regions where air pollution has a significant impact on mortality

Lockdowns initiated to curb the spread of the coronavirus in China and Europe at the beginning of the pandemic improved air quality, averting tens of thousands of deaths in regions where air pollution has a significant impact on mortality, a new study shows.

According to research published in *The Lancet Planetary Health*, scientists at the University of Notre Dame found that particulate matter concentrations in China dropped by an unprecedented 29.7 percent, and by 17.1 percent in parts of Europe, during lockdowns that took place between Feb. 1 and March 31 in China and Feb. 21 to May 17 in Europe. Particulate matter (PM2.5) -- tiny airborne particles smaller than 1/10,000 of an inch in diameter -- comes from various combustion-related sources including industrial emissions, transportation, wildfires and chemical reactions of pollutants in the atmosphere.

"We look on these lockdowns as the first global experiment of forced low-emission scenarios," said Paola Crippa, assistant professor in the Department of Civil and Environmental Engineering and Earth Sciences at Notre Dame and corresponding author of the study. "This unique, real-world experiment shows us that strong improvements in severely polluted areas are achievable even in the short term, if strong measures are implemented."

Air pollution is considered the leading environmental cause of death. In 2016, the World Health Organization attributed air pollution to 4.2 million premature deaths worldwide, with Western Pacific and Southeast Asian regions being the most affected. Long-term exposure can be hazardous to human health, with premature death associated to lung cancer, ischemic heart disease, stroke and chronic obstructive pulmonary diseases.

Crippa and her team integrated advanced computer simulations with measured particulate matter concentrations from more than 2,500 sites in Europe and China in total between Jan. 1, 2016, and June 30, 2020 -- during which both regions initiated lockdowns as COVID-19 began spreading rapidly.

The team estimated rates of premature death against four different economic recovery scenarios: an immediate resumption to normal activity and subsequent emissions, a gradual resumption with a three-month proportional increase of emissions, the potential of a second outbreak of COVID-19 between October and December in each region, and a permanent lockdown for the remainder of 2020 in the case of ineffective control strategies.

"The most surprising part of this work is related to the impact on human health of the air quality improvements," Crippa said. "It was somewhat unexpected to see that the number of averted fatalities in the long term due to air quality improvements is similar to the COVID-19 related fatalities, at least in China where a small number of COVID-19 casualties were reported. These results underline the

severity of air quality issues in some areas of the world and the need for immediate action."

From February to March, the study found an estimated 24,200 premature deaths associated with particulate matter were averted throughout China compared to 3,309 reported COVID-19 fatalities, and "improvements in air quality were widespread across China because of extended lockdown measures." The study found the situation in Europe to be quite different. While COVID-19 related deaths were far higher in Europe compared to what was reported in China, an estimated 2,190 deaths were still avoided during the lockdown period when compared to averages between 2016 and 2019. The averted fatalities figures become much larger (up to 287,000 in China and 29,500 in Europe) when considering long-term effects, which will depend on the future pathway of economic recovery.

The study serves as an example of the need for ad hoc control policies to be developed to achieve effective air quality improvements, said Crippa, and highlights the issue of risk perception between the current immediate crisis of the coronavirus pandemic versus the ongoing crisis of hazardous pollutants in the atmosphere.

"In China, we saw that lockdowns implied very significant reductions in PM2.5 concentrations, which means that policies targeting industrial and traffic emissions might be very effective in the future," Crippa said. "In Europe those reductions were somewhat smaller but there was still a significant effect, suggesting that other factors might be considered to shape an effective mitigation strategy."

Those strategies could include subsidies to electric vehicles, prioritizing public transport in heavily trafficked cities and adoption of more stringent emission limitations for industries. Heating emissions and agriculture are also contributors to total particulate matter concentrations. In the study, researchers stressed that aggressive mitigation strategies to reduce air pollution could achieve significant improvements to health, stating, "If interventions of a similar scale to those adopted to address the COVID-19 pandemic were widely and systematically adopted, substantial progress towards solving the most pressing environmental and health crisis of our time could be achieved."

Co-authors of the study include Paolo Giani, Stefano Castruccio, Wenjing Hu and Don Howard, all at Notre Dame, and Alessandro Anav with the Italian National Agency for New Technologies, Energy and Sustainable Economic Development. Crippa is an affiliate member of Notre Dame's Environmental Change Initiative.

The study combined aspects of epidemiology, environmental engineering, statistics and philosophy for a comprehensive analysis and interpretation of results through collaboration with Notre Dame's Department of Applied and Computational Mathematics and Statistics and the Department of Philosophy.

https://wb.md/348X4cT

COVID-19 Doesn't Seem Seasonal, Study Says

Respiratory viruses tend to be seasonal, but the coronavirus that causes COVID-19 seems to be a year-round nuisance

Carolyn Crist

Respiratory viruses tend to be seasonal, including the two most common flu viruses, but the coronavirus that causes COVID-19 seems to be a year-round nuisance, according to a new study published in the journal *Nature*.

Environmental factors such as humidity and temperature don't appear to affect the coronavirus as much as other viruses, which flourish more in the dry, cold months in the winter.

Coronavirus transmission "can still happen in warm and humid places, as seen in the U.S. during the past summer months," Mauricio Santillana, one of the study authors and an epidemiologist at the Harvard T.H. Chan School of Public Health, told Yahoo Life.

The research team investigated epidemiological data from Johns Hopkins University, as well as major public health organizations such as the WHO, CDC, European CDC and China CDC. They

looked at several additional countries, including Iran, Italy, Singapore, Japan, South Korea, as well as 345 cities in China.

Based on the spatial patterns of COVID-19, the transmission doesn't seem to be affected by temperature, humidity or human movements alone. In fact, higher temperatures may have led to an increase in transmission in 122 cities in China, Santillana said, and the coronavirus has thrived in both cold provinces and tropical locations globally.

However, the study findings don't "negate the possibility that temperature and humidity could play a modulating role on COVID-19 transmission as they do in influenza transmission," he added.

For now, the study authors suggest that people continue to wear face masks and follow social distancing guidelines since most people have still not been exposed to the coronavirus worldwide.

"We will have to follow preventive measures to protect the most vulnerable groups all year round," Santillana said. "This may change as more people get infected and/or if an effective and broadly available vaccine becomes available."

Sources

Nature, "The role of environmental factors on transmission rates of the COVID-19 outbreak: an initial assessment in two spatial scales."

Yahoo Life, "COVID-19 may not be seasonal like the flu, study finds: 'Transmission has not slowed down during warm months.'"

https://bit.ly/3j9ZTi7

All-terrain microrobot flips through a live colon

A rectangular robot as tiny as a few human hairs can travel throughout a colon by doing back flips.

West Lafayette, Ind. -- A rectangular robot as tiny as a few human hairs can travel throughout a colon by doing back flips, Purdue University engineers have demonstrated in live animal models.

Why the back flips? Because the goal is to use these robots to transport drugs in humans, whose colons and other organs have rough terrain. Side flips work, too.

Why a back-flipping robot to transport drugs? Getting a drug directly to its target site could remove side effects, such as hair loss or stomach bleeding, that the drug may otherwise cause by interacting with other organs along the way.

The study, published in the journal *Micromachines*, is the first demonstration of a microrobot tumbling through a biological system in vivo. Since it is too small to carry a battery, the microrobot is powered and wirelessly controlled from the outside by a magnetic field.

"When we apply a rotating external magnetic field to these robots, they rotate just like a car tire would to go over rough terrain," said David Cappelleri, a Purdue associate professor of mechanical engineering. "The magnetic field also safely penetrates different types of mediums, which is important for using these robots in the human body."

The researchers chose the colon for in vivo experiments because it has an easy point of entry - and it's very messy.

"Moving a robot around the colon is like using the people-walker at an airport to get to a terminal faster. Not only is the floor moving, but also the people around you," said Luis Solorio, an assistant professor in Purdue's Weldon School of Biomedical Engineering.

"In the colon, you have all these fluids and materials that are following along the path, but the robot is moving in the opposite direction. It's just not an easy voyage."

But this magnetic microrobot can successfully tumble throughout the colon despite these rough conditions, the researchers' experiments showed. A video explaining the work is available on YouTube at https://youtu.be/9OsYpJFWnN8.

The team conducted the in vivo experiments in the colons of live mice under anesthesia, inserting the microrobot in a saline solution through the rectum. They used ultrasound equipment to observe in real time how well the microrobot moved around.

The microrobots could also tumble in colons excised from pigs, the researchers found, which have similar guts to humans.

"Moving up to large animals or humans may require dozens of robots, but that also means you can target multiple sites with multiple drug payloads," said Craig Goergen, Purdue's Leslie A. Geddes Associate Professor of Biomedical Engineering, whose research group led work on imaging the microrobot through various kinds of tissue.

Solorio's lab tested the microrobot's ability to carry and release a drug payload in a vial of saline. The researchers coated the microrobot with a fluorescent mock drug, which the microrobot successfully carried throughout the solution in a tumbling motion before the payload slowly diffused from its body an hour later.

"We were able to get a nice, controlled release of the drug payload. This means that we could potentially steer the microrobot to a location in the body, leave it there, and then allow the drug to slowly come out. And because the microrobot has a polymer coating, the drug wouldn't fall off before reaching a target location," Solorio said.

The magnetic microrobots, cheaply made of polymer and metal, are nontoxic and biocompatible, the study showed. Cappelleri's research group designed and built each of these robots using facilities at the Birck Nanotechnology Center in Purdue's Discovery Park.

Commonly-used roll-to-roll manufacturing machinery could potentially produce hundreds of these microrobots at once, Cappelleri said.

The researchers believe that the microrobots could act as diagnostic tools in addition to drug delivery vehicles.

"From a diagnostic perspective, these microrobots might prevent the need for minimally invasive colonoscopies by helping to collect tissue. Or they could deliver payloads without having to do the prep work that's needed for traditional colonoscopies," Goergen said.

This research is part of the Purdue Center for Cancer Research and aligns with Purdue Engineering Initiatives in Autonomous and Connected Systems and Engineering-Medicine. The work is supported by the National Science Foundation and the National Cancer Institute at the National Institutes of Health.

ABSTRACT

A Tumbling Magnetic Microrobot System for Biomedical Applications

Elizabeth E. Niedert, Chenghao Bi, Georges Adam, Elly Lambert, Luis Solorio, Craig J. Goergen and David J. Cappelleri

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A microrobot system comprising an untethered tumbling magnetic microrobot, a two-degree-of-freedom rotating permanent magnet, and an ultrasound imaging system has been developed for in vitro and in vivo biomedical applications. The microrobot tumbles end-over-end in a net forward motion due to applied magnetic torque from the rotating magnet. By turning the rotational axis of the magnet, two-dimensional directional control is possible and the microrobot was steered along various trajectories, including a circular path and P-shaped path. The microrobot is capable of moving over the unstructured terrain within a murine colon in in vitro, in situ, and in vivo conditions, as well as a porcine colon in ex vivo conditions. High-frequency ultrasound imaging allows for real-time determination of the microrobot's position while it is optically occluded by animal tissue. When coated with a fluorescein payload, the microrobot was shown to release the majority of the payload over a 1-h time period in phosphate-buffered saline. Cytotoxicity tests demonstrated that the microrobot's constituent materials, SU-8 and polydimethylsiloxane (PDMS), did not show a statistically significant difference in toxicity to murine fibroblasts from the negative control, even when the materials were doped with magnetic neodymium microparticles. The microrobot system's capabilities make it promising for targeted drug delivery and other in vivo biomedical applications.

https://bit.ly/357m4Ak

Decoy Cells Trick SARS-CoV-2, Reduce Cytokines In Vitro

Genetically engineered cells that overproduce ACE2, the receptor the novel coronavirus uses to enter cells, neutralize infection in vitro and mop up inflammatory cytokines in mice.

Max Kozlov

Scientists have summoned every trick in the book to develop a COVID-19 treatment over the last few months, from stem cells and synthetic antibodies to common over-the-counter medications and tried-and-true steroids. Some have even attempted to lure SARS-CoV-2 away from human cells by using molecular decoys. But few have tried to distract the novel coronavirus with fake human cells. Scientists reported in *PNAS* last week (October 6) that genetically engineered cells can bind and neutralize the coronavirus in vitro. They envision that such cellular decoys could be deployed to combat infections.

"It's a very elegant study," says Karolinska Institute molecular toxicologist Bengt Fadeel, who was not involved in this study. "Provided that you know the receptor of a given virus, you could, in principle, adopt this approach to intercept any virus."

Xiaoyuan Chen, a senior investigator at the National Institute of Biomedical Imaging and Bioengineering at the National Institutes of Health (NIH), pivoted from developing nanotechnology to diagnose and treat cancers to study SARS-CoV-2 when the virus began spreading around the world early this year. He had seen previous reports of using decoy receptors to trick pathogens such as HIV and was curious if the emerging technique might work against SARS-CoV-2.

To find out, Chen and his collaborators at Wuhan University fused membranes from human monocytic THP-1 cells, a cell line derived from leukemia, with membranes from human embryonic kidney cells that overproduce the ACE2 receptors that SARS-CoV-2 grabs hold of to infiltrate cells. Chen says they hoped that, if the hybrid vesicles were injected in vivo, the virus would ignore unmodified human cells and instead home in on the decoys. Once attached to the engineered cells' ACE2, the virus would be absorbed and neutralized, according to Chen.

By embedding monocytic membranes, which have cytokine receptors, into the engineered vesicles, the decoys can bind with inflammatory cytokines such as IL-6, preventing them from building up and causing cytokine storms, overreactive immune responses thought to contribute to more severe COVID-19.

The idea of a decoy to thwart SARS-CoV-2 infection is not a new one. One team of scientists created a decoy using engineered, free-floating ACE2 receptors that bind especially well with the virus. Their decoys, which the developers propose can "significantly block early stages of SARS-CoV-2 infections," are now in a Phase 2 clinical trial run by Apeiron Biologics. In a July preprint, pharmacologist Gaurav Sahay of Oregon State University described a method that delivers engineered mRNA that codes for ACE2 to the liver of mice using lipid nanoparticles, causing ACE2 decoys to be translated and secreted into the blood. He found that the method successfully led to an increase of ACE2 decoys in vivo and they inhibited a modified, nonpathogenic version of SARS-CoV-2 in vitro.

Chen's new spin on the concept is to couple the decoys with cytokine receptors. "The combination of [ACE2 and cytokine receptors in] the vesicle structure is something new," says Sahay, who was not involved in Chen's study. "It's a very exciting development."

Researchers tested the nanodecoys by incubating both SARS-CoV, responsible for the 2003 SARS outbreak, and SARS-CoV-2, which causes COVID-19, in human and monkey cells, and found that the

decoys significantly inhibited viral infection, regardless of cell or virus type.

To test whether the decoys could work outside a petri dish, researchers induced acute lung inflammation in mice by having them inhale lipopolysaccharide, an irritant. Four hours later, the mice inhaled the nanodecoys, and after eight hours, the researchers collected fluid from the mice's lungs. They found that the decoys successfully mopped up cytokines compared to mice that did not receive decoys.

"This study is rather straightforward," says Chen. "It's surprising that such a simple approach is able to neutralize the virus, at least at the cellular level, and in vivo neutralize cytokines within hours. For COVID-19, a rapid response is essential, and these nanodecoys do just that."

While these results suggest that these decoys can neutralize cytokines in mice's lungs, their ability to block a SARS-CoV-2 infection was not tested in mice. Chen cited a shortage of the transgenic mice bearing human *ACE2* that would be needed to conduct such experiments.

Mice that received the nanodecoys showed no adverse reaction to the treatment, which is encouraging, says Fadeel, but he says he wonders if that would hold true in humans as well, particularly because the engineered cells use material from human cancer cells. "I would be cautious about administering small bits of cancer cells, especially into the lungs," he says.

Sahay also notes that cell membranes in the lungs, arteries, heart, kidney, and intestines produce ACE2 for a reason—it cleaves angiotensin, a protein that raises blood pressure. He questions if the decoys might impair the body's ability to regulate blood pressure, as angiotensin may bind to the decoys.

Neither Chen nor his colleagues at Wuhan University currently have plans to test the decoys in humans, but he filed a patent for their design through the NIH. "It's a very simple approach—almost too simple," says Chen. "That's the beauty of this study."

L. Rao et al., "Decoy nanoparticles protect against COVID-19 by concurrently adsorbing viruses and inflammatory cytokines," PNAS, doi:10.1073/pnas.2014352117, 2020.

https://bit.ly/3m0ODqa

Monkey study suggests that they, like humans, may have 'self-domesticated'

Ever since Darwin's time, some scientists have speculated that humans "self-domesticated"

It's not a coincidence that dogs are cuter than wolves, or that goats at a petting zoo have shorter horns and friendlier demeanors than their wild ancestors. Scientists call this "domestication syndrome" -- the idea that breeding out aggression inadvertently leads to physical changes, including floppier ears, shorter muzzles and snouts, curlier tails, paler fur, smaller brains, and more.

Asif Ghazanfar, a professor of neuroscience and psychology at Princeton University, led a team of scientists who determined that changing an infant monkey's vocal development also changed a physical marker of domesticity: a patch of white fur on its forehead. **Credit: Rebecca Terrett and Lauren Kelly, Ghazanfar Lab, Princeton University**

The link appears to come from certain neural crest cells, present before birth and in newborns, that have a versatility akin to stem cells. These neural crest cells can turn into a handful of different things, specifically adrenal cells -- which boost the strength of the "fight or flight" response -- as well as physical traits like larger teeth and stiffer ears.

Ever since Darwin's time, some scientists have speculated that humans "self-domesticated" -- that we chose less aggressive and more helpful partners, with the result that we have shifted the trajectory of our own evolution.

"The evidence for this has been largely circumstantial," said Asif Ghazanfar, a professor of psychology and neuroscience. "It's really a popular and exciting idea but one that lacks direct evidence, a link between friendly behavior and other features of domestication."

To see if the story could be put on a robust foundation, Ghazanfar turned to marmoset monkeys. Like humans, marmosets are extremely social and cooperative, plus they have several of the physical markers consistent with domestication, including a patch of white fur on their foreheads that is common in domesticated mammals.

What does cooperation look like in a monkey? Friendly vocal exchanges, caring for each other's young, and sharing food, among other signs, said Ghazanfar.

The research team showed that the size of a marmoset's white fur patch was strongly related to how frequently it produced friendly vocal responses to another. This is the first set of data to show an association between a friendly behavior and a physical domestication trait in individual animals.

To show a causal link between the white patch and vocal behavior, the researchers tested infant twins in different ways. In very brief sessions, one twin got reliable vocal feedback from a simulated parent -- a computer programmed with adult calls that responded to 100% of their vocalizations -- while the other twin only heard parental responses to 10% of their sounds.

These experimental sessions lasted 40 minutes, every other day, for most of the first 60 days of the monkeys' lives. For the other 23+ hours of each day, the monkeys were with their families.

In previous work, Ghazanfar and his colleagues showed that the infants who received more feedback learned to speak -- or more precisely, developed their adult-sounding calls -- faster than their siblings. By also measuring the white fur patches on the developing monkeys' foreheads at the same time and for three more months, the researchers discovered that the rate of the white facial coloration development was also accelerated by increased parental vocal responses. This shows a developmental connection between facial fur coloration and vocal development -- they are both influenced by parents.

That connection may be via those neural crest cells that can turn into "fight or flight" cells and that also contribute to parts of the larynx, which is necessary for producing vocalizations.

Domestication in other species has also been linked to changes in vocal behavior. Foxes selected for tameness have altered their vocalizations in response to the presence of humans. Similarly, a tame Bengalese finch learns and produces a more complex song, and retains greater song plasticity in adulthood, than its wild cousins.

But this is the first study linking the degree of a social trait with the size of a physical sign of domestication, in any species, said the researchers. Their findings are detailed in an article published online in the journal *Current Biology*. Ghazanfar's co-authors include Daniel Takahashi, a former postdoctoral researcher who is now a professor of neuroscience at Federal University of Rio Grande do Norte, Brazil; Rebecca Terrett of the Class of 2016; Lauren Kelly, Ghazanfar's former lab manager, who now works at Rutgers-Robert Wood Johnson Medical School; and two collaborators from New York University, James Higham and Sandra Winters.

"If you change the rate of the marmosets' vocal development, then you change the rate of fur coloration," said Ghazanfar. "It's both a fascinating and strange set of results!"

"Domestication Phenotype Linked to Vocal Behavior in Marmoset Monkeys," by Asif A. Ghazanfar, Lauren M. Kelly, Daniel Y. Takahashi, Sandra Winters, Rebecca Terrett, James P. Higham was published in Current Biology on Oct. 15. The research was supported by a National Institutes of Health-National Institute of Neurological Disorders and Stroke grant to A.A.G. (R01NS054898).

https://bit.ly/31h60Lc

This Startup Is Making Fully Edible 'Plastic' Sauce Packets Out of Seaweed

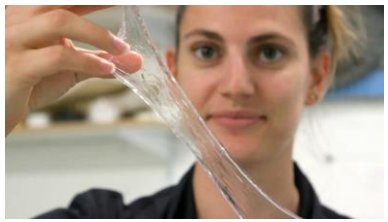
From a pile of seaweed to a packet of soy sauce.

Claire Price

The London startup Notpla has created a plastic alternative from seaweed that's biodegradable - and even edible. And it's hoping it could put a dent in the 300 million tons of plastic waste humans generate each year.

Notpla's natural plastic-like casing is biodegradable within four to six weeks, the company says, compared to the several hundred years it takes synthetic plastics to biodegrade.

The membrane is made from seaweed farmed in northern France. It's dried and ground down into powder, and then a secret recipe transforms it into a thick, gloopy fluid, which dries to form a plastic-like substance.



Gooey membrane that hardens into plastic-like material. **(Claire Price/Business Insider Today)**

The company shot to fame five years ago with edible water pods that you swallow after use - they proved popular among runners at the London Marathon and other events. The company's now exploring other uses for the technology.

Seaweed is more eco-friendly than starch-based alternatives since it doesn't need land, or time, to grow.

"It's one of the resources that is the most abundant," Notpla cofounder Rodrigo Garcia said. "One of the seaweeds we use grows up to 1 metre per day. Can you imagine something growing that fast? You don't need fertiliser, you don't need to put water on it, and it's a resource that we have been using for a long time."

Later this year, Notpla is launching a new line of disposable food containers that are free from synthetic chemicals and are covered with a waterproof and greaseproof lining.

The cardboard completely decomposes in three to six weeks, compared to three months for untreated cardboard and hundreds of years for cardboard lined with a kind of plastic known as PLA.

"What we've done is replace the PLA with our natural material, so even if it does enter nature, it will degrade naturally like a piece of fruit or a vegetable," Juno Wilson, Notpla's projects and business manager, told Business Insider Today.

Notpla's pricing is private, but it sells products wholesale to companies whose customers value their eco-friendly credentials.

Single-use plastics are everywhere in our daily life, and account for more than half of the 300 million tons of plastic made every year.

That makes some people sceptical about what kind of impact these small-scale alternatives actually have.

One survey conducted by Everyday Plastic founder Daniel Webb revealed that we're throwing away even more plastic this year than last. And much of it about 8 million tons a year ends up in the ocean. And the pandemic has made the problem worse.

"Before lockdown, we found that people were throwing away about 99 pieces of plastic in a single week," Webb said. "During lockdown, we found that 128 pieces of plastic were being thrown away by households in a single week, which is a difference of around 25 percent to 30 percent."

Notpla's founders see plastic use as a tough addiction that needs to be broken. They're working on new packets for food and drink, as well as clothes and screws for ready-to-assemble furniture.

"It's all about impact. We started this because we wanted to be part of a solution to this plastic crisis. That's what drives all this team," said cofounder Pierre Paslier. "So that's a really exciting problem to work on."

https://bit.ly/3o5eZJp

A deadly long-distance hunter: DNA study reveals insights about the scimitar-toothed cat

'Their genetic makeup hints towards scimitar-toothed cats being highly skilled hunters

Along with the woolly mammoth and the giant ground sloth, the sabre-toothed cats were probably among the most famous animals that lived during the Pleistocene Epoch and went extinct before the end of last ice age. Over the years, sabre-toothed cats have also been the subject of many research projects.

Now, for the first time, researchers from the University of Copenhagen have succeeded in mapping the entire nuclear genome of a sabre-toothed cat, the scimitar-toothed cat "Homotherium latidens". Their DNA study reveals what genes were highly selected upon and important in evolution of the species.

'Their genetic makeup hints towards scimitar-toothed cats being highly skilled hunters. They likely had very good daytime vision and displayed complex social behaviours. They had genetic adaptations for strong bones and cardiovascular and respiratory systems, meaning they were well suited for endurance running. Based on this, we think they hunted in a pack until their prey reached exhaustion with an endurance-based hunting-style during the day light hours,' says co-first author Michael Westbury, Postdoc at the Section for Evolutionary Genomics, GLOBE Institute, University of Copenhagen.

Abundant species

The researchers extracted DNA from a Homotherium fossil recovered from Pleistocene permafrost sediments near Dawson City, Yukon Territory, Canada. This specimen was so old it could not be dated using conventional radio-carbon dating meaning that it was at least 47.5 thousand years old.

They then used a variety of modern genomic sequencing techniques to map the entire genome of the fossil. They used complex comparative analyses to modern living cat species such as lions and tigers and showed that this sabre-toothed cat were very genetically diverse, relative to modern cat species.

'We know that genetic diversity correlates to how many of a given species that exists. Based on this, our best guess is that there were a lot of these big cats around. This also makes perfect sense given that their fossils have been found on every single continent except Australia and Antarctica,' says Michael Westbury.

***Illustration of "Homotherium Latidens "*. Credit: University of Copenhagen**

Synergies with medical research and bioinformatics

Their analysis also showed that the sabre-toothed cat is very distantly related to all modern cats. They diverged from them around least 22.5 million years ago. In comparison, humans and gibbons split between 15 and 20 million years ago.

'This was an extremely successful family of cats. They were present on five continents and roamed the earth for millions of years before going extinct. The current geological period is the first time in 40 million years that earth has lacked sabretooth predators. We just missed them' says co-first author Ross Barnett.

The researchers also emphasize that their study is an example of how different fields of research can benefit from each other. They hope to see similar bioinformatics methods used on many other extinct animals in the future.

'Modern advancements within medicine and genetic research means that the sequencing methods are a lot better for us now than they were just a few years ago. On top of that, we know what specific genes are associated with in animals and humans from medical research. This means that we can infer a lot of things about extinct

animals as we have done here. You could say that the fast progression of medical research has made this study possible,' says professor Tom Gilbert.

https://bit.ly/2FGN7tH

Moon's Ancient Magnetosphere May Have Helped Early Earth Retain Its Atmosphere

When the Moon had a magnetic field, it would have been shielded from incoming solar wind

Solar storms strip a planet's atmosphere over time, and only a strong magnetosphere would be able to provide maximum protection. Lunar samples gathered by NASA's Apollo missions recently revealed that the Moon had its own global magnetosphere, lasting from about 4.25 to 2.5 billion years ago. According to new research, the Earth-Moon coupled magnetospheres presented a previously unrecognized protective barrier against the solar wind for our home planet, reducing Earth's atmospheric loss to space.

Planetary researchers once thought that the Moon never had a long-lasting global magnetic field because it has such a small core.

They have long known about Earth's magnetic field, which causes the beautifully colored aurorae in the Arctic and Antarctic regions.

But thanks to recent studies of the lunar samples from the Apollo missions, they figured out that the Moon once had a magnetosphere, too.

Like Earth, the heat from the Moon's formation would have kept iron flowing deep inside, although not for nearly as long because of its size. "It's like baking a cake: You take it out of the oven, and it's still cooling off. The bigger the mass, the longer it takes to cool off," said lead author Dr. James Green, chief scientist at NASA's Headquarters in Washington, DC.

Dr. Green and colleagues created a computer model to look at the behavior of the magnetic fields of the Earth and Moon about 4 billion years ago.

At certain times, the Moon's magnetosphere would have served as a barrier to the harsh solar radiation raining down on the Earth-Moon system. That's because, according to the model, the magnetospheres of the Moon and Earth would have been magnetically connected in the polar regions of each object.

Importantly for the evolution of Earth, the high-energy solar wind particles could not completely penetrate the coupled magnetic field and strip away the atmosphere.

But there was some atmospheric exchange, too. The extreme UV light from the Sun would have stripped electrons from neutral particles in Earth's uppermost atmosphere, making those particles charged and enabling them to travel to the Moon along the lunar magnetic field lines. This may have contributed to the Moon maintaining a thin atmosphere at that time, too.

The discovery of nitrogen in lunar rock samples support the idea that Earth's atmosphere, which is dominated by nitrogen, contributed to the Moon's ancient atmosphere and its crust.

The scientists calculate that this shared magnetic field situation, with Earth and Moon's magnetospheres joined, could have persisted from 4.1 to 3.5 billion years ago.

"Understanding the history of the Moon's magnetic field helps us understand not only possible early atmospheres, but how the lunar interior evolved," said co-author Dr. David Draper, deputy chief scientist at NASA's Headquarters in Washington, DC.

"It tells us about what the Moon's core could have been like — probably a combination of both liquid and solid metal at some point in its history — and that is a very important piece of the puzzle for how the Moon works on the inside."

Over time, as the Moon's interior cooled, our nearest neighbor lost its magnetosphere, and eventually its atmosphere.

The field must have diminished significantly 3.2 billion years ago, and vanished by about 1.5 billion years ago. Without a magnetic

field, the solar wind stripped the atmosphere away.

"If our Moon played a role in shielding our planet from harmful radiation during a critical early time, then in a similar way, there may be other moons around terrestrial exoplanets in our Milky Way Galaxy that help preserve atmospheres for their host planets, and even contribute to habitable conditions," the authors said.

"This would be of interest to the field of astrobiology — the study of the origins of life and the search for life beyond Earth."

The study was published in the journal *Science Advances*.

James Green et al. 2020. When the Moon had a magnetosphere. Science Advances 6 (42): eabc0865; doi: 10.1126/sciadv.abc0865

https://bit.ly/34aYSlF

Putin touts second dubious approval of an unproven COVID-19 vaccine

It has only been tested in 100 people, and there's no published data.

Beth Mole

Russian President Vladimir Putin on Wednesday announced the second dubious approval of a COVID-19 vaccine that has not been evaluated in clinical trials.

The vaccine, dubbed EpiVacCorona, is said to be a synthetic peptide-based vaccine, which uses fragments of the pandemic virus SARS-CoV-2 to spur protective immune responses in those vaccinated. It was developed by Vector State Virology and Biotechnology Center, a former Soviet bioweapons research lab.

Like the first Russian-approved vaccine, whether EpiVacCorona is actually safe and effective is completely unknown. In a televised news conference, Putin said that early trials involving 100 people were successful. But researchers have not published any safety or efficacy data from those trials. Russian health officials have said they are still reviewing the vaccine for "safety and quality" but declined to provide any additional information on the vaccine, data, or approval process.

Moreover, EpiVacCorona has not yet entered larger clinical trials necessary to determine safety and efficacy. Generally, data from late-stage clinical trials (Phase III trials) are required for standard regulatory approval. Those trials tend to involve tens of thousands of participants, who are closely followed for months to assess how effective the vaccine is at preventing infection and to monitor for rare side-effects.

Still, Putin touted the new vaccine in the news conference, revealing that Deputy Prime Minister Tatyana Golikova and the head of Russia's consumer safety watchdog Anna Popova have both been given doses of EpiVacCorona as part of a clinical trial.

The dearth of data on EpiVacCorona echoes what was seen in August, when Russia approved its first COVID-19 vaccine, Sputnik V. That vaccine was also approved without published data after being tested in only 76 people. Early trial results have since been released on the vaccine, but researchers quickly noted oddities in the data. Sputnik V is now in large Phase III trials.

And, like EpiVacCorona, Putin announced the approval of Sputnik V while noting early, high-profile vaccinations. Putin revealed that one of his own daughters had received a dose of the vaccine.

https://bit.ly/2T62XBh

Pinpointing the 'silent' mutations that gave the coronavirus an evolutionary edge

RNA folding may help explain how the coronavirus became so hard to stop after it spilled over from wildlife to humans.

Durham, N.C. -- We know that the coronavirus behind the COVID-19 crisis lived harmlessly in bats and other wildlife before it jumped the species barrier and spilled over to humans.

Now, researchers at Duke University have identified a number of "silent" mutations in the roughly 30,000 letters of the virus's genetic code that helped it thrive once it made the leap -- and possibly

helped set the stage for the global pandemic. The subtle changes involved how the virus folded its RNA molecules within human cells.

For the study, published Oct. 16 in the journal *PeerJ*, the researchers used statistical methods they developed to identify adaptive changes that arose in the SARS-CoV-2 genome in humans, but not in closely related coronaviruses found in bats and pangolins.

"We're trying to figure out what made this virus so unique," said lead author Alejandro Berrio, a postdoctoral associate in biologist Greg Wray's lab at Duke.

Previous research detected fingerprints of positive selection within a gene that encodes the "spike" proteins studding the coronavirus's surface, which play a key role in its ability to infect new cells.

The new study likewise flagged mutations that altered the spike proteins, suggesting that viral strains carrying these mutations were more likely to thrive. But with their approach, study authors Berrio, Wray and Duke Ph.D. student Valerie Gartner also identified additional culprits that previous studies failed to detect.

The researchers report that so-called silent mutations in two other regions of the SARS-CoV-2 genome, dubbed Nsp4 and Nsp16, appear to have given the virus a biological edge over previous strains without altering the proteins they encode.

Instead of affecting proteins, Berrio said, the changes likely affected how the virus's genetic material -- which is made of RNA -- folds up into 3-D shapes and functions inside human cells.

What these changes in RNA structure might have done to set the SARS-CoV-2 virus in humans apart from other coronaviruses is still unknown, Berrio said. But they may have contributed to the virus's ability to spread before people even know they have it -- a crucial difference that made the current situation so much more difficult to control than the SARS coronavirus outbreak of 2003.

The research could lead to new molecular targets for treating or preventing COVID-19, Berrio said.

"Nsp4 and Nsp16 are among the first RNA molecules that are produced when the virus infects a new person," Berrio said. "The spike protein doesn't get expressed until later. So they could make a better therapeutic target because they appear earlier in the viral life cycle."

More generally, by pinpointing the genetic changes that enabled the new coronavirus to thrive in human hosts, scientists hope to better predict future zoonotic disease outbreaks before they happen.

"Viruses are constantly mutating and evolving," Berrio said. "So it's possible that a new strain of coronavirus capable of infecting other animals may come along that also has the potential to spread to people, like SARS-CoV-2 did. We'll need to be able to recognize it and make efforts to contain it early."

CITATION: "Positive Selection Within the Genomes of SARS-CoV-2 and Other Coronaviruses Independent of Impact on Protein Function," Alejandro Berrio, Valerie Gartner, Gregory A Wray. PeerJ, October 16, 2020. DOI: 10.7717/peerj.10234

https://wb.md/3m0LdUi

Widespread COVID-19 Vaccine Could Be Ready by April, Fauci Says

A "safe and effective" coronavirus vaccine may be widely available by April, a top infectious disease expert said on Wednesday.

Carolyn Crist

"That would be predicated on the fact that all of the vaccines that are in clinical trials have been proven to be safe and effective," Anthony Fauci, MD, the director of the National Institute of Allergy and Infectious Diseases, told CBS Evening News.

Fauci spoke about several coronavirus-related topics in the 30-minute interview, including the national surge in cases, vaccine progress and holiday gatherings.

Based on the current clinical trial timelines, researchers will likely

know by November or December whether a safe vaccine candidate is ready, he said. A few million doses may be available by then, and a larger number of doses would be available by the end of the first quarter of 2021.

If all six companies that have received federal funding can produce a safe and effective vaccine, about 700 million doses could be ready in the spring, Fauci said, though not all of the companies may be ready by then.

"There will be hundreds of millions of doses available, but available to use in a person would mean that the vaccine would have to have been proven to be safe and effective," he said.

The recent pause by Johnson & Johnson to investigate an unexplained illness should reassure people who are worried about safety, Fauci added. "When those things occur, we jump all over that," he said. "We want to find out what the reason is and if it's associated with the vaccine."

Until a vaccine is widely available, Fauci warned against large gatherings and indoor events. Thanksgiving gatherings and other holiday celebrations could lead to a surge in coronavirus cases, particularly if family members and friends travel from other locations and need to travel through airports. He encouraged people to wear face masks, use good ventilation and "try and keep windows open."

"Don't be afraid to wear a mask in your house if you're not certain that the persons in the house are negative," he said.

More virus transmission is happening in households, he added, which people should keep in mind this fall and winter.

"Don't assume because you're in your own home with your own family that you're not going to spread infection," he said. "You may feel perfectly well, and when you were outside speaking with someone…they transmitted the virus to you, and then you're in danger of transmitting it to your family."

https://bit.ly/37qPY81

Fats fighting back against bacteria

Droplets of fat inside our cells are helping the body's own defence system fight back against infection, University of Queensland researchers have discovered.

The international collaboration between UQ Institute for Molecular Bioscience researchers Professor Robert Parton and Professor Matt Sweet, and the University of Barcelona's Professor Albert Pol found that these fat droplets are both a food source and weapon against bacterial invaders.

"It was previously thought that bacteria were merely using the lipid droplets to feed on, but we have discovered these fatty droplets are involved in the battle between the pathogens and our cells," Professor Parton said.

"Fat is part of the cell's arsenal—cells manufacture toxic proteins, package them into the lipid droplets, then fire them at the intruders.

"This is a new way that cells are protecting themselves, using fats as a covert weapon, and giving us new insights into ways of fighting infection."

With antibiotic-resistant superbugs on the rise, researchers are determined to find alternative ways to fight infection.

One possibility is ramping up the body's natural defences.

"We showed that upon infection of white blood cells called macrophages, lipid droplets move to the part of the macrophage where the bacteria are present," Professor Sweet said.

The bacterial infection also changed the way that white blood cells used energy.

"Lipid droplets can be used as a fuel source for mitochondria when there aren't enough other nutrients," Professor Sweet said.

"During an infection, lipid droplets move away from the mitochondria and attack the bacteria instead, altering metabolism of the cell."

Cell biologist Professor Parton was inspired to continue this research after the phenomenon was seen in fruit flies.

"Most people thought the lipid droplets were 'blobs of fat', only useful for energy storage but now we are seeing that they act as metabolic switches in the cell, defend against infection and much more—there are now entire scientific conferences of researchers working on them," he said. "Our next step is to find out how the lipid droplets target the bacteria. "By understanding the body's natural defences, we can develop new therapies that don't rely on antibiotics to fight drug-resistant infections."

This research is published in *Science*.

More information: *"Immiscible immunity," Science (2020). science.sciencemag.org/cgi/doi ... 1126/science.abe7891*

"Mammalian lipid droplets are innate immune hubs integrating cell metabolism and host defense," Science (2020). science.sciencemag.org/cgi/doi ... 1126/science.aay8085

https://bit.ly/37jOnOJ

This might be one of the biggest breakthroughs of the coronavirus pandemic

Researchers have devised a coronavirus score based on blood test results for two molecules that can predict severe COVID-19 cases.

By Chris Smith @chris_writes

Fall brought a resurgence of the coronavirus in the northern hemisphere, the so-called second COVID-19 wave that health experts anticipated. It's not just that colder weather and lower humidity favor the spread of a virus that still quite resilient during the summer months. The virus is also taking advantage of people who are either have covid fatigue or who still deny the virus exists. Many people still think they're safe just because they do not suffer from other medical conditions or are relatively young. While COVID-19 generally kills older people and those with preexisting conditions, there are plenty of exceptions to those rules. There's no way to tell how your COVID-19 experience will be if you catch it. And while doctors have made significant progress when it comes to saving lives and reducing the death toll, many people still succumb to COVID-19 complications on a daily basis.

A team of doctors has devised a first of its kind COVID-19 severity score to predict the severity of the illness in individuals. Knowing in advance that a patient's condition is about to worsen might be the kind of valuable information that can save lives. Doctors would be forewarned and could take appropriate measures in the early stages of the illness to attempt to stop the onset of complications before they arrive.

If the Dublin-Boston score proves that it can indeed save more COVID-19 patients, it might be one of the biggest breakthroughs of the coronavirus pandemic so far. It also might become just as popular as other medical scores you might be familiar with: the Apgar score that doctors use to assess the condition of newborn babies quickly. As a parent or doctor, you always want that score to be a perfect 10, which is an indication the baby does not need any sort of emergency attention after birth.

The Dublin-Boston score is named after the two hospitals that contributed to the research, RCSI, Harvard University, Beaumont Hospital in Dublin, and the Brigham and Women's Hospital in Boston. Their study was published in *The Lancet's EBioMedicine* (via *ScieTechDaily*).

This new prognostic score is calculated using a ratio between two markers of inflammation: interleukin-6 (IL-6) and interleukin-10 (IL-10). IL-6 is a pro-inflammatory marker and IL-10 is anti-inflammatory. The score attempts to determine cytokine fluctuations — and the term "cytokine" has been made quite popular during the pandemic. It's the so-called "cytokine storms" that can kill patients, sending the immune response into overdrive so it attacks both infected cells and healthy tissue. "Using inflammatory cytokine balance as a means to project outcome makes mechanistic sense," the researchers explain. "Both IL-6 and

IL-10 are inextricably linked to cell metabolism, which in turn is influenced by factors such as infection, severe inflammation, hypoxia, and obesity, all of which are encountered in patients with COVID-19 who require hospitalization."

"Both the Dublin-Boston score and the 4-day change in IL-6:IL-10 ratio significantly outperformed IL-6 alone in predicting clinical outcome at day 7," the paper reads. A study from April indicated that raised troponin and IL-6 levels are associated with a poor COVID-19 prognosis.

The levels of IL-6 and IL-10 markers change in severe COVID-19 cases. The researchers came up with the ratio between them as well as a point system. Each 1-point increase is means that a more severe outcome is 5.6 times more likely. The higher the score, the worse the prognosis.

The scientists selected 80 patients for the study, and their treating physicians were blind to the levels of IL-6 and IL-10 or the Dublin-Boston score while attending them. This way, they wouldn't adapt the therapies based on those measurements.

"The Dublin-Boston score is easily calculated and can be applied to all hospitalized Covid-19 patients," RCSI Professor of Medicine Gerry McElvaney told *SciTechDaily*. "More informed prognosis could help determine when to escalate or de-escalate care, a key component of the efficient allocation of resources during the current pandemic. The score may also have a role in evaluating whether new therapies designed to decrease inflammation in Covid-19 actually provide benefit."

As with other COVID-19 studies, more research might be required to verify whether the Dublin-Boston score can save lives. For example, the researchers also warn of the risks involved in attempting to correct the value of the ratio with treatment. "While the Dublin-Boston score and changes in the IL-6:IL-10 ratio both predict clinical outcome and give an insight into the pathogenesis of COVID-19 inflammation, we emphasize that these data alone do not support attempts to manipulate the ratio directly as a therapeutic target. Although IL-6 may contribute to organ injury and death in sepsis syndromes, it is also required for innate immunity and microbial clearance. Imprecise inhibition of the pro-inflammatory effects may therefore represent a double-edged sword."

Whether or not it works, researchers will not stop looking for markers that might allow them to predict severe COVID-19 complications. Other ideas already exist, including a common blood test that might predict the severity of the illness.

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Remdesivir Fails to Prevent Covid-19 Deaths in Huge Trial

Critics said the study, sponsored by the W.H.O., was too poorly conducted to be definitive.

By Katherine J. Wu and Gina Kolata

Remdesivir, the only antiviral drug authorized for treatment of Covid-19 in the United States, fails to prevent deaths among patients, according to a study of more than 11,000 people in 30 countries sponsored by the World Health Organization.

A study by the World Health Organization found that remdesivir did not reduce deaths in a large group of patients. "This puts the issue to rest," one scientist said. **Credit...Amr Abdallah Dalsh/Reuters**

The drug was granted emergency authorization by the Food and Drug Administration on May 1 after a trial by the National Institutes of Health found that remdesivir modestly reduced the time to recovery in hospitalized patients. President Trump received the antiviral after he began showing symptoms earlier this month.

"This puts the issue to rest — there is certainly no mortality

benefit," said Dr. Ilan Schwartz, an infectious disease physician at the University of Alberta in Canada.

But other scientists said the design of the W.H.O.'s sprawling clinical trial, which collected data from hundreds of hospitals, meant the conclusions were not definitive.

Conducted in dozens of countries with various health care systems and inconsistent treatment protocols, the data are difficult to analyze and compare, said Dr. Peter Chin-Hong, an infectious disease expert at the University of California, San Francisco.

The findings, which were posted online on Thursday, have not yet been peer-reviewed or published in a scientific journal.

Remdesivir, which was originally developed as a treatment for Ebola and hepatitis C, interferes with the reproduction of viruses by jamming itself into new viral genes.

The N.I.H. study also did not find that remdesivir prevented deaths in patients with Covid-19. Dr. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, acknowledged in the spring that remdesivir was not a "knockout" drug.

A final analysis, published in The New England Journal of Medicine on Oct. 8, suggested "a trend toward reduced mortality" in certain patients receiving remdesivir, according to the drug's maker, Gilead.

Gilead disputed the conclusions of the W.H.O. study on Thursday, noting that a variety of drugs and drug combinations had been evaluated under a wide range of circumstances and that more rigorous studies had found a benefit.

"Consequently, it is unclear if any conclusive findings can be drawn from the study results," the company said in a prepared statement.

Dr. Andre Kalil, a principal investigator of the federal study of remdesivir and an infectious disease expert at the University of Nebraska Medical Center, faulted the W.H.O. trial for not having a placebo group, and for allowing patients and doctors to know which treatments were administered. So-called open-label trials can skew the reporting of results.

There was "a large amount of missing data" on the patients, he added, which "cannot be fixed by a large sample size, no matter how large it is."

Coronavirus Schools Briefing: It's back to school — or is it?

The antiviral has been administered to thousands of patients since its emergency authorization. The drug costs $3,120 per treatment course for patients with private insurance in the United States.

Although originally cleared only for use in people who were sick enough to need supplemental oxygen or breathing support, remdesivir's emergency authorization was expanded in August to include all hospitalized patients, regardless of disease severity.

The move was criticized by some experts, who said the F.D.A. had made the shift without sufficient evidence.

The W.H.O.'s study, called the Solidarity trial, enrolled more than 11,300 adults with Covid-19 in 405 hospitals in 30 countries. The participants were given four drugs singly or in combination: remdesivir, hydroxychloroquine, lopinavir, interferon or interferon plus lopinavir. About 4,100 received no drug treatment.

In the end, no drug or combination reduced mortality, the chances that mechanical ventilation would be needed, or time spent in the hospital, compared with the patients without drug treatment.

Several previous studies had pointed to the futility of hydroxychloroquine and lopinavir as treatments against the coronavirus. Less data has been published on interferon, a molecule produced by the immune system in response to viruses.

In their manuscript, the study's authors called the overall findings "unpromising" and said they "suffice to refute early hopes" that any of the drugs tested "will substantially reduce inpatient mortality,

initiation of ventilation or hospitalization duration."

The remdesivir findings aren't terribly surprising, based on previous research, but they are "still impactful," especially given the dizzying size of the Solidarity trial, said Dr. Maricar Malinis, an infectious disease specialist at Yale University.

Still, several experts noted that some of the drugs in the trial may benefit people with Covid-19 earlier in the course of their illness.

"All the emerging evidence points to interferon treatment being effective at the early, viral phase of Covid-19," said Eleanor Fish, an immunologist at the University of Toronto.

Until enough data emerge to group patients by factors like the stage of disease they are in, "it is premature to dismiss some of these repurposed drugs as 'ineffective' and to suggest they should not be evaluated further," Dr. Fish said.

As for remdesivir, "I don't think this study is the nail in the coffin," said Dr. Taison Bell, a critical care physician at the University of Virginia. "But I do think it shows that we have to be selective about the patient population we use it in."

Mr. Trump, who was hospitalized on Oct. 2, the day after his diagnosis, may have been well-suited to receive remdesivir, Dr. Bell said.

The president had not been symptomatic for long, and though his oxygen levels dropped on two occasions, his doctors did not need to put the president on a breathing machine. He did receive supplemental oxygen.

Severe Covid-19 is thought to be driven largely by an overly exuberant immune response that starts several days after the virus infects the body. Before that happens, an antiviral might tamp down the virus enough to protect a person from the immune system's overreaction.

Administering remdesivir after that stage may be pointless, Dr. Schwartz said, adding, "The horse is out of the barn."

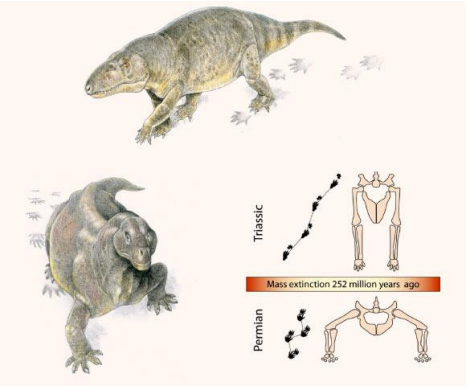
https://bit.ly/3m1aJZv

End-Permian Extinction Triggered Switch to Warm-Bloodedness

The ancestors of both mammals and birds became warm-blooded at the same time, some 250 million years ago, in the time of the end-Permian mass extinction, according to new research from the University of Bristol.

The end-Permian extinction, also known as the Permian-Triassic extinction event and the Great Dying, is the Earth's most severe mass extinction that peaked about 252.3 million years ago.

The catastrophe killed off nearly 96% of all marine species and 70% of terrestrial vertebrate species on the planet over the course of thousands of years.



Posture shift at the end of the Permian period, 252 million years ago. Before the crisis, most reptiles had sprawling posture; afterwards they walked upright. This may have been the first sign of a new pace of life in the Triassic. **Image credit: Jim Robins, University of Bristol.**

Calculations of sea water temperature indicate that at the peak of the extinction, the Earth underwent hot global warming, in which equatorial ocean temperatures exceeded 40 degrees Celsius (104 degrees Fahrenheit).

Among the possible causes of this event, and one of the most long-hypothesized, is that massive burning coal led to catastrophic global warming, which in turn was devastating to life.

Two main groups of tetrapods survived, the synapsids and archosaurs, including ancestors of mammals and birds respectively.

Paleontologists had identified indications of warm-bloodedness (endothermy) in these Triassic survivors, including evidence for a

diaphragm and possible whiskers in the synapsids.

More recently, similar evidence for early origin of feathers in dinosaur and bird ancestors has come to light.

In both synapsids and archosaurs of the Triassic, the bone structure shows characteristics of warm-bloodedness.

The evidence that mammal ancestors had hair from the beginning of the Triassic has been suspected for a long time, but the suggestion that archosaurs had feathers from 250 million years ago is new.

But a strong hint for this sudden origin of warm-bloodedness in both synapsids and archosaurs at exactly the time of the Permian-Triassic mass extinction was found in 2009.

In their research, University of Bristol's Professor Mike Benton and Masters student Tai Kubo analyzed fossilized footprints and found that all medium-sized and large tetrapods switched from sprawling to erect posture right at the Permian-Triassic boundary.

The paleontologists looked at a sample of hundreds of fossil trackways, and they were surprised to see the posture shift happened instantly, not strung out over tens of millions of years, as had been suggested. It also happened in all groups, not just the mammal ancestors or bird ancestors.

"Modern amphibians and reptiles are sprawlers, holding their limbs partly sideways," Professor Benton said.

"Birds and mammals have erect postures, with the limbs immediately below their bodies. This allows them to run faster, and especially further."

"There are great advantages in erect posture and warm-bloodedness, but the cost is that endotherms have to eat much more than cold-blooded animals just to fuel their inner temperature control."

The evidence from posture change and from early origin of hair and feathers, all happening at the same time, suggested this was the beginning of a kind of 'arms race.'

"The Triassic was a remarkable time in the history of life on Earth. You see birds and mammals everywhere on land today, whereas amphibians and reptiles are often quite hidden," Professor Benton said.

"This revolution in ecosystems was triggered by the independent origins of endothermy in birds and mammals, but until recently we didn't realize that these two events might have been coordinated."

"That happened because only a tiny number of species survived the Permian-Triassic mass extinction — who survived depended on intense competition in a tough world."

"Because a few of the survivors were already endothermic in a primitive way, all the others had to become endothermic to survive in the new fast-paced world."

The study was published in the journal *Gondwana Research*.

Michael J. Benton et al. The origin of endothermy in synapsids and archosaurs and arms races in the Triassic. Gondwana Research, published online September 3, 2020; doi: 10.1016/j.gr.2020.08.003

https://bit.ly/2HdWUrJ

Etching a Simple Pattern on Solar Panels Boosts Light Absorption by 125%, Study Shows

Checkerboard design on solar cells can enhance the current generated by crystalline silicon by as much as 125 percent

Peter Dockrill

Solar panels offer huge potential to move more people away from electricity generated from burning coal, and a new innovation devised by scientists stands to more than double the amount of light captured by conventional solar cells.

In a new study, a team of scientists from the UK, Portugal, and Brazil discovered that etching a shallow pattern of grating lines in a checkerboard design on solar cells can enhance the current generated by crystalline silicon (c-Si) by as much as 125 percent.

"We found a simple trick for boosting the absorption of slim solar cells," explains photovoltaics researcher Christian Schuster from the University of York.

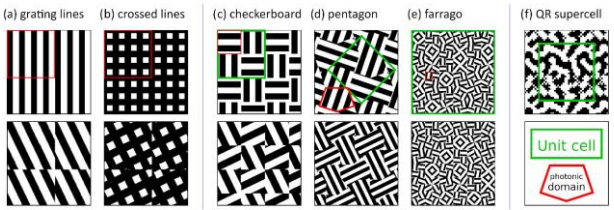
"Our investigations show that our idea actually rivals the absorption enhancement of more sophisticated designs – while also absorbing more light deep in the plane and less light near the surface structure itself."

Up until now, comparable attempts using simple grating designs had only produced marginal gains in sunlight absorption, the team says.

This has led to more theoretically complicated structural tweaks, not to mention all kinds of alternative solar-based designs, including anti-solar panels, light-harvesting algae, and transparent solar cells.

While every single discovery is its own legitimate advancement towards a world less (and ultimately not) reliant on fossil fuels, Schuster and team say even very simple tweaks to existing solar cell technology could significantly increase our ability to reap power from the Sun.

Instead of looking at new structural designs based on natural textures or computational algorithms, the researchers instead focused on identifying what core theoretical considerations would enable an optimised pattern for the scattering and diffraction of sunlight.



Their goal was to make a solar cell absorb more energy by trapping more sunlight, while reflecting less away from itself.

(Li et al., Optica, 2020)

Their modelling suggests that grating lines, arranged in simple periodic, quasi-random structure optimise the performance of a "photonic domain": the region within a photonic structure in which a basic diffractive element is periodically arranged in a one-dimensional fashion.

In an experiment, the team simulated the performance of a checkerboard-patterned photonic domain, made from a crystalline silicon slab just 1 micrometre thick (several times thinner than a strand of spider web silk), and compared it against other kinds of solar cell designs including a plain planar cell, vertical grating lines, crossed lines, and others.

The results suggested the checkerboard with randomised rotations of its repeating units generates more current than any of the competing cells, and generates about 125 percent as much as a conventional solar cell without a grating line design.

In addition, because of its inherent simplicity, the team says the checkerboard design could be easier to manufacture on an industrial scale, and also more robust than other more complex nano-structured solar cell patterns.

"Our design rule meets all relevant aspects of light-trapping for solar cells, clearing the way for simple, practical, and yet outstanding diffractive structures, with a potential impact beyond photonic applications," Schuster says.

"This design offers potential to further integrate solar cells into thinner, flexible materials and therefore create more opportunity to use solar power in more products."

The researchers acknowledge that their modelled results might deliver somewhat less impressively in the real world, once fabrication measures are put in place, depending on certain materials used to manufacture and encapsulate the cells. Changing the etching depth or size of the slabs would also have an effect.

Still, the team says the design principles they've pointed to here could lead to positive impacts in solar cell designs, and also in related areas that also depend on disruptive physical functions akin

to light diffraction, such as acoustic noise shields, wind break panels, anti-skid surfaces, and more.

Further, by manufacturing such thin solar cells with a checkerboard design, the cost-effectiveness of resources used for cell fabrication could be 10-fold, the team thinks.

"In principle, we would deploy 10 times more solar power with the same amount of absorber material," Schuster says.

"Ten times thinner solar cells could enable a rapid expansion of photovoltaics, increase solar electricity production, and greatly reduce our carbon footprint." The findings are reported in *Optica*.

https://bit.ly/359Os4Z

Scientists identify a powerful anti-inflammatory compound in psychedelic drugs

The compound, called 2 C-H, reduces inflammation without mind-altering effects

Milena Marinković

People have long believed that using psychedelic drugs such as LSD, DMT, and psilocybin (from ″magic mushrooms”) can help the body fight inflammation. Scientific support for this idea has emerged in the past couple decades, and newly published research goes further to show exactly which structural parts of these molecules are responsible for the anti-inflammatory effect.

Psychedelic drugs exert their profound effects on the mind by interacting with a serotonin receptor in the brain called 5HT-2A. This receptor can also be found in almost all other parts of the body, including immune-related structures like the spleen and white blood cells. The effects of serotonin made in immune cells are mainly pro-inflammatory, and its secretion can influence the progression of disorders like asthma and rheumatoid arthritis.

Like serotonin, psychedelic drugs can also activate the 5HT-2A receptor and reduce inflammation. This new study, which was published in *ACS Pharmacology & Translational Science*, shows what molecular structure is responsible for this effect. The researchers looked at rats with asthmatic symptoms to test 21 different compounds that activate the 5HT-2A receptor, and found that many of them were able to prevent and reverse inflammation in the lungs. They also discovered that the compound called 2C-H has the molecular structure that yields the fullest anti-inflammatory effects of the compounds they tested.

2C-H is structurally very similar to the popular psychedelic drug 2C-B (which is similar to ecstasy and MDMA), but it does not itself have any psychoactive effects. As such, 2C-H might open an exciting new venue in anti-inflammatory drug design: it is a powerful anti-inflammatory agent that won’t get you high.

https://bit.ly/3dDVXox

The Very First Forms of Life May Have Been More Animal-Like Than We Ever Realised

Early life may have been far more like animals than we thought, suggests new research that shows bacteria can 'develop' like an embryo.

Tessa Koumoundouros

When bacteria band together, they ooze out a protective communal home of slime to form thriving, densely packed colonies known as biofilms. Together these teeny organisms are more powerful.

Within the safety of the biofilm, they can better withstand environmental changes, communicate long-range to cells outside their communities, and even share a collective memory of sorts – essentially behaving like one multicellular organism.

Now an international team of researchers led by evolutionary geneticist Momir Futo from the Ruđer Bošković Institute in Croatia has discovered biofilms develop like a multicellular organism, too.

Most cells on Earth live in the form of these biofilms. They can be composed of multiple species, and we're increasingly finding more ways in which they act like multicellular beings – including

division of labour, programmed cell death, and self-recognition.

In the lab, Futo and the team investigated rod-shaped *Bacillus subtilis*, which is commonly found in soil, cows, and us. The researchers established a timeline of gene expression across the whole biofilm as it developed, from a few initial cells until it was two months old.

They also compared the products of the bacteria's genes with those of others in its family tree, mapping out a timeline for their evolutionary relationships.

"Surprisingly, we found that evolutionary younger genes were increasingly expressed towards the later timepoints of biofilm growth," explained geneticist Tomislav Domazet-Lošo from the Catholic University of Croatia.

Bacillus subtilis biofilms. **(Momir Futo/Ruđer Bošković Institute)**

The order of gene expression during biofilm growth mirrors the timing of these genes' evolution - just like the expressions of genes in developing animal embryos.

And that is not the only way the biofilms mimicked embryogenesis (the development of an animal embryo). The step-by-step organisation of the gene expression observed is also seen in embryos, as is a big increase in communication between cells during the middle of development, which in the biofilm coincides with growing 3D wrinkles.

"This means that bacteria are true multicellular organisms just like we are," said Domazet-Lošo. "Considering that the oldest known fossils are bacterial biofilms, it is quite likely that the first life was also multicellular, and not a single-celled creature as considered so far."

The phylostratigraphy method the researchers used is relatively new and still has some questions around its reliability, so the team double-checked their results using older genetic tools, and found they supported their findings.

The team cautions these results are limited to single-species biofilms in laboratory conditions, so more research is required to see if the findings also hold true in the natural environment with multi-species interactions.

It also remains to be seen if other embryogenesis features – like localised waves of new gene expressions – are also present in biofilms. But the similarities they have observed are quite striking.

As biofilms are responsible for more than 80 percent of microbial infections in our bodies, they would certainly also play a large role in how our friendly bacteria function too, so understanding how these not-so-single organisms develop and work together could help with a myriad of medical problems.

"It is indisputable that the cell is the basic unit of life; however, that does not readily imply that the first life was strictly unicellular," the researchers concluded.

This research was published in *Molecular Biology and Evolution*.

https://bit.ly/3ksuZD7

Study shows main cell type in the liver has key role in defending against some viruses

The findings open up a new front in the war on disease-causing microbes, with possible relevance to COVID-19

La Jolla, Ca--Scientists at Scripps Research have uncovered an important disease-fighting role for cells called hepatocytes, which constitute most of the liver. The discovery could potentially be harnessed to develop new medicines for viral illnesses.

According to the new study, which appears in *Communications Biology*, hepatocytes help control infections from common viruses called coxsackieviruses, and probably defend against many other viruses as well. The findings suggest these liver cells, long known

for their role in deactivating chemical toxins in the blood, should also be viewed as a significant element of the immune system--an element that future drugs might be able to enhance to strengthen the body's defense against emergent viruses.

"Hepatocytes may have evolved the ability to absorb and silence a variety of different viruses, to slow their spread in the body and reduce infection-related illness," says Taishi Kimura, PhD, postdoctoral research associate at Scripps Research and first author of the study.

Kimura worked on the study while in the laboratory of J. Lindsay Whitton, MD, PhD, professor in the Department of Immunology and Microbiology at Scripps Research and senior author of the study.

Whitton and his lab have long studied coxsackieviruses, a family of polio-like viruses that spread via the fecal-oral route and can cause a broad array of symptoms including fever, sore throat, rash, diarrhea, meningitis, pancreatitis and inflammation of the heart muscle. The viruses are named for the New York town of Coxsackie, where virus specimens were initially isolated from patients in the late 1940s.

Recently Kimura and research assistant Claudia Flynn observed that mice experience significant liver damage, including damage to and deaths of hepatocytes, when infected with a type of coxsackievirus called coxsackievirus B3 (CVB3).

Hepatocytes, along with many other cell types, express a cell-surface protein called "coxsackievirus-adenovirus receptor" or CAR, which CVB3 uses to get into cells. So Kimura and Flynn genetically engineered mice whose hepatocytes--but no other cell types--lack CAR, and thus could not be infected by CVB3. Unsurprisingly, when these mutant mice were infected with CVB3, their hepatocytes were spared significant damage.

However, the CVB3 infection hit these mutant mice much harder on the whole, compared with non-mutant siblings. The mutants with protected hepatocytes swiftly showed high blood levels of virus, lost more weight, developed complications such as heart inflammation and were much more likely to die from the infection.

These findings showed that ordinary hepatocytes, when they are able to be infected by CVB3, help protect the rest of the body from the virus. In further experiments, the team found more support for this idea, observing that when hepatocytes absorb CVB3, they quickly shut down the virus's replication using an immune protein called IRF1. Although the infected hepatocytes are damaged by taking up the virus, the liver itself does not show the strong inflammation that is seen in other virus-infected organs, such as the heart and pancreas.

Virus researchers have known that other, much-less numerous cell types in the liver--such as so-called Kupffer cells--can trap and neutralize viruses that are circulating in the blood. Hepatocytes had not been thought to do this, but the study shows that they do.

Given the large size of the liver, hepatocytes constitute a major cell type in the body. To the researchers, it seems unlikely that this major cell type has evolved to defend against only one family of viruses. More likely, they say, it acts broadly, like an antiviral "sponge," soaking up any of a variety of virus types from the bloodstream early in infection, to help slow and limit the infection in the rest of the body. Hepatocytes that absorb viruses in this way may be damaged or die, the researchers add, but the harm to the liver is perhaps only temporary.

"Hepatocytes have an extraordinary capacity for regeneration, and this may be an adaptation that has more to do with their antiviral role than with their better-known role against toxins," Whitton says. "Toxins may not have been enough of a threat during animal evolution to create pressure for such an adaptation, but viruses probably have been."

Whitton and Kimura also note that other common viruses, including the SARS-CoV-2 coronavirus that causes COVID-19, can cause modest and often temporary liver damage, much like that observed for CVB3. This again hints that hepatocytes' defensive role may extend far beyond coxsackieviruses. Though Whitton is retiring this year, Kimura intends to continue this line of research into whether--and how--hepatocytes defend against SARS-CoV-2 and other viruses.

"The protein IRF1, which hepatocytes use to silence CVB3, works by activating a broad set of antiviral genes, and it may be that each of these antiviral genes is adapted to silence a different set of viruses," Whitton says.

By actively taking up virus that is circulating in the blood, hepatocytes may also serve as a first-alert mechanism that helps activate other immune system elements, Kimura says. In principle, Kimura adds, future drug treatments might enhance hepatocytes' uptake of viruses to limit serious infections when no other option is available, such as with new human-infecting viruses.

"This hepatocyte response might turn out to be a key element of the human immune response against emergent viruses," he says.

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