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Scientists uncover huge reservoir of melting carbon under Western United States

Melting region challenges accepted understanding of how much carbon the Earth contains

New research published in Earth and Planetary Science Letters describes how scientists have used the world's largest array of seismic sensors to map a deep-Earth area of melting carbon covering 1.8 million square kilometres. Situated under the Western US, 350km beneath the Earth's surface, the discovered melting region challenges accepted understanding of how much carbon the Earth contains – much more than previously understood.

The study, conducted by geologist at Royal Holloway, University of London's Department of Earth Sciences used a huge network of 583 seismic sensors that measure the Earth's vibrations, to create a picture of the area's deep sub surface. Known as the upper mantle, this section of the Earth's interior is recognised by its high temperatures where solid carbonates melt, creating very particular seismic patterns.

"It would be impossible for us to drill far enough down to physically 'see' the Earth's mantle, so using this massive group of sensors we have to paint a picture of it using mathematical equations to interpret what is beneath us," said Dr Sash Hier-Majumder of Royal Holloway.

He continued, "Under the western US is a huge underground partially-molten reservoir of liquid carbonate. It is a result of one of the tectonic plates of the Pacific Ocean forced underneath the western USA, undergoing partial melting thanks to gasses like CO2 and H2O contained in the minerals dissolved in it."

As a result of this study, scientists now understand the amount of CO2 in the Earth's upper mantle may be up to 100 trillion metric tons. In comparison, the US Environmental Protection Agency estimates the global carbon emission in 2011 was nearly 10 billion metric tons – a tiny amount in comparison. The deep carbon reservoir discovered by Dr. Hier-Majumder will eventually make its way to the surface through volcanic eruptions, and contribute to climate change albeit very slowly.

"We might not think of the deep structure of the Earth as linked to climate change above us, but this discovery not only has implications for subterranean mapping but also for our future atmosphere," concluded Dr Hier-Majumder,"For example, releasing only 1% of this CO2 into the atmosphere will be the equivalent of burning 2.3 trillion barrels of oil. The existence of such deep reservoirs show how important is the role of deep Earth in the global carbon cycle."

More information: Saswata Hier-Majumder et al. Pervasive upper mantle melting beneath the western US, Earth and Planetary Science Letters (2017). DOI: 10.1016/j.epsl.2016.12.041

http://bit.ly/2lheKqC

Study finds that people are attracted to outward signs of health, not actual health

Skin with yellow and red pigments is perceived as more attractive in Caucasian males

Findings published in the journal Behavioral Ecology reveal that skin with yellow and red pigments is perceived as more attractive in Caucasian males, but this skin coloring does not necessarily signal actual good health.

Some people are more attractive as mating partners than others. One trait that plays an important role in sexual selection is carotenoid-based coloration. Carotenoids are red and yellow plant pigments present in fruits and vegetables that animals consume. They're the reason carrots are orange. Previous research has found that in various species--of birds, fish, and reptiles--females are more attracted to their colorful male counterpart. Researchers have argued that carotenoid-based coloration is an honest signal of health, and is associated with acting as an antioxidant. One proposal is that people are attracted to signs of health in a desire to reproduce, and those who display signs of health have a greater chance of survival, greater fertility, and providing genes that promote good health in offspring.

Researchers investigated if there was any validity to the "signal of health" idea by experimentally testing the effect of carotenoid supplementation on facial appearance and actual health. Participants consisted of 43 heterosexual Caucasian men with a mean age of 21 years. 23 men were assigned to the treatment group and the other 20 to the placebo group.

Photographs of the participants at the start of the trial were taken in order to document changes in skin color. Participants were tested on their health, which included their level of oxidative stress, immune function, and semen quality. After the participants' health was reviewed, they were given a 12-week supplementation of beta-carotene for the treatment group or "dummy pills" for the placebo group. Participants returned after the 12 week period, where researchers repeated the photography and health tests. Sixty-six heterosexual Caucasian female raters with a mean age of 33 were recruited online to assess attractiveness of the pre- and post-supplementation faces of each male participant presented side by side on a computer screen.

Results indicated that, as predicted, beta-carotene supplementation increased overall yellowness and redness of the skin. Compared to the placebo group, post-supplementation faces in the beta-carotene group were more likely to be chosen as more attractive as well as healthier looking over the pre-supplementation faces. Therefore, beta-carotene significantly enhanced participants' attractiveness and appearance of health. Beta-carotene treatment did not, however, affect any health functions.

This study provides the first experimental evidence of beta-carotene's effect on attractiveness and health. The results suggest that carotenoid-based skin color may be sexually selected in humans, but there is no evidence to suggest that this is an honest signal of health. This study calls for further research on the influence of carotenoid coloration on mammals, in particular, if findings are replicated in women.

Yong Zhi Foo, author and postgraduate Animal Biology student at The University of Western Australia, says "Carotenoids are known to be responsible for the striking mating displays in many animal species. Our study is one of the first to causally demonstrate that carotenoids can affect attractiveness in humans as well. It also reaffirms the results of previous studies showing that what we eat can affect how we look"

Funding:

The study is supported by the ARC Centre of Excellence in Cognition and its Disorders (CE110001021), ARC Professorial Fellowships to L.W.S. (DP110104594) and G.R. (DP0877379), an ARC Discovery Outstanding Researcher Award to G.R. (DP130102300) and student research grants awarded to Y.Z.F. by The Australasian Society for the Study of Animal Behavior (ASSAB) and European Human Behaviour and Evolution Association (EHBEA).

The paper "The carotenoid beta-carotene enhances facial color, attractiveness and perceived health, but not actual health, in humans" is available at: DOI: 10.1093/beheco/arw188.

http://bit.ly/2kxEuAR

Plant-made hemophilia therapy shows promise, Penn study finds

Using a protein drug produced in plant cells to teach the body to tolerate clotting factor

People with hemophilia require regular infusions of clotting factor to prevent them from experiencing uncontrolled bleeding. But a significant fraction develop antibodies against the clotting factor, essentially experiencing an allergic reaction to the very treatment that can prolong their lives.

Researchers from the University of Pennsylvania School of Dental Medicine and University of Florida have worked to develop a therapy to prevent these antibodies from developing, using a protein drug produced in plant cells to teach the body to tolerate rather than block the clotting factor. Successful results from a new study of the treatment in dogs give hope for an eventual human treatment.

Henry Daniell a professor in Penn Dental Medicine's Department of Biochemistry and director of translational research, was the senior author on the study, collaborating on the work with his former advisee, Roland W. Herzog, a professor at the University of Florida and lead

author on the paper. The work was published in the journal Molecular Therapy.

"The results were quite dramatic," Daniell said. "We corrected blood clotting time in each of the dogs and were able to suppress antibody formation as well. All signs point to this material being ready for the clinic."

The study made use of Daniell's patented plant-based drug-production platform, in which genetic modifications enable the growth of plants that have specified human proteins in their leaves. In the case of hemophilia, the researchers' aim was to prevent individuals with hemophilia from developing antibodies that would cause a rejection of life-saving clotting-factor infusions.

The researchers had the idea that ingesting a material containing the clotting factor, such as the transformed plant leaves, could promote oral tolerance to the factor protein, just as children fed peanuts early in life are less likely to develop an allergic reaction.

This technique had shown promise in previous experiments, in which the researchers demonstrated that feeding hemophilia A plant material containing the clotting factor VIII to mice greatly reduced the formation of inhibitors against that factor.

In the new work, the team focused on hemophilia B, a rarer form of disease in which patients have deficiencies in clotting factor IX. The researchers produced lettuce that had been modified to produce a fusion protein containing human clotting factor IX and the cholera non-toxin B subunit. The latter component helps the fused protein cross the intestinal lining as the lettuce cells are digested by gut microbes while the plant cell walls protect the clotting factor from digestion in the stomach. The lettuce plants were grown in a hydroponic facility.

Because the researchers also wanted to ensure that the therapy would work in an animal model closer to humans, they pursued their trials in dogs with hemophilia B.

The researchers began with a pilot study of two dogs, headed by co-author Timothy Nichols of the University of North Carolina. Twice a week for 10 months, the dogs consumed the freeze-dried lettuce material, which was spiked with bacon flavor and sprinkled on their food.

Observing no negative effects of the treatment, the team went on to a more robust study, including four dogs that were fed the lettuce material and four others that served as controls. The four dogs in the experimental group were fed the lettuce material for four weeks. At that point, they also began receiving weekly injections of factor IX, which continued for eight weeks. The control dogs only received the injections.

All four of the dogs in the control group developed significant levels of antibodies aginst factor IX, and two had visible anaphylactic reactions that required the administration of antihistamine. In contrast, three of the four dogs in the experimental group had only minimal levels of one type of antibody, IgG2, and no detectable levels of IgG1 or IgE. The fourth dog in the experimental group had only a partial response to the treatment, which the researchers believe to be due to a pre-existing antibody to human factor IX.

Overall, levels of IgG2 were 32 times lower in the treated dogs than in the controls. In addition, the dogs showed no negative side effects from the treatment, and blood samples taken throughout the experiment revealed no signs of toxicity from the treatment.

Daniell said the results are encouraging.

"Looking at the dogs that were fed the lettuce materials, you can see it's quite effective," he said. "They either developed no antibodies to factor IX, or their antibodies went up just a little bit and then came down."

The next steps for the research team include additional toxicology and pharmacokinetics studies before applying for an Investigational New Drug application with the FDA, a step they hope to take before the end of the year. A National Institutes of Health grant called Science

Moving Towards Research Translation and Therapy and which uses the acronym SMARTT, is supporting IND-enabling studies. SMARTT's mission is to accelerate the progress of therapies that have shown promise in animal models to the stage of pursuing clinical trials in humans.

In addition to Daniell and Herzog, the study's coauthors were Penn Dental's Jin Su and Bei Zhang; the University of North Carolina's Nichols, Elizabeth P. Merrick and Robin Raymer; the University of Florida's Alexandra Sherman and George Q. Perrin; and Novo Nordisk's Mattias Häger and Bo Wiinberg.

The research was supported by the NIH's National Heart, Lung and Blood Institute and Novo Nordisk.

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Taking a high-priced cancer drug with a low-fat meal can cut cost by 75 percent

1/4 a standard dose of a commonly-used drug for prostate cancer with a low-fat breakfast as effective, ¼ cheaper than the standard dose

The study, a multi-center, randomized, phase-II clinical trial to be presented at ASCO's 2017 Genitourinary Cancers Symposium in Orlando, FL, found that the 36 patients who took 250 milligrams of the drug with a low-fat breakfast had outcomes that were virtually identical to the 36 patients who took the standard dose, 1,000 milligrams of the drug on an empty stomach.

Taking one-fourth the standard dose of a widely used drug for prostate cancer with a low-fat breakfast can be as effective - and four times less expensive - as taking the standard dose as recommended: on an empty stomach.

The study, a multi-center, randomized, phase-II clinical trial to be presented at ASCO's 2017 Genitourinary Cancers Symposium in Orlando, FL, found that the 36 patients who took 250 milligrams of the drug with a low-fat breakfast had outcomes that were virtually identical to the 36 patients who took the standard dose, 1,000 milligrams of the drug on an empty stomach.

The finding has significant financial implications. The drug, abiraterone acetate - marketed as ZYTIGA® - now retails for more than $9,000 per month. Even patients with blue-ribbon health insurance can have co-pays ranging from $1,000 to $3,000 per month.

Patients taking abiraterone acetate typically stay on the medication for 12 to 18 months. Since 2011, according to the manufacturer's website, more than 100,000 patients in the United States alone have filled prescriptions for abiraterone.

If each of those 100,000 patients had taken the drug for 12 months and, theoretically, paid the list price out of pocket but took the lower dose with food, the 75-percent cost reduction could have saved them more than $6 billion.

Seventy-two patients from multiple centers in the United States and Singapore participated in the study. Patients aged 52 to 89 years (median 74) with advanced prostate cancer whose disease had progressed despite standard initial hormonal therapy, were randomly assigned to take the standard dose on an empty stomach or the low dose with breakfast.

The primary objective of the study was to compare the change in blood levels of prostate specific antigen (PSA), a measure of disease burden and progression. Despite a 75-percent difference in dose, there was no difference in abiraterone activity as measured by variation in PSA levels between the two groups of patients. The time to disease progression also was nearly identical for both arms of the study, about 14 months.

Patients who took the drug with food appeared to have an additional benefit. They were less likely to complain about stomach discomfort than those who took the drug as recommended. The drug's label recommends fasting for 2 hours before and 1 hour after swallowing the medication. Taking the medication with breakfast is therefore logistically easier for patients.

"We know this drug is absorbed much more efficiently when taken with food," said study director Russell Szmulewitz, MD, assistant

professor of medicine at the University of Chicago and a specialist in medical treatment of patients with advanced prostate cancer. "It's inefficient, even wasteful, to take this medicine while fasting, which is how the drug's label says to take it."

"Given the pharmaco-economic implications," he added, "our results warrant consideration by doctors who care for prostate cancer patients as well as payers."

Many drugs taken by mouth have a "food effect," which can alter how the drug is absorbed. Abiraterone has one of the most dramatic food effects. Blood levels of the drug can be up to 17 times higher when taken with a high-fat meal. Taking the drug with a low-fat meal is more predictable. It increases blood levels four to seven fold.

"This is a widely prescribed drug, a mainstay for patients with prostate cancer," Szmulewitz said. "It is a great medication that has shifted the standard of care."

Patients with early stage prostate cancer patients are usually treated initially with hormone therapy, drugs that disrupt the production of male hormones such as testosterone, which promotes tumor growth. This can slow or halt progression of the disease.

Over time, however, cancer cells adapt. They develop the ability to grow and spread without relying on hormones, a stage known as castration-resistant prostate cancer. Historically, those patients were treated with chemotherapy, which can have significant side effects.

Abiraterone, approved for treatment of metastatic prostate cancer in April, 2011, added a new layer to the sequence. It "sits between hormone therapy and chemotherapy," Szmulewitz explained. "It delays disease progression, improves survival and delays deterioration of quality of life." When its effects diminish, they shift to a similar, competing drug or move on to chemotherapy.

Patients who take abiraterone for prostate cancer should not "conduct such experiments on their own," Szmulewitz warned. "This was a relatively small study, too small to show with confidence that the lower dose is as effective. It gives us preliminary but far from definitive evidence. Physicians should use their discretion, based on patient needs."

The study shows that patients with genuine concerns about costs could, with careful guidance and regular follow-up from their doctors, consider the smaller dose taken with a low-fat breakfast. This would enable them to spread the cost of one month's of pills over four months, a per-patient savings of up to $7,500 each month.

The American Cancer Society estimates that 161,360 men will be diagnosed with prostate cancer in 2017 and 26,730 men will die from the disease. "If we could reduce the cost of medication for this stage of the disease by a few thousand dollars each month simply by having patients take it with food," Szmulewitz said, "that would be significant."

http://bit.ly/2kJMtfj

Disease 'superspreaders' were driving cause of 2014 Ebola epidemic

3% of infected people responsible for infecting 61% of all cases

CORVALLIS, Ore. - A new study about the overwhelming importance of "superspreaders" in some infectious disease epidemics has shown that in the catastrophic 2014-15 Ebola epidemic in West Africa, about 3 percent of the people infected were ultimately responsible for infecting 61 percent of all cases.

The issue of superspreaders is so significant, scientists say, that it's important to put a better face on just who these people are. It might then be possible to better reach them with public health measures designed to control the spread of infectious disease during epidemics.

Findings were reported this week in Proceedings of the National Academy of Sciences.

The researchers concluded that Ebola superspreaders often fit into certain age groups and were based more in the community than in health care facilities. They also continued to spread the disease after many of the people first infected had been placed in care facilities, where transmission was much better controlled.

If superspreading had been completely controlled, almost two thirds of the infections might have been prevented, scientists said in the study. The researchers also noted that their findings were conservative, since they only focused on people who had been buried safely.

This suggests that the role of superspreaders may have been even more profound than this research indicates.

The research was led by Princeton University, in collaboration with scientists from Oregon State University, the London School of Hygiene and Tropical Medicine, the International Federation of Red Cross and Red Crescent Societies, the Imperial College London, and the National Institutes of Health.

The concept of superspreaders is not new, researchers say, and it has evolved during the 2000s as scientists increasingly appreciate that not all individuals play an equal role in spreading an infectious disease.

Superspreaders, for instance, have also been implicated in the spread of severe acute respiratory syndrome, or SARS, in 2003; and the more recent Middle East respiratory syndrome in 2012.

But there's less understanding of who and how important these superspreaders are.

"In the recent Ebola outbreak it's now clear that superspreaders were an important component in driving the epidemic," said Benjamin Dalziel, an assistant professor of population biology in the College of Science at Oregon State University, and co-author of the study.

"We now see the role of superspreaders as larger than initially suspected. There wasn't a lot of transmission once people reached hospitals and care centers. Because case counts during the epidemic relied heavily on hospital data, those hospitalized cases tended to be the cases we 'saw.'

"However, it was the cases you didn't see that really drove the epidemic, particularly people who died at home, without making it to a care center. In our analysis we were able to see a web of transmission that would often track back to a community-based superspreader."

Superspreading has already been cited in many first-hand narratives of Ebola transmission. This study, however, created a new statistical framework that allowed scientists to measure how important the phenomenon was in driving the epidemic. It also allowed them to measure how superspreading changed over time, as the epidemic progressed, and as control measures were implemented.

The outbreak size of the 2014 Ebola epidemic in Africa was unprecedented, and early control measures failed. Scientists believe that a better understanding of superspreading might allow more targeted, and effective interventions, instead of focusing on whole populations.

"As we can learn more about these infection pathways, we should be better able to focus on the types of individual behavior and demographics that are at highest risk for becoming infected, and transmitting infection," Dalziel said.

Researchers pointed out, for instance, that millions of dollars were spent implementing message strategies about Ebola prevention and control across entire countries. They suggest that messages tailored to individuals with higher risk and certain types of behavior may have been more successful, and prevented the epidemic from being so persistent.

Lead author on the study was Max Lau at Princeton University. Support and funding was provided by the Bill and Melinda Gates Foundation, the National Institutes of Health, and the UK Medical Research Council.

http://bit.ly/2kpUc6d

Drug developed at University of Minnesota increases survival in dogs with cancer

Research shows potential for use in humans

A breakthrough trial at the University of Minnesota testing a new UMN-developed drug resulted in improved survival rates for dogs diagnosed with a cancer called hemangiosarcoma (HSA). The results were published today in the journal Molecular Cancer Therapeutics.

"This is likely the most significant advance in the treatment of canine HSA in the last three decades," said study co-author Jaime Modiano, V.M.D., Ph.D. professor in the University of Minnesota College of Veterinary Medicine and member of the Masonic Cancer Center, University of Minnesota.

Canine HSA is a common, aggressive, incurable sarcoma. It is remarkably similar to angiosarcoma, which affects humans. Both cancers typically spread before diagnosis and the survival time for affected patients is extremely short, even with aggressive treatment. Only 50% of humans diagnosed with angiosarcoma live longer than 16 months and the prognosis for dogs with HSA is similarly dire: less than 50% will survive 4-6 months and only about 10% will be alive one-year after their diagnosis.

The study tested a drug called eBAT, invented by study senior author Daniel Vallera, Ph.D., professor at the University of Minnesota Medical School and Masonic Cancer Center.

"eBAT was created to specifically target tumors while causing minimal damage to the immune system. HSA is a vascular cancer, meaning it forms from blood vessels. eBAT was selected for this trial because it can simultaneously target the tumor and its vascular system," said Vallera.

Traditional cancer treatments have side effects that can be very hard on patients. "In this trial we aimed for a sweet spot by identifying a dose of eBAT that was effective to treat the cancer, but caused no appreciable harm to the patient. Essentially we're treating the cancer in a safer and more effective way, improving quality of life and providing a better chance at survival," lead study author Antonella Borgatti, D.V.M., M.S., associate professor with the University of Minnesota College of Veterinary Medicine said.

eBAT was tested on 23 dogs of various breeds, both large and small, with HSA of the spleen. Dogs received three treatments of eBAT after surgery to remove the tumor and before conventional chemotherapy. The drug treatment improved the 6-month survival rate to approximately 70%. Furthermore, five of the 23 dogs that received eBAT treatment lived more than 450 days.

The positive results for canine patients, the similarities between this cancer and angiosarcoma in humans, and the fact that many other tumor types can be targeted by eBAT, make a strong case for translating this drug into clinical trials for human cancer patients. The researchers want these results to bring hope to those touched by this disease.

"This drug was invented here at the University of Minnesota, developed here, manufactured here, tested here and showed positive results here. We would also like this drug to achieve positive outcomes for humans here," Modiano said.

"The ultimate goal for all of us is to create a world in which we no longer fear cancer," Modiano said.

This project is an example of the remarkable progress that is being made through collaborations among the multiple colleges and schools within the University of Minnesota's Academic Health Center.

Funding was provided by many sources, including various foundations and individuals along with the National Institutes of Health, showing the broad interest in identifying cures for these devastating cancers.

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A kiss of death -- mammals were the first animals to produce venom

CT scans of fossils of the pre-mammalian reptile, Euchambersia, shows anatomical features, designed for venom production

Africa is a tough place. It always has been. Especially if you have to fend off gigantic predators like sabre-toothed carnivores in order to survive. And, when you're a small, dog-sized pre-mammalian reptile, sometimes the only way to protect yourself against these monsters is to turn your saliva into a deadly venomous cocktail.

That is exactly what a distant, pre-mammalian reptile, the therapsid Euchambersia, did about 260 million years ago, in order to survive the rough conditions offered by the deadly South African environment. Living in the Karoo, near Colesberg in South Africa, the Euchambersia developed a deep and circular fossa, just behind its canine teeth in the upper jaw, in which a deadly venomous cocktail was produced, and delivered directly into the mouth through a fine network of bony grooves and canals.

"This is the first evidence of the oldest venomous vertebrate ever found, and what is even more surprising is that it is not in a species

that we expected it to be, " says Dr Julien Benoit, researcher at the Bernard Price Institute for Palaeontological Research at the University of the Witwatersrand in South Africa.

"Today, snakes are notorious for their venomous bite, but their fossil record vanishes in the depth of geological times at about 167 million years ago, so, at 260 million years ago, the Euchambersia evolved venom more than a 100 million years before the very first snake was even born. "

As venom glands don't fossilise, Benoit and his colleagues from at Wits University, in association with the Natural History Museum of London used cutting edge CT scanning and 3D imagery techniques to analyse the only two fossilised skulls of the Euchambersia ever found, and discovered stunning anatomical adaptions that are compatible with venom production. Their results were published in the open access journal, PlosOne, in February.

"First, a wide, deep and circular fossa (a space in the skull) to accommodate a venom gland was present on the upper jaw and was connected to the canine and the mouth by a fine network of bony grooves and canals," says Benoit. "Moreover, we discovered previously undescribed teeth hidden in the vicinity of the bones and rock: two incisors with preserved crowns and a pair of large canines, that all had a sharp ridge. Such a ridged dentition would have helped the injection of venom inside a prey. "

Unlike snakes like vipers or cobras, which actively inject their prey with venom through needle-like grooves in their teeth, the Euchambersia's venom flowed directly into its mouth, and the venom was passively introduced into its victim through ridges on the outside of its canine teeth.

"Euchambersia could have used its venom for protection or hunting. Most venomous species today use their venom for hunting, so I would rather go for this option. In addition, animals at that time were not all insectivorous, particularly among therapsids, which were very diverse."

The Euchambersia fossils

The first Euchambersia fossil was found in 1932, and the second in 1966. The two fossils were both found on the farm Vanwyksfontein, near Colesberg in the Eastern Cape, and while they were found more than 34 years apart from each other, for millions of years, they were lying only a few metres apart.

The life and times of the Euchambersia

According to measurements of the two fossils, the Euchambersia was a small dog-like pre-mammalian reptile that grew between 40 and 50cm long, and lived well before the first dinosaur even appeared.

Venom in mammals

What is intriguing is that Euchambersia is related to early mammals, not snakes. More and more venom producing mammals are discovered every year, including shrews and primates like the Loris of South East Asia. Researchers believe that mammals that lived millions of years ago used to be venomous, but lost this ability in time. However, in some mammals, the genes responsible for venom production were activated again at a later stage.

Venom in snakes

The first evidence of snakes date back to 167 million years ago. There are two hypotheses as to how and when snakes became venomous. The first suggests that snakes like cobras and vipers became venomous independently about 20 million years ago. However, other researchers suggest that the common ancestors of snakes and lizards became venomous about 250 million years ago, which means the Euchambersia became venomous about 100 million years before snakes did.

http://nyti.ms/2lVaX5c

Lower Back Ache? Be Active and Wait It Out, New Guidelines Say

Recommendations for the treatment of most people with lower back pain, the group is bucking what many doctors do

By GINA KOLATA FEB. 13, 2017

Dr. James Weinstein, a back pain specialist and chief executive of Dartmouth-Hitchcock Health System, has some advice for most people with lower back pain: Take two aspirin and don't call me in the morning.

On Monday, the American College of Physicians published updated guidelines that say much the same. In making the new recommendations for the treatment of most people with lower back pain, the group is bucking what many doctors do and changing its previous guidelines, which called for medication as first-line therapy.

Dr. Nitin Damle, president of the group's board of regents and a practicing internist, said pills, even over-the-counter pain relievers and anti-inflammatories, should not be the first choice. "We need to look at therapies that are nonpharmacological first," he said. "That is a change."

The recommendations come as the United States is struggling with an epidemic of opioid addiction that often begins with a simple prescription for ailments like back pain. In recent years, a number of states have enacted measures aimed at curbing prescription painkillers. The problem has also led many doctors around the country to reassess prescribing practices. The group did not address surgery. Its focus was on noninvasive treatment.

The new guidelines said that doctors should avoid prescribing opioid painkillers for relief of back pain and suggested that before patients try anti-inflammatories or muscle relaxants, they should try alternative therapies like exercise, acupuncture, massage therapy or yoga. Doctors should reassure their patients that they will get better no matter what treatment they try, the group said. The guidelines also said that steroid injections were not helpful, and neither was acetaminophen, like Tylenol, although other over-the-counter pain relievers like aspirin, naproxen or ibuprofen could provide some relief. Dr. Weinstein, who was not an author of the guidelines, said patients have to stay active and wait it out. "Back pain has a natural course that does not require intervention," he said.

In fact, for most of the people with acute back pain — defined as present for four weeks or less that does not radiate down the leg — there is no need to see a doctor at all, said Dr. Rick Deyo, a spine researcher and professor at the Oregon Health and Science University in Portland, Ore., and an author of the new guidelines.

"For acute back pain, the analogy is to the common cold," Dr. Deyo said. "It is very common and very annoying when it happens. But most of the time it will not result in anything major or serious. "

Even those with chronic back pain — lasting at least 12 weeks — should start with nonpharmacological treatments, the guidelines say. If patients still want medication, they can try over-the-counter drugs like ibuprofen or aspirin.

Scans, like an M.R.I., for diagnosis are worse than useless for back pain patients, members of the group said in telephone interviews. The results can be misleading, showing what look like abnormalities that actually are not related to the pain.

Measures that help patients get back to their usual routines can help along the way, as Sommer Kleweno Walley, 43, of Seattle, can attest. Last spring, she slipped on the stairs in her house and fell down hard, on her back. "After a couple of hours I could barely walk," she said. "I was in real pain."

She saw a physical therapist, but the pain persisted. Eleven days later, she showed up at the office of Dr. Christopher J. Standaert, a spine specialist at the University of Washington and Harborview Medical Center. She expected to receive an M.R.I., at least, and maybe a drug for pain.

But Dr. Standaert told her an M.R.I. would not make any difference in her diagnosis or recovery and that the main thing was to keep active. She ended up getting anti-inflammatory medication and doing physical therapy. A few months later, her back stopped hurting.

It is surprising, some experts in back pain say, how often patients are helped by treatments that are not medical, even by a placebo that patients are told at the start is really a placebo.

Dr. Standaert cited a study in which patients with chronic low back pain were offered a placebo, and were told it was a placebo, along with their usual treatment — often an anti-inflammatory drug like ibuprofen or naproxen. Or, the patients remained with their usual treatment alone.

Those taking the placebo reported less pain and disability than those in the control group who did not take it. The placebo effect, although modest, was about the same as the effect in studies testing

nonpharmacological treatments for back pain like acupuncture, massage or chiropractic manipulations.

Many people with chronic back pain tend to shut down, avoiding their usual activities, afraid of making things worse, Dr. Standaert said. Helping them is not a matter of prescribing drugs but rather teaching them to set goals and work toward returning to an active life, even if they still have pain.

“They have to believe their life can get better,” Dr. Standaert said. “They have to believe they can get to a better state.”

The question is: Will the new guidelines be adopted?

“Patients are looking for a cure,” said Dr. Steven J. Atlas, a back pain specialist at Massachusetts General Hospital, who wrote an editorial accompanying the article on the new recommendations. “The guidelines are for managing pain.”

Added to the problem are the incentives that push doctors and patients toward medications, scans and injections, Dr. Deyo said. “There is marketing from professional organizations and from industry,” he said. “‘We have the cure. You can expect to be cured. You can expect to be pain free.’”

Medical insurance also contributes to the treatment problem, back experts say, because it does not pay for remedies like mindfulness training or chiropractic manipulations which, Dr. Deyo added, “are not cheap.”

Even if doctors want to recommend such treatments, there is no easy referral system, Dr. Atlas said.

“It is much easier at Mass General to get a shot than to get a mind-body or cognitive behavioral therapy,” he added.

Dr. Weinstein has a prescription: “What we need to do is to stop medicalizing symptoms,” he said. Pills are not going to make people better and as for other treatments, he said, “yoga and tai chi, all those things are wonderful, but why not just go back to your normal activities?”

“I know your back hurts, but go run, be active, instead of taking a pill.”

http://bit.ly/2kBvfzE

Researchers calculate major cost savings of 3-D printing household items

Interested in making an investment that promises a 100 percent return on your money, and then some? Buy a low-cost, open-source 3-D printer, plug it in and print household items.

by Stefanie Sidortsova

In a recent study published in Technologies, Michigan Technological University Associate Professor Joshua Pearce set out to determine how practical and cost effective at-home 3-D printing is for the average consumer.

He found that consumers—even those who are technologically illiterate—can not only make their money back within six months, but can also earn an almost 1,000 percent return on their investment over a five-year period. Pearce estimates that using only the random 26 objects analyzed in the study may have already saved consumers who use 3-D printers at home more than $4 million. There are several million free 3-D printable designs available on the web.

Out of the Box

To compile the data, Pearce asked Emily Petersen, an undergraduate student majoring in materials science and engineering, to use a 3-D printer fresh out of the box with no prior experience, instruction or guidance.

"I'd never been up close and personal with a 3-D printer before," Petersen says. "And the few printers I had seen were industrial ones. I thought learning to operate the printer was going to take me forever, but I was relieved when it turned out to be so easy."

Petersen used a Lulzbot Mini – a low-cost model that can print in high resolution, works with a variety of operating systems and supports open-source hardware and software (meaning that all source codes associated with the printer and its programs are freely available and can be modified).

After commissioning the Lulzbot—a process that took roughly half an hour—Petersen used a 3-D design file search engine called Yeggi to find and build 26 popular, everyday items.

"You search, select, and hit print," Pearce says, "just like a regular computer and office paper printer."

Petersen's favorite creation? A fan-art Pokemon Bulbasaur planter that she filled with a small cactus and gave to her mom for Christmas.

Printing Money

After Petersen finished printing, she worked with Pearce on the economic analysis. By printing 26 items, the researchers simulated household 3-D printer use over a six-month period, with the conservative assumption that a typical household might print one "homemade" item per week.

Petersen printed items that were reasonably popular, such as tool holders, snowboard binder clips and shower heads. She and Pearce monitored each item's energy, print time and plastic use to determine its costs, then conducted a savings analysis on a per-item basis.

For each item printed, from mounts for GoPro cameras to Dremel tools, Pearce and Petersen ran high-cost and low-cost comparisons. For example, for a printed cell phone case, the total cost of printing was compared with the purchase cost of both a high-end phone case and the least expensive model available.

The low-cost comparisons showed an average 93 percent savings, while the high-cost comparisons showed an average savings of 98.65 percent.

"With the low-cost estimates, the printer pays for itself in three years and all the costs associated with printing—such as the price of plastic and electricity—are not only earned back, but provide a 25 percent return on investment. After five years, it's more than 100 percent," Pearce says. "With the high-cost estimates, the printer pays for itself within six months. And after five years, you've not only recouped all the costs associated with printing, you've saved more than $12,000."

Pearce says a five-year life cycle for the printer is reasonable, mainly because the Lulzbot Mini is open source—all the files to upgrade and fix the machine are available for free online. Many of the parts most likely to break are even 3-D printable. Pearce also emphasizes that Petersen used the printer's default settings and didn't print any complicated items, such as scientific equipment.

"I'm an engineering student," Petersen says, "but I was new to this type of hands-on troubleshooting. The fact that I was able to troubleshoot any issues I had and produce 26 items relatively easily is a testament to how accessible this technology is to the average American consumer."

Petersen hopes her experience will help others have more confidence in at-home 3-D printing. As the technology develops and more printable designs become freely available online, Pearce and Petersen agree that it will only get easier.

More information: Emily Petersen et al. Emergence of Home Manufacturing in the Developed World: Return on Investment for Open-Source 3-D Printers, Technologies (2017). DOI: 10.3390/technologies5010007

http://wb.md/2lmW3I0

Did Carrie Fisher Die From Chronic Magnesium Deficiency?

Low magnesium levels can trigger a range of cardiac rhythm abnormalities, including some that are potentially lethal

George D. Lundberg, MD

Hello and welcome. I am Dr George Lundberg and this is At Large at Medscape.

Magnesium and Sudden Death

Did Carrie Fisher die from low total body magnesium? I don't know, but I say "probably yes." News reports stated that she was suddenly unresponsive and not breathing while traveling on an airplane. She was resuscitated, transferred to the UCLA Medical Center after the airplane landed, never regained consciousness, and died again a few days later.

It has long been known that low magnesium levels can trigger a range of cardiac rhythm abnormalities, including some that are potentially lethal.[1] It has also long been known that magnesium infusions are successful at quickly reversing many cardiac arrhythmias.[2]

Sudden unexpected, unattended death is probably the most common mode of death in the United States,[3] with an annual estimated incidence of 300,000-400,000.[4] This is a huge number. For perspective, the most common causes of death in a recent year were[5]:

- ***Heart disease (including sudden death): 600,000***
- ***Cancer: 591,000***
- ***Chronic lower respiratory diseases: 147,000***
- ***Unintentional injuries (eg, accidents): 136,000***
- ***Stroke: 133,000***
- ***Alzheimer's disease: 93,000***
- ***Diabetes: 76,000***
- ***Influenza and pneumonia: 55,000***

The vast majority of sudden deaths occur outside of a hospital and are unobserved. Without a cardiac rhythm monitor in place at time of death, or an informed autopsy, the actual cause of death in this large cohort is unknown. However, daily practice and conventional wisdom suggest that sudden cardiac death (cardiac arrest, asystole, cardiac standstill, or ventricular fibrillation) is the cause in most cases.

The large body of observational literature that has evolved over many decades, beginning with magnesium concentrations in drinking water, suggests that low total body magnesium could be causative of sudden death. Others have recently noted that a low serum magnesium level is associated with increased likelihood of coronary artery heart disease and sudden cardiac death.[6] The problem has always been the difficulty in measuring total body magnesium stores. Serum magnesium levels are protected metabolically and only become "low" if overall stores are very low. A careful dietary history can tease out the likelihood of insufficient magnesium intake, but this is rarely done in medical practice.

There is no doubt that magnesium is a vital element that is required for a large number of metabolic cellular activities. The National Institutes of Health (NIH) website says: "Magnesium is needed for more than 300 biochemical reactions in the body. It helps maintain normal muscle and nerve function, supports a healthy immune system, keeps heart rhythm steady, and helps bones remain strong."[7] Serious magnesium deficiency could adversely affect many vital human bodily functions, producing so many malfunctions that I termed magnesium deficiency "the emperor of all maladies" in 2015.[8]

Meanwhile, Back to Carrie Fisher

I do not know why Ms Fisher died suddenly on an airplane at age 60, nor do you or, I might add, the physicians who cared for her until she died again. I credit the UCLA physicians and staff for keeping her information private, and I credit the Los Angeles County Medical Examiner-Coroner's office for requiring an autopsy--quite proper. The results have not been made public at this time. But it would be very difficult for either the UCLA physicians or the pathologists to confirm the cause of death, taking into account the clinical interventions that doubtless were applied between Ms Fisher's sudden collapse on the airplane and subsequent studies. Regardless, I will assure you that an assessment of total magnesium stores will not have been done.

What is my point? I called for much more study about magnesium deficiency in 2015.[7] I don't think that it has been done. This is a pity. Judging from the large number of comments we received in 2015, average physicians seem to care about this; leading research scientists and government agencies, not so much.

Look at the numbers of sudden unexpected deaths in adults, which are allegedly sudden cardiac deaths. Wake up, people! This could be a really big deal. Study it. Intervention studies have been proposed for many years.[9] I have been unable to find that any such studies have been done or are being done.

The 2003 book *The Magnesium Factor*,[10] by Seelig and Rosanoff, may be the best source for reliable information. Drugs that increase

magnesium excretion include diuretics, proton pump inhibitors, ethyl alcohol, and cola drinks. Do you know any people who use these? Do you know any people who don't?

We should use food as our principal source of magnesium, especially almonds, cashews, shrimp, crab, spinach, peanuts, pecans, whole grains, soy, black beans, edamame, dark chocolate, brown rice, oatmeal, figs, apricots, and bran. Unfortunately, the best data I can find indicate that nearly half of all Americans and two thirds of teens and people over age 80 do not ingest the recommended daily allowance of 300-400 mg of magnesium.

What to Do?

If you are an American physician, nurse, or other healthcare professional, you are probably magnesium deficient. Be selfish; correct that now. Either eat high-magnesium foods or take nutritional supplements, or both. I take 400 mg of magnesium citrate daily. Other magnesium salts are also okay.

Assuming normal renal function, you can't overdose on magnesium. If your magnesium stores are low, they will replenish, and when you reach magnesium balance, any excess is eliminated by the kidneys. If you take more magnesium than you need, your stools may become loose; then cut back. Give your patients the same advice.

If you work in academia or at NIH, try to get some serious interventional trials going. If you work at the Department of Agriculture or the US Food and Drug Administration, try to establish policies that get much more magnesium into the American people. If you are a clinical laboratory scientist, try to figure out how to measure total body magnesium stores so that physicians can order the test(s). It could be some combination of serum, plasma, or red blood cell magnesium levels, urine magnesium (eg, a 24-hour collection), and a detailed dietary history. Physicians "manage what they measure," so just making a good test available would do wonders for ascertaining truth and changing behavior, if needed.

I do not understand why there seems to be no sense of urgency about better understanding the causes of sudden, unobserved, unexpected death in Americans. There is a vast interest in cardiac resuscitation (with a < 5% success rate) but not in prevention. Go figure.

Fix it.

That is my opinion. I am Dr George Lundberg, at large at Medscape.

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http://bit.ly/2kBNqVR

People can 'suppress' hay fever with three years of pollen pills or injections

Three-year course of treatment required to markedly reduce symptoms for several years

Patients blighted by hay fever could markedly reduce symptoms for several years after a three-year course of treatment, but not after two years of treatment, researchers have found.

*****Case study available - see notes*****

Previous research has shown that a type of immunotherapy that exposes patients to increasing amounts of grass pollen over time is an effective way to reduce severe symptoms in the long term.

But in a new study, published today in the journal JAMA, scientists from Imperial College London have found that a two-year course of treatment is not enough to achieve lasting effects, bolstering previous findings that more time is needed taking the medication to get lasting benefit. The research was funded by the Immune Tolerance Network, supported by the National Institute of Allergy and Infectious Diseases, National Institutes of Health, USA.

"You treat patients for three years and then they have a big improvement in their hay fever for several years afterwards," said Professor Stephen Durham, Head of Allergy and Clinical Immunology at the National Heart and Lung Institute at Imperial and clinical lead for allergy services at Royal Brompton Hospital, who led the study.

"Exposing people to grass pollen in this way is a very effective treatment for people who really have debilitating hay fever."

Hay fever, or seasonal allergic rhinitis, affects as many as one in four people in the UK, leaving sufferers with bouts of sneezing, runny nose and itchy eyes -- all of which can affect work, school and leisure during the summer months when the pollen count soars.

In the majority of cases in the UK the culprit is grass pollen, which the body recognises as an invader, launching an immune response.

A number of over the counter medications are available, such as nasal sprays and antihistamine tablets, but patients with more severe symptoms can be treated with immunotherapy, using a similar approach to the one trialled in children with peanut allergies.

By exposing their immune system to grass pollen extracts over time they are able to build up their resistance, either through injections or a pill containing pollen extract.

The latest study involved patient volunteers at Royal Brompton Hospital in London, which runs a world-class allergy clinic, researchers tested the effectiveness of two immunotherapies prescribed by the NHS which use grass pollen extract: an injection and a pill taken under the tongue.

It was the first head to head trial of the two therapies, in which researchers set out to see if a two-year treatment could achieve the same long-lasting benefits to patients as seen with three-years of immunotherapy, potentially leading to clinical cost savings.

The study was a double blind, placebo-controlled trial in which 106 patients were randomised to one of three treatment groups: injection, tablets and placebo.

Patients had moderate to severe hay fever and were administered either the daily oral treatment, weekly injections for 15 weeks followed by monthly boosters, or a placebo. A total of 92 patients completed the study.

After a two year course of treatment, the results showed that both therapies were effective at tackling symptoms, with patients reporting a dramatic improvement in their quality of life. However, one year after patients had stopped taking the medication the effects were no better than the placebo group.

"Hay fever causes major impairment of sleep, work and school performance and leisure activities during what for most of us is the best time of the year," said Professor Durham.

"Most people respond to the usual antihistamines and nasal sprays, although there is a portion who do not respond adequately or who have unacceptable side effects to the treatment."

Describing the current findings, Professor Durham said: "This study shows that whereas both immunotherapy treatments were highly effective, two years of treatment was insufficient for long-term benefits.

"Clinicians and patients should continue to follow international guidelines that recommend a minimum of three years' treatment."

Previous studies published by Imperial researchers have shown the long-lasting benefits of both immunotherapy injections and pills for

severe hay fever - benefits which persist for at least two to three years after the treatment has stopped.

Professor Durham added: "We have reconfirmed that both treatments are effective but that in order to get the long-term clinical benefits after stopping the treatment, you have to take it for three years."

Researchers at Imperial have a long legacy with immunotherapy dating back to 1911, when a grass pollen injection treatment was first shown to be highly effective in treating hay fever.

Patient Case Study

Max Warner, 51, who lives in London, had successful results in improving his symptoms of hay fever by receiving injections of grass pollen immunotherapy as part of the randomised, placebo-controlled trial over a three-year period at Royal Brompton Hospital.

"I've been allergic to grass pollen ever since I can remember," explained Mr Warner. "Hay fever has a massive impact on my lifestyle and I choose to work from home because of it, I just find commuting through central London worsens my symptoms. I suffer with irritability, sneezing, wheezing and at times this can manifest into a tightened chest where I feel as if I can't breathe properly, especially during summer."

Mr Warner was first tested for his sensitivity to pollen at Royal Brompton Hospital when doctor's sprayed pollen up his nose to compare his reaction before he began receiving injections to his reactions a year into receiving the hay fever treatment.

He received weekly injections for 15 weeks and then monthly injections for the remainder of the two-year treatment period.

"My hay fever symptoms improved over the two years of having injections and the following year as well. My hay fever season can start in April and not finish until September. May, June, July and August are obviously the peak months and these peaks took place during the trial where I felt no symptoms in April or September.

"In the peak months I had less of a blocked up nose; less of a runny nose, less, if any, sneezing, no irritable or watering eyes, no tight chest and just generally much less of a sense of feeling unwell and having less energy throughout the grass pollen season.

"My reaction to pollen had decreased an incredible amount," said Mr Warner. "I really did feel a huge improvement and was relieved to discover I had received the immunotherapy treatment. Last summer [after the trial had finished] I was back to taking antihistamines and was shocked with how bad my symptoms were."

He added: "They are a fantastic team at Royal Brompton. Everyone who was participating felt confident that we were doing something that would make a worthwhile improvement to our health and the health of others. If I had the opportunity, I would carry on receiving the injections."

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Shock from heart device often triggers further health care needs

American Heart Association Rapid Access Journal Report

DALLAS - A shock from an implantable cardioverter defibrillator (ICD) may trigger an increase in health care needs for many people, regardless whether the shock was medically necessary, according to a new study published in Circulation: Cardiovascular Quality and Outcomes, an American Heart Association journal.

ICDs save people from sudden cardiac death by delivering a shock to restore a normal rhythm when the lower chambers of their heart, or ventricles, beat erratically. Inappropriate shocks occur with ICDs, most often when the device mistakes a different heart rhythm problem for ventricular arrhythmia--abnormal heart rhythms that originate in the lower chambers of the heart.

"ICDs cannot assess patients the way a doctor can," said lead study author Mintu Turakhia, M.D., M.A.S., cardiac electrophysiologist and senior director of research and innovation at the Center for Digital Health at Stanford University in California. "The device doesn't know, for instance, if the patient is unconscious or has a pulse. We wanted to

see what happens after a shock, in terms of care and cost, to help define the potential benefit of smarter ways to program these devices."
The authors analyzed the experience of 10,266 patients implanted with an ICD in the U.S. between 2008 and 2010 by linking data transmitted to the device manufacturer with the patients' healthcare records. During that time, 963 patients, average age 61, experienced 1,885 shocks. Thirty-eight percent of those shocks were determined to be inappropriate.
Researchers also found:

Nearly half of all patients (46 percent) who experienced a shock received health care related to the shock.

One in three patients received emergency room or outpatient care only.

One in seven patients was admitted to the hospital.

Invasive cardiovascular procedures, including electrophysiology studies, cardiac catheterization and cardia ablation, were commonly performed following both appropriate and inappropriate shock.

The average cost of health care following a shock was $5,592 for an appropriate shock and $4,470 for an inappropriate shock.

"Obviously, shocks that save people's lives are a good thing, but they are also very painful, can be traumatic and often lead to more health care procedures and expenses," Turakhia said. "This is why strategies to make these ICDs more selective so that they deliver fewer inappropriate shocks is especially important. Fortunately, the industry has made many advancements in this area."
Turakhia added that newer programming strategies reduce the number of inappropriate shocks, even among older-generation ICDs. The devices can be programmed by clinicians to deliver fewer inappropriate shocks by waiting briefly to see if the ventricular arrhythmia resolves itself and by cautiously avoiding triggering shocks for heart rhythms with moderately fast rates.
"The quality of care is no longer just an issue of whether an ICD was implanted in appropriate patients but also whether it was programmed in the best way possible," he said. "We have the technology to do that today."
The findings may be limited as all patients had an ICD from the same manufacturer (Medtronic) and information about factors that may have biased results, including patient behavior and health status, was not available.
"From this study, we cannot tell whether any patient received appropriate or inappropriate care -- only whether they received an appropriate shock or not," Turakhia said. "We can say, however, that the costs associated with both kinds of shock are substantial and that optimal device programming that reduce shock events are likely to decrease healthcare costs and improve patient health."
Co-authors are Steven Zweibel, M.D.; Andrea L. Swain, M.B.A.; Sarah A. Mollenkopf, M.P.H.; and Matthew R. Reynolds, M.D., M.Sc.
Author disclosures are on the manuscript. Medtronic Inc. funded the study.

http://bit.ly/2kWa0w7

Traditional Chinese medicine in HIV cure issue of AIDS Research & Human Retroviruses

Nine individuals were treated with a unique formula of traditional Chinese herbal medicine

New Rochelle, NY - A special issue on progress toward a cure for HIV includes a description of a previously unreported study started in the early 2000s that describes AIDS patients currently ages 51-67 in good health. These nine individuals were treated with a unique formula of traditional Chinese herbal medicine (TCM) from 2001-2006 or longer, with or without occasional antiviral therapy added later. The fact that the patients currently have low or undetectable HIV in their systems is unexpected and intriguing, and suggests a potential promise of TCM as a functional cure for HIV/AIDS, as discussed in a Letter to the Editor in the special issue of AIDS Research and Human Retroviruses, a peer-reviewed journal from Mary Ann Liebert, Inc., publishers. The Letter to the Editor is available open access on the AIDS Research and Human Retroviruses website.
In "Long-Term Survival of AIDS Patients Treated with Only Traditional Chinese Medicine," Yifei Wang, Fujun Jin, Qiaoli Wang, and Zucai Suo, Jinan University (Guangdong, China) and The Ohio

State University (Columbus), report that most of the individuals in this small study have undetectable viral loads, with one patient having a low viral load. Their CD4+ counts and CD4+/CD8+ ratios are all excellent.

In an accompanying Editorial entitled "Can a Traditional Chinese Medicine Contribute to a Cure for HIV?" Thomas Hope, PhD, Editor-in-Chief of AIDS Research and Human Retroviruses and Professor of Cell and Molecular Biology at Northwestern University, Feinberg School of Medicine (Chicago, IL), while pointing out the limitations in interpreting the outcome of this small, non-placebo-controlled study, comments on the importance of putting "these observations into the hands of the HIV research community." He writes, "I believe there should be some effort to further explore this phenomenon."

Both the Letter to the Editor and Editorial are part of a new Special Issue on HIV Cure Research published in AIDS Research and Human Retroviruses.

http://bit.ly/2kN9a28

How far they'll go: Moana shows the power of Polynesian celestial navigation

One of the greatest feats of human migration in history was the colonisation of the vast Pacific Ocean by Polynesian peoples. They achieved it thanks to their sophisticated knowledge of positional astronomy and celestial navigation.

Duane W. Hamacher Senior ARC Discovery Early Career Research Fellow, Monash University

Carla Bento Guedes Cultural Astronomy & Cultural Competence Researcher, UNSW

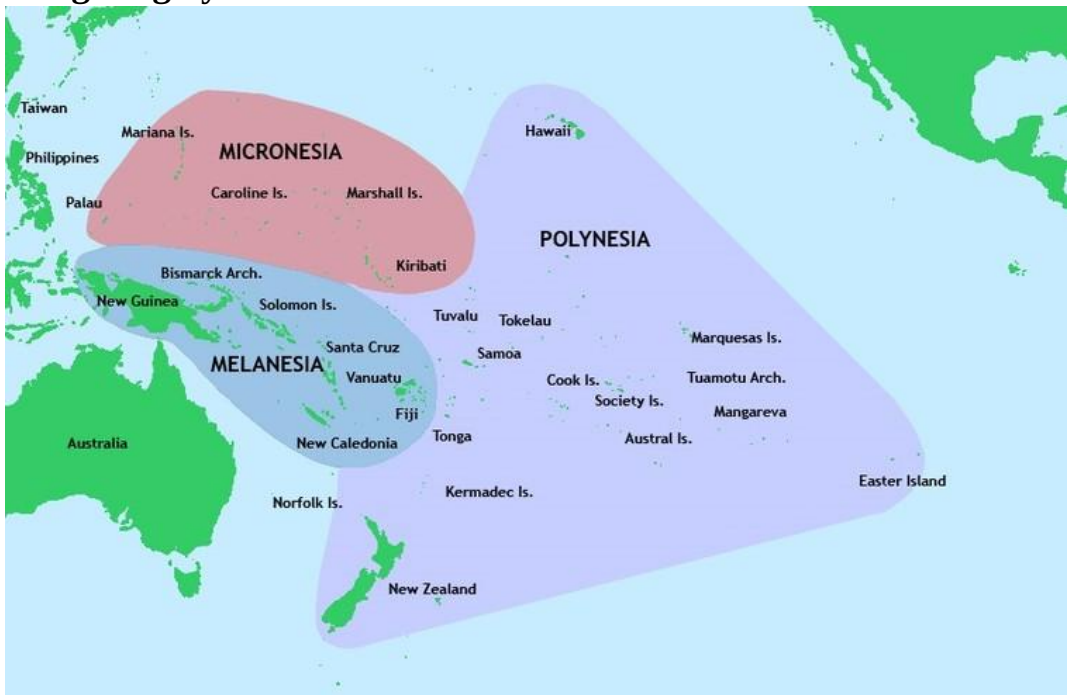
The Disney film Moana has drawn attention to these accomplishments and helped inform a new generation about the complexity of Indigenous astronomy.

Polynesia forms a triangle across the Pacific, with Hawaii to the north, Rapa Nui (Easter Island) to the southeast, and Aotearoa (New Zealand) to the southwest, with Tahiti in the centre. But Polynesian voyaging extends beyond this triangle; there is strong evidence they reached the coast of South America and sub-Antarctic islands.

Moana touches on Polynesian voyaging, showing the eponymous main character using traditional celestial techniques to navigate across the sea.

During production, Disney created the Oceanic Story Trust – a board of experts, including Polynesian locals and elders – to advise on cultural accuracy. The film accomplished this reasonably well, especially in respect to celestial navigation, despite the producers facing criticism for cultural appropriation and commodification.

Navigating by hand



The Polynesian triangle with the areas of Melanesia and Micronesia. **Opinion Global**

To navigate the wide expanse of the Pacific, voyagers need to map the stars to determine their position from our perspective here on Earth. Navigator and Polynesian Voyaging Society president Nainoa Thompson explains:

If you can identify the stars as they rise and set, and if you have memorised where they rise and set, you can find your direction.

Since 1976, the famous Hokule'a voyages have demonstrated how Polynesians used traditional sea-craft and navigational techniques to cross the expanse of the Pacific, from Japan to Canada.

So what are some of these navigational techniques?

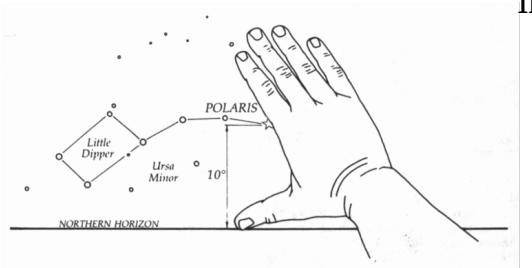
To calculate their position on Earth, voyagers memorised star maps and used the angle of stars above the horizon to determine latitude. For example, the top and bottom stars of the Southern Cross are separated by six degrees. When the distance between those stars is equal to the bottom star's altitude above the horizon, your northerly latitude is 21º: that of Honolulu.

When the bright stars Sirius and Pollux set at exactly the same time, your latitude is 18º South: the latitude of Tahiti.

Voyagers measure the angles between stars and the horizon using their hands. The width of your pinkie finger at arm's length is roughly one degree, or double the angular diameter of the Sun or Moon.

Hold your hand with the palm facing outward and thumb fully extended, touching the horizon. Each part of your hand is used to measure a particular altitude.

In Hawai'i, the "North Star", Polaris, is *Hokupa'a*, meaning "fixed star". It lies close to the north celestial pole. The altitude of *Hokupa'a* indicates your northerly latitude.



The hand method used by Nainoa Thompson to find the altitude of the Polaris. **Journal of the Polynesian Society**

Moana measures altitude of Orion's belt stars. **Walt Disney Studios Motion Pictures**

In the film, we see Moana Waialiki using this technique to measure the altitude of a group of stars. Look closely and you can see that she's measuring the stars in Orion's Belt. The position of Moana's hand indicates the star above her index finger has an altitude of 21º. Given that the movie takes place about 2,000 years ago near Samoa, the position of Orion indicates they are travelling exactly due East.

Later in the film, we see Moana navigating by following Maui's fish hook. In the various Polynesian traditions, the hook was used to pull islands from the sea. It is represented by the constellation Scorpius, which rises at dusk in mid-May. This indicates southeasterly travel.

However, the positions of the stars are not fixed in time. Over the 3,500 years that Polynesians have been exploring the Pacific, the stars have gradually shifted due to precession of the equinoxes.

From the latitude of Samoa, the Southern Cross has lowered from 60º altitude in 1500 BCE to 41º today. Those navigating by the stars must gradually adjust their measurements as the positions of stars slowly shift over time. In his book *Hawaiki Rising*, Sam Low tells how navigators would develop new techniques.

Aboriginal knowledge

In Australia, colonists knew little about Aboriginal celestial navigation, with some researchers claiming Aboriginal people did not use it at all. However, collaborations with elders shows that Aboriginal people use celestial navigation and developed star maps to link the sky with the land.

Celestial navigation is an important component of Indigenous astronomy around the world. Try going out tonight and measuring the positions of the stars with your own hands. It's actually quite fun!

Duane W. Hamacher receives funding from the Australian Research Council.

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Bipolar disorder candidate gene, validated in mouse experiment

A team of researchers, affiliated with UNIST has made a significant breakthrough in the search for the potential root causes of bipolar disorder.

The research team, led by Professor Pann-Ghill Suh of Life Sciences at UNIST conducted a study that suggests the cellular protein Phospholipase Cγ1 (PLCγ1) could be a new promising candidate gene for bipolar disorder, also known as manic-depressive illness.

The research published by the journal Molecular Psychiatry outlines the findings on January 31, 2017. The findings provide evidence that PLCγ1 is critical for synaptic function and plasticity and that the loss of PLCγ1 from the forebrain results in manic-like behavior. This breakthrough is expected to be widely used in research for the treatment of the manic symptoms associated with bipolar disorder.

The PLCγ1 has once been proposed as a candidate gene for bipolar disorder in previous studies. However, it has been unclear that how the PLCγ1 plays a role in neuron-to-neuron signaling and how it is related to mental illnesses, like bipolar disorder.

In the study, Professor Suh and his team created forebrain-specific PLCγ1-deficient mice and observed what happened in the brain synapse of this mouse. Synapse is the part of the neuron where the signal is transmitted from the end.

To test whether dysfunction of PLCγ1 in the brain contributes to development of neuropsychiatric disorders, the research team generated mouse models, lacking PLCγ1 in the forebrain and studied the synaptic and neuronal changes in mouse models.

The research team reported that mice with forebrain-selective deletion of PLCγ1 also exhibit manic-like behavior, as well as deficits in inhibitory transmission and BDNF-dependent synaptic plasticity.

This resulted in the imbalance between excitatory and inhibitory synaptic transmission in forebrain circuits, leading to behavioral abnormalities and manic episodes of bipolar disorder. These symptoms were alleviated after the drug treatment for bipolar disorder was given.

"In the brain, excitatory synapses and inhibitory synapses work together to remain balanced for proper neurotransmission," says Professor Suh. "Our study demonstrated that the imbalance between these two is a major cause of various neuropsychiatric disorders and the GABAergic dysfunction observed in the hippocampi of bipolar disorder patients."

According to the research team, the inhibitory synapses that lacks PLCγ1 protein do not work properly in excitatory neurons. This is due to the improper signaling of BDNF, which is critical for the synapse formation. This leads to an imbalance of excitatory synapses and inhibitory synapses, and causes mental illnesses, like bipolar disorder.

"After 10 years of research, we have finally revealed PLCγ1 protein plays a major role in the onset of bipolar disorder," says Professor Suh. "Our findings, therefore, provide evidence that PLCγ1 is critical for synaptic function and plasticity and that the loss of PLCγ1 from the forebrain results in manic-like behavior."

The research was carried out with the support of the future creation science department and the Korea Research Foundation.

Y R Yang, et al.,"Forebrain-specific ablation of phospholipase Cγ1 causes manic-like behavior," Molecular Psychiatry, (2017).

http://bit.ly/2ktLqUF

Vitamin D protects against colds and flu, finds major global study

Vitamin D supplements protect against acute respiratory infections including colds and flu, according to a study led by Queen Mary University of London (QMUL)

Vitamin D supplements protect against acute respiratory infections including colds and flu, according to a study led by Queen Mary University of London (QMUL).

The study provides the most robust evidence yet that vitamin D has benefits beyond bone and muscle health, and could have major

implications for public health policy, including the fortification of foods with vitamin D to tackle high levels of deficiency in the UK.

The results, published in the BMJ, are based on a new analysis of raw data from around 11,000 participants in 25 clinical trials conducted in 14 countries including the UK, USA, Japan, India, Afghanistan, Belgium, Italy, Australia and Canada. Individually, these trials yielded conflicting results, with some reporting that vitamin D protected against respiratory infections, and others showing no effect.

Lead researcher Professor Adrian Martineau from QMUL said: "This major collaborative research effort has yielded the first definitive evidence that vitamin D really does protect against respiratory infections. Our analysis of pooled raw data from each of the 10,933 trial participants allowed us to address the thorny question of why vitamin D 'worked' in some trials, but not in others.

"The bottom line is that the protective effects of vitamin D supplementation are strongest in those who have the lowest vitamin D levels, and when supplementation is given daily or weekly rather than in more widely spaced doses.

"Vitamin D fortification of foods provides a steady, low-level intake of vitamin D that has virtually eliminated profound vitamin D deficiency in several countries. By demonstrating this new benefit of vitamin D, our study strengthens the case for introducing food fortification to improve vitamin D levels in countries such as the UK where profound vitamin D deficiency is common."

Vitamin D - the 'sunshine vitamin' - is thought to protect against respiratory infections by boosting levels of antimicrobial peptides - natural antibiotic-like substances - in the lungs. Results of the study fit with the observation that colds and 'flu are commonest in winter and spring, when levels of vitamin D are at their lowest. They may also explain why vitamin D protects against asthma attacks, which are commonly triggered by respiratory viruses.

Daily or weekly supplementation halved the risk of acute respiratory infection in people with the lowest baseline vitamin D levels, below 25 nanomoles per litre (nmol/L). However, people with higher baseline vitamin D levels also benefited, although the effect was more modest (10 per cent risk reduction). Overall, the reduction in risk of acute respiratory infection induced by vitamin D was on a par with the protective effect of injectable 'flu vaccine against 'flu-like illnesses.

Acute respiratory infections are a major cause of global morbidity and mortality. Upper respiratory infections such as colds and 'flu are the commonest reason for GP consultations and days off work. Acute lower respiratory infections such as pneumonia are less common, but caused an estimated 2.65 million deaths worldwide in 2013. Vitamin D supplementation is safe and inexpensive, so reductions in acute respiratory infections brought about by vitamin D supplementation could be highly cost-effective.

The study was conducted by a consortium of 25 investigators from 21 institutions worldwide and funded by the National Institute for Health Research.*

** Institutions involved in the research: Edmond and Lily Safra Children's Hospital (Tel Hashomer, Israel), Geisel School of Medicine at Dartmouth (NH, USA), Harvard School of Public Health (Boston, MA, USA), Jikei University School of Medicine (Tokyo, Japan), Karolinska Institutet (Stockholm, Sweden), Massachusetts General Hospital (Boston, MA, USA), McMaster University (Hamilton, Ontario, Canada), Medical University of Lodz (Poland), QIMR Berghofer Medical Research Institute (Queensland, Australia), Queen Mary University of London (UK), The Pennsylvania State University (Hershey, PA, USA), Università degli Studi di Milano (Milan, Italy), Universitair ziekenhuis Leuven (Belgium), University of Auckland (New Zealand), University of Birmingham (UK), University of Colorado School of Medicine (Aurora, CO, USA), University of Delhi (India), University of Otago (Christchurch, New Zealand), University of Tampere (Finland), University of Tasmania (Australia), Winthrop University Hospital (Mineola, NY, USA).*

Research paper: 'Vitamin D supplementation to prevent acute respiratory infections: systematic review and meta-analysis of individual participant data'. Martineau et al. BMJ 2017 http://www.bmj.com/cgi/doi/10.1136/bmj.i6583

http://bit.ly/2lWwHOd

Researchers find autism biomarkers in infancy

MRI enables scientists to identify 80% of babies who would be diagnosed with autism at age 2

By using magnetic resonance imaging (MRI) to study the brains of infants who have older siblings with autism, scientists were able to correctly identify 80 percent of the babies who would be subsequently diagnosed with autism at 2 years of age.

Researchers from the University of Washington were part of a North American effort led by the University of North Carolina to use MRI to measure the brains of "low-risk" infants, with no family history of autism, and "high-risk" infants who had at least one autistic older sibling. A computer algorithm was then used to predict autism before clinically diagnosable behaviors set in. The study was published Feb. 16 in the journal Nature.

This is the first study to show that it is possible to use brain biomarkers to identify which infants in a high-risk pool -- that is, those having an older sibling with autism -- will be diagnosed with autism spectrum disorder, or ASD, at 24 months of age.

"Typically, the earliest we can reliably diagnose autism in a child is age 2, when there are consistent behavioral symptoms, and due to health access disparities the average age of diagnosis in the U.S. is actually age 4," said co-author and UW professor of speech and hearing sciences Annette Estes, who is also director of the UW Autism Center and a research affiliate at the UW Center on Human Development and Disability, or CHDD. "But in our study, brain imaging biomarkers at 6 and 12 months were able to identify babies who would be later diagnosed with ASD."

The predictive power of the team's findings may inform the development of a diagnostic tool for ASD that could be used in the first year of life, before behavioral symptoms have emerged.

"We don't have such a tool yet," said Estes. "But if we did, parents of high-risk infants wouldn't need to wait for a diagnosis of ASD at 2, 3 or even 4 years and researchers could start developing interventions to prevent these children from falling behind in social and communication skills."

People with ASD -- which includes 3 million people in the United States -- have characteristic social communication deficits and demonstrate a range of ritualistic, repetitive and stereotyped behaviors. In the United States, it is estimated that up to one out of 68 babies develops autism. But for infants with an autistic older sibling, the risk may be as high as one out of every five births.

This research project included hundreds of children from across the country and was led by researchers at four clinical sites across the United States: the University of North Carolina-Chapel Hill, UW, Washington University in St. Louis and The Children's Hospital of Philadelphia. Other key collaborators are at the Montreal Neurological Institute, the University of Alberta and New York University.

"We have wonderful, dedicated families involved in this study," said Stephen Dager, a UW professor of radiology and associate director of the CHDD, who led the study at the UW. "They have been willing to travel long distances to our research site and then stay up until late at night so we can collect brain imaging data on their sleeping children. The families also return for follow-up visits so we can measure how their child's brain grows over time. We could not have made these discoveries without their wholehearted participation."

Researchers obtained MRI scans of children while they were sleeping at 6, 12 and 24 months of age. The study also assessed behavior and intellectual ability at each visit, using criteria developed by Estes and her team. They found that the babies who developed autism experienced a hyper-expansion of brain surface area from 6 to 12 months, as compared to babies who had an older sibling with autism but did not themselves show evidence of autism at 24 months of age. Increased surface area growth rate in the first year of life was linked to increased growth rate of brain volume in the second year of life. Brain overgrowth was tied to the emergence of autistic social deficits in the second year.

The researchers input these data -- MRI calculations of brain volume, surface area, and cortical thickness at 6 and 12 months of age, as well as sex of the infants -- into a computer program, asking it to classify babies most likely to meet ASD criteria at 24 months of age. The program developed the best algorithm to accomplish this, and the researchers applied the algorithm to a separate set of study participants.

Researchers found that, among infants with an older ASD sibling, the brain differences at 6 and 12 months of age successfully identified 80 percent of those infants who would be clinically diagnosed with autism at 24 months of age. If these findings could form the basis for a "pre-symptomatic" diagnosis of ASD, health care professionals could intervene even earlier.

"By the time ASD is diagnosed at 2 to 4 years, often children have already fallen behind their peers in terms of social skills, communication and language," said Estes, who directs behavioral evaluations for the network. "Once you've missed those developmental milestones, catching up is a struggle for many and nearly impossible for some."

Research could then begin to examine interventions on children during a period before the syndrome is present and when the brain is most malleable. Such interventions may have a greater chance of improving outcomes than treatments started after diagnosis.

"Our hope is that early intervention - before age 2 - can change the clinical course of those children whose brain development has gone awry and help them acquire skills that they would otherwise struggle to achieve," said Dager.

The research team has gathered additional behavioral and brain imaging data on these infants and children -- such as changes in blood flow in the brain and the movement of water along white matter networks -- to understand how brain connectivity and neural activity may differ between high-risk children who do and don't develop autism. In a separate study published Jan. 6 in Cerebral Cortex, the researchers identified specific brain regions that may be important for acquiring an early social behavior called joint attention, which is orienting attention toward an object after another person points to it.

"These longitudinal imaging studies, which follow the same infants as they grow older, are really starting to hone in on critical brain developmental processes that can distinguish children who go on to develop ASD and those who do not," said Dager. "We hope these ongoing efforts will lead to additional biomarkers, which could provide the basis for early, pre-symptomatic diagnosis and serve also to guide individualized interventions to help these kids from falling behind their peers."

The research was funded by the National Institutes of Health, Autism Speaks and the Simons Foundation.

http://bit.ly/2kNJW3N

Molecular mechanism behind why allergies are more common in developed countries discovered

Researchers have discovered a molecular mechanism that could explain why allergies are less common in developing countries.

Writing in the journal, Immunology, they report that this finding could be the first step to developing new immunotherapies to prevent allergies.

For a long time, we've been aware that allergies occur much more frequently in Western countries, but we don't know why this is. One idea that has grown in popularity is the hygiene hypothesis, which suggests that our immune systems need to come into contact with a range of micro-organisms when we are young to be able to produce appropriate immune responses later in life.

"Allergies are a type of inappropriate immune response, where our bodies misidentify a harmless substance as a threat," said lead author Dr Joseph Igetei, formally of the University of Nottingham, UK, now at the University of Benin, Nigeria.

"We know that worm infections occur more frequently in less developed countries, i.e. in places where allergies are rare. Although it's been suggested that worm infections could prevent against different allergies, there has been little concrete evidence of the potential molecular mechanisms that might mediate any such relationship."

In this study, the research team led by Professor Mike Doenhoff from the University of Nottingham, and including Dr Joseph Igetei, Dr Marwa El-Faham from Alexandria University and Dr Susan Liddell,

set out to discover if the antigens produced by a common species of parasitic worm that infects humans (called Schistosoma mansoni) were cross-reactive to antigens from peanuts, i.e. do the proteins from the worm and from the peanuts trigger the same immune response?

To investigate this, they used antibodies from rabbits that had been exposed to various life stages of the worm -- antibodies are a type of immune protein made by the body to provide a tailored response to any substance deemed to be a threat. The researchers tested if these antibodies (which had been produced specifically against the parasitic worm) also reacted to various proteins found in peanuts.

They found that the antibodies responded to several proteins in the peanut, in particular one called Ara h 1, which is known to be a key player in inducing the negative response in people who are allergic to peanuts.

"It may sound strange that peanuts and worms have anything in common that could cause the immune system to generate the same response," said Professor Mike Doenhoff. "However, our work indicates that proteins from these two seemingly very different organisms actually have identical markers on them, meaning the immune system views them in the same way and targets them with similar antibodies."

These findings are important in two ways. Firstly, this work goes some way to explaining the molecular mechanisms behind the observation that countries with a high incidence of worm infections have a low incidence of allergy.

Although more work is needed to confirm the exact relationship, the team think that antibodies produced in response to a worm infection could stop the immune system from producing an allergic reaction when faced with a novel substance such as peanut protein. Secondly, this work may lead to new ideas to treat allergies. The team's next step is, however, to see if antibodies produced by humans in response to a worm infection also cross-react with peanut proteins.

http://bit.ly/2lq5Xc2

Squishy supercapacitors bathed in green tea could power wearable electronics

Comfortable wearable electronics could become available in softer materials made in part with an unexpected ingredient: green tea.

Wearable electronics are here -- the most prominent versions are sold in the form of watches or sports bands. But soon, more comfortable products could become available in softer materials made in part with an unexpected ingredient: green tea. Researchers report in ACS' *The Journal of Physical Chemistry C* a new flexible and compact rechargeable energy storage device for wearable electronics that is infused with green tea polyphenols.

Powering soft wearable electronics with a long-lasting source of energy remains a big challenge. Supercapacitors could potentially fill this role -- they meet the power requirements, and can rapidly charge and discharge many times. But most supercapacitors are rigid, and the compressible supercapacitors developed so far have run into roadblocks. They have been made with carbon-coated polymer sponges, but the coating material tends to bunch up and compromise performance. Guruswamy Kumaraswamy, Kothandam Krishnamoorthy and colleagues wanted to take a different approach.

The researchers prepared polymer gels in green tea extract, which infuses the gel with polyphenols. The polyphenols converted a silver nitrate solution into a uniform coating of silver nanoparticles. Thin layers of conducting gold and poly(3,4-ethylenedioxythiophene) were then applied. And the resulting supercapacitor demonstrated power and energy densities of 2,715 watts per kilogram and 22 watt-hours per kilogram -- enough to operate a heart rate monitor, LEDs or a Bluetooth module. The researchers tested the device's durability and found that it performed well even after being compressed more than 100 times.

The authors acknowledge funding from the University Grants Commission of India, the Council of Scientific and Industrial Research (India) and the Board of Research in Nuclear Sciences (India). The abstract that accompanies this study is available here.

http://bit.ly/2kw2sSc

Unsaturated fatty acid may reverse aging effect of obesity

Obesity, or a high fat diet, can lead to changes in the immune system similar to those observed with aging.

That's what research published this week in Experimental Physiology suggests.

The research was carried out by scientists at Liverpool John Moores University in the United Kingdom and the Institute of Food Science, Technology and Nutrition of the Spanish National Research Council (ICTAN-CSIC), the University Complutense of Madrid and the Research Institute of the Hospital 12 de Octubre, in Spain.

These findings are useful as they help scientists understand the impact of obesity on our body's ability to fight infection. They also found that it was possible to reverse some of these effects by supplementing the diet with unsaturated fatty acids found in vegetable oils, such as olive or fish oils.

Obesity affects one in four adults in the UK and can lead to a number of serious and potentially life-threatening conditions, such as type 2 diabetes, coronary heart disease, some types of cancer, and stroke[1].

The researchers fed mice a high-fat diet, causing them to become obese.

Signs of oxidative stress and certain properties of immune cells indicated aging of the immune system. These obese mice were then split into groups and received food supplemented either with 2-hydroxyoleic acid or omega-3 fatty acids for eight weeks.

Author Dr. Fatima Perez de Heredia from Liverpool John Moores University said: 'This is the first study, at least to our knowledge, to suggest the efficacy of 2-hydroxyoleic acid for reversing obesity-associated immune alterations and improving oxidative stress.'

1. Link to source: http://www.nhs.uk/conditions/Obesity/Pages/Introduction.aspx

2. Full paper title: Oxidative stress and immunosenescence in spleen of obese mice can be reversed by 2-hydroxyoleic acid DOI: 10.1113/EP086157

Link to paper http://onlinelibrary.wiley.com/doi/10.1113/EP086157/full

http://bit.ly/2m0bov9

Experiments suggest dogs and monkeys have a human-like sense of morality

A team of researchers from Kyoto University has found that dogs and capuchin monkeys watch how humans interact with one another and react less positively to those that are less willing to help or share.

February 15, 2017 by Bob Yirka report

Phys.org - In their paper published in the journal Neuroscience & Biobehavioral Reviews, the team describes a series of experiments they carried out with several dogs and capuchin monkeys and what they discovered about both species social preferences.

Common sense suggests that most people prefer to deal with other people who are fair and in some cases, helpful. In this new effort, the researchers sought to learn if the same might be true of dogs and capuchin monkeys regarding human interactions. To that end, they set up three experiments designed to test how dogs and monkeys reacted to humans behaving rudely.

In the first experiment, a capuchin monkey was allowed to watch a scene in which a person was trying to open a can. After failing, the person asked another person for help—in some cases, the other person complied, and in some cases, they did not. Also in some cases, there was another person present who did nothing, serving as a passive actor in the scene.

In the second experiment, the researchers positioned a capuchin monkey to watch as two people arrived with three balls each. One of the people then asked the other person to give them all of their balls and the other person complied. Next, the person who had given up their balls asked the other to return them—in some cases the other person complied, and in other cases refused.

The third experiment was nearly identical to the second, except it involved dogs, their owners and another person unknown to the dog.

At the conclusion of all three experiments, the people involved (including passive actors) all offered a treat to the monkey or dog that had been observing the action. The researchers report that in all three scenarios, the animals showed a clear disinclination to accept a treat from a person that refused to help with the can or refused to give back the balls, as compared to those that were helpful or fair or were passive actors. The researchers claim this shows that capuchin monkeys and dogs make social judgments in ways similar to human infants, and that it might even offer clues regarding the development of morals in humans.

Explore further: Study shows capuchins less receptive to others who refuse to help when asked

More information: James R. Anderson et al, Third-party social evaluations of humans by monkeys and dogs, Neuroscience & Biobehavioral Reviews (2017). DOI: 10.1016/j.neubiorev.2017.01.003

Abstract

Developmental psychologists are increasingly interested in young children's evaluations of individuals based on third-party interactions. Studies have shown that infants react negatively to agents who display harmful intentions toward others, and to those who behave unfairly. We describe experimental studies of capuchin monkeys' and pet dogs' differential reactions to people who are helpful or unhelpful in third-party contexts, and monkeys' responses to people who behave unfairly in exchanges of objects with a third party. We also present evidence that capuchin monkeys monitor the context of failures to help and violations of reciprocity, and that intentionality is one factor underlying their social evaluations of individuals whom they see interacting with others. We conclude by proposing some questions for studies of nonhuman species' third party-based social evaluations.

http://bit.ly/2llJeO7

Dormouse might be first tree-climbing mammal shown to echolocate

A rare rodent isn't just blind as a bat: it may navigate like one too.

By Sandrine Ceurstemont

The tree-climbing Vietnamese pygmy dormouse seems to make ultrasonic calls to guide its motion. If that's confirmed, it would be the first arboreal mammal known to use echolocation.

Apart from bats, dolphins, whales, rats and shrews – which use calls in the audible range – few mammals echolocate as vision is usually more efficient. But Aleksandra Panyutina at the Russian Academy of Sciences in Moscow and her team thought the dormouse was a good candidate. They had access to two of these seldom-studied, mainly nocturnal rodents at the Moscow zoo, where keepers had noticed that they were able to climb with remarkable agility despite poor eyesight. They also have big, bat-like ears. "We suspected that they use echolocation," says Panyutina.

To find out, the team first confirmed the rodent's poor vision by analysing the preserved eyes of dead individuals. Then, the two zoo dormice were filmed in cages filled with branches (pictured below).

The soundtrack revealed that they often produced a series of quick, ultrasonic pulses similar in structure to bat echolocation calls but much quieter. Syncing the video and audio showed that they typically made sounds while moving, suggesting that the sounds are for navigation.

Gareth Jones, a bat researcher at the University of Bristol in the UK, thinks the results are interesting although further work is needed. "It is important to determine whether the mice can hear echoes from the calls," he says.

Panyutina and her colleagues are not sure whether the rodent is producing sounds from its larynx or elsewhere. In addition, the experiments were not performed in darkness and didn't test if the call rate changes on approaching an obstacle, says Eran Amichai from Tel Aviv University, who studies bat echolocation.

However, if the dormouse is indeed echolocating, it could help solve an age-old question in bat evolution: whether flight or echolocation came first. There is some evidence that bats gained the ability to echolocate very early on, although fossils suggest at least one early bat species seems to have lacked the ability. New examples of echolocation in land mammals could help support the theory that it evolved prior to flight.

"It is conceivable that the terrestrial ancestors of echolocating bats used echolocation in a similar way," says Jones – although he points out that bats are not closely related to rodents, so the dormice would have gained their ability to echolocate independently rather than from an ancestor common to them and bats.

Journal reference: Integrative Zoology, DOI: 10.1111/1749-4877.12249

http://bit.ly/2ldDpQV

Two new drug therapies might cure every form of tuberculosis

Tuberculosis, the world's leading infectious killer, may have finally met its match.

By Andy Coghlan

Two new drug therapies may be able to cure all forms of tuberculosis – even the ones most difficult to treat. "We will have something to offer every single patient," says Mel Spigelman, president of the TB Alliance, the organisation coordinating trials of the two treatments. "We are on the brink of turning TB around."

It presently takes six months of drug treatment to cure ordinary TB, and two years to cure people whose infections are resistant to drugs. People may need to take up to 20 tablets a day, plus injections.

Together, the new treatments, called BPaMZ and BPaL, could make treating TB much simpler and more effective.

BPaMZ involves taking four drugs once a day. Trials carried out in 240 people across 10 countries in Africa suggest that it cures almost all cases of ordinary TB in four months, and most people with drug-resistant TB in about six months. In the majority of cases, the TB bacterium had disappeared from sputum within two months.

"The alliance has never before seen such rapid action against TB bacteria," says Spigelman.

Meanwhile, BPaL, a therapy that involves taking three drugs once a day, has so far cured 40 of 69 patients with "extremely-drug-resistant TB" – the most difficult form to treat. What's more, it achieved this within six months. The 29 remaining participants in this trial are still to be assessed.

The TB Alliance says that BPaMZ has the potential to treat 99 per cent of people who catch TB each year, while BPaL could treat the remainder. Researchers presented results from both sets of trials at the Conference on Retroviruses and Opportunistic Infections in Seattle this week.

Caution needed

The arrival of new drugs is long-awaited, says Spigelman, because the existing treatment for TB is now 50 years old. According to the latest figures from the World Health Organization, there were 10.4 million new cases of TB in 2015, but only 20 per cent of those with resistant TB were treated, and of those only half were cured.

Once mass produced, BPaMZ could cost just a tenth of the $3000 it now costs to treat drug-resistant TB.

Spigelman cautions, however, that larger trials are needed to confirm the effectiveness of both therapies and for them to be approved for global use. At best, this would take at least three years for BPaMZ, he says, although the therapy for extremely-drug-resistant TB may be available sooner.

"The results are exciting and encouraging, but we must be cautious saying we can treat everyone with these regimes," says David Moore at the London School of Hygiene and Tropical Medicine. "These are only preliminary data, so there's a danger of jumping the gun."

http://bit.ly/2lRQL8z

Team develops a biosensor able to detect HIV only one week after infection

A team from the Spanish National Research Council (CSIC) has developed a biosensor that can detect type 1 HIV during the first week after infection.

In the experiments, performed on human serum, the biosensor detected the p24 antigen, a protein present in the HIV-1 virus. This

new technology, which has been patented by CSIC, detects the protein at concentrations 100,000 times lower than in current techniques.

In addition, the total test time is 4 hours, 45 minutes, meaning clinical results could be obtained on the same day. The research is published today in the journal PLOS ONE.

The biosensor combines micromechanical silicon structures with gold nanoparticles, both functionalised with p24-specific antibodies. At the end of the immunoassay procedure, p24 is sandwiched between the gold nanoparticles and the micromechanical silicon structures. The gold nanoparticles have optical resonances known as plasmons. These are capable of scattering light very efficiently and have attracted interest in the field of optics over the last decade. Micromechanical structures are excellent mechanical sensors capable of detecting interactions even at the scale of intermolecular forces. The combination of these two structures produces both mechanical and optical signals that amplify one another, producing the sensitivity required to detect p24.

The technology, which has been patented by CSIC, is also being applied toward the early detection of certain types of cancer.

"The chip itself, the physical part, is identical for HIV tests and for cancer biomarker tests. What changes is the chemical component—the solution applied— so that it reacts to what we are looking for. That's why our fundamental work is focused on developing applications for this new technology," says CSIC researcher Javier Tamayo, who works at the Institute of Microelectronics in Madrid.

"The biosensor uses structures which are manufactured using well-established microelectronics technology, thus making large-scale, low-cost production possible. This, combined with its simplicity, could make it a great choice for use in developing countries," says Tamayo.

How the biosensor works

The experiment begins by incubating one millilitre of human serum on the sensor for one hour at 37 °C to allow binding of HIV-1 p24 antigens to the capture antibodies located on the sensor's surface. Next, it is re-incubated at 37 °C, for 15 minutes so the captured p24 proteins can be marked.

Finally, the resulting material is rinsed to remove any unbound particles. "The test takes a total of four hours and 45 minutes, which is really rapid. In fact, to confirm the diagnosis you could even repeat the test and the clinical results could be back on the same day as the medical examination. The results are statistically significant and could be adapted to medical requirements," explains the CSIC researcher.

HIV detection systems

Acute human immunodeficiency virus infection is defined as the time from virus acquisition to seroconversion, i.e. the onset of detectable antibodies of HIV in the blood. Today there are two ways to detect HIV in the blood. First, infection can be diagnosed by detecting viral RNA in the blood using nucleic acid amplification tests (NAAT); second, by detecting that p24 protein with fourth-generation immunoassays.

The first method, based on detecting viral RNA in the blood, has a detection limit of 20 to 35 copies of RNA per millilitre, i.e. a concentration typically occurring two weeks after HIV acquisition. In the second method, during the fourth-generation immunoassays, a detection threshold of p24 in 10 picograms per millilitre is reached. This occurs approximately three to four weeks after infection.

CSIC develops a biosensor able to detect HIV only one week after infection

"This new technology is capable of detecting p24 at concentrations up to 100,000 times lower than the previous generation of approved immunoassays methods and 100 times lower than methods for detecting viral RNA in blood. This reduces the undetectable phase after infection to just one week," says CSIC researcher Priscila Kosaka from Madrid's Institute of Microelectronics.

Detecting HIV in blood

The period between infection and seroconversion is approximately four weeks. The early detection of HIV is crucial to improving a person's health. Progressive changes occur after HIV acquisition, such as irreversible depletion of gut CD4 lymphocytes, replication in the central nervous system, and the establishment of latent HIV reservoirs. "The potential for HIV infectivity in the first stage of infection is much higher than in the later stages. Therefore, initiating antiretroviral therapy prior to seroconversion improves immune control and has been associated with benefits in CD4 cell count, a reduction in systemic inflammation, the preservation of cognitive function, and a reduction of the latent reservoir. Logically, its detection is critical to the prevention of HIV transmission," explains Kosaka.

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The Amount of Exercise Needed to Reduce All-Cause Mortality

Recent reports illuminate key questions about physical activity and health, including how much, how often, and what type is best

JoAnn E. Manson, MD, DrPH

Hello. This is Dr JoAnn Manson, professor of medicine at Harvard Medical School, Brigham and Women's Hospital. Two recent reports from the UK (England and Scotland) shed light on several key questions about physical activity and health, including how much, how often, and what type is best.

As you know, current physical activity guidelines recommend moderate-intensity exercise for about 30 minutes most days of the week (a total of 150 minutes/week) or vigorous exercise for half that amount of time (75 minutes), spread out over three or more sessions per week. In a report published in *JAMA Internal Medicine*,[1] researchers asked a large cohort of more than 63,000 men and women over age 40 about their moderate to vigorous physical activity. Participants were classified into one of four groups: those who did no moderate or vigorous physical activity, those who met the guidelines (150 or 75 minutes/week) and exercised at least three times per week, those who met the guidelines but compressed the activity into one to two sessions per week (commonly referred to as "weekend warriors"), and those who reported some moderate to vigorous physical activity but less than the guidelines.

The results were surprising. All of the active groups, compared with the group not having any moderate to vigorous activity, had substantial reductions in cardiovascular and all-cause mortality. Weekend warriors and those getting less than the recommended amount, compared with those getting no moderate to vigorous exercise, had close to a 30% reduction in all-cause mortality. Those meeting the guidelines and having at least three sessions per week had a 35% reduction in all-cause mortality. So there was not too much difference. All three active groups had about a 40% reduction in cardiovascular mortality compared with those who did not report any moderate to vigorous activity.

In a second report from the UK cohort, published in the *British Journal of Sports Medicine*,[2] researchers asked participants about specific types of sports and moderate to vigorous activities that they engaged in. What they found was very interesting. A really wide range of sports and leisure-time activities were associated with substantial reductions in all-cause and cardiovascular mortality, including swimming, racket sports, and aerobics. Similar reductions in cardiovascular mortality were found with these types of activities.

It is a very good clinical public health message that some moderate to vigorous physical activity is substantially better than none, and that more is at least slightly better than some. We should encourage

patients who are unable to meet the target, or who have to compress activity into one or two sessions per week or the weekend, to stick with it and be as active as they are able. We can expect that any activity will be better than none.

We need more research on physical activity and health, including randomized clinical trials of different types of activity, to further refine the activity guidelines. Thank you so much for your attention. This is JoAnn Manson.

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Spinal Manipulation for Back and Neck Pain: Does It Work?

Spinal Manipulation: A Valid Technique?

Laird Harrison

In her office at McMaster University in Toronto, Anita Gross, MSc, has logged paper after paper showing that spinal manipulation can help control neck pain. "The evidence keeps growing and growing," she says.

Gross, a physiotherapist and associate professor of rehabilitation science, helped write a 2015 Cochrane review of the literature and is already at work on updating that paper.[1]

Mounting evidence also supports spinal manipulation for low back pain, says Roger Chou, MD, professor of medicine at Oregon Health & Science University in Portland, Oregon, who led a similar review for the Agency for Healthcare Research and Quality last year.[2]

Orthopedists can confidently refer many neck and back patients for this type of treatment when surgery is not indicated, these and other experts agree. The findings counter decades of accusations of quackery mounted against healers who massage or manipulate patients' muscles or joints.

But other therapies, particularly exercise, may work just as well. And the research so far leaves big questions unanswered. For example, does one technique for spinal manipulation work better than another? What is the mechanism of these techniques? Are patients better off being treated by physical therapists, chiropractors, osteopathic physicians, massage therapists, or some other category of practitioner? How long should a patient keep trying spinal manipulation before deciding that no more benefits are likely?

Osteopathic vs Chiropractic Approaches

Spinal manipulation—along with manual therapy involving other anatomical structures—has evolved over thousands of years, starting with bone-setting practices that probably preceded recorded history. Mention can be found in ancient Egyptian and Chinese texts, as well as in the writings of Hippocrates.[3,4]

Two prominent traditions in the United States arose in the late 19th century, when Andrew Taylor Still, MD, a physician and surgeon, founded osteopathy and osteopathic medicine, and Daniel David Palmer, a practitioner of magnet healing (a pseudoscientific alternative medicine practice), founded chiropractic.

These founders cited different influences: Palmer ascribed his knowledge to visitations from the spirit world,[5] whereas Dr Still made a more conventional study of both allopathic and alternative medicine current in his day. (Because Dr Still's publications preceded Palmer's, some authorities have speculated that Palmer based his approach on Dr Still's.[3]) The founders of both modalities believed that they could treat not only joint and muscle pain, but also many other apparently unrelated ailments.

Perhaps because of the differences in their founders' inspirations, chiropractic and osteopathy have diverged. In the United States, schools of osteopathy now resemble allopathic medical schools, although musculoskeletal manipulation therapy remains part of the

curriculum. Osteopathic physicians in the United States have the same scope of practice as medical doctors. Many don't practice manual therapy at all, and most of those who do confine those therapies to treatment of musculoskeletal and neuromuscular disorders. In many other countries, there are osteopaths who practice manual therapies but not medicine.

Chiropractors in most US states cannot prescribe drugs or perform surgery. Some focus entirely on manual therapy, whereas many others incorporate other modes of alternative medicine into their practices, such as herbal medicine or acupuncture. Some chiropractors confine themselves to musculoskeletal and neuromuscular disorders, especially for back pain, but others treat a broader range of disorders.

Physical therapists and physiatrists may also use manual therapy, including spinal manipulation, among other techniques.

Unknown Mechanisms of Action

Researchers have distinguished between manipulation and mobilization. Anita Gross, the Canadian researcher, describes mobilization as a "slow, sustained, or repeated type of movement." Most of what massage therapists do fits into this category. Manipulation, on the other hand, is "a more high-velocity quick stretch at the end of a range." Chiropractors are particularly associated with this type of therapy.

No one knows for sure why spinal manipulation works. Palmer said chiropractic manipulation corrects subluxations—misalignments of vertebrae that impinge nerves. Dr Still contended that osteopathic manipulation improved circulation.

Contemporary theories on the mechanism of spinal manipulation include the disruption of articular or periarticular adhesions; release of entrapped synovial folds; unbuckling of motion segments that have undergone disproportionate displacements; relaxation of hypertonic muscle; alteration of mechanoreceptors in the spinal apophyseal joints; and release of endorphins.[6]

However spinal manipulation works, it's at least better than nothing when it comes to chronic low back pain, says Dr Chou. "Our general finding was that manipulation appears to be more effective than treatments that are thought to be basically control treatments—such things as pretend ultrasound or giving somebody an educational booklet," he explains.

It's hard to say whether spinal manipulation is significantly better than other noninvasive, active treatments for chronic low back pain. Effect sizes for all of these therapies are small. Spinal manipulation "seems to be similar in effectiveness to such things as exercise, which is probably the thing that it has been most commonly compared with," Dr Chou says.

The few trials that looked at radicular low back pain, however, found that spinal manipulation was not effective.

The effects of spinal manipulation appeared to be not only modest but also short in duration. And there was some evidence that spinal manipulation might work best in combination with other therapies.

For example, in one trial that Dr Chou says was good-quality, patients who had spinal manipulation plus home exercise and advice reported after 12 weeks that their pain was about 1 point lower on a scale of 0-10 than did patients who exercised and got advice without spinal manipulation. After 1 year, though, the difference faded to less than 0.7 point and was no longer significant.[2]

Evidence for Cervical Manipulation

Gross and her colleagues reached similar conclusions about improving pain, function, and quality of life related to neck complaints. "There is some immediate pain relief—not necessarily long-term," she says. And most of the evidence was for chronic rather than acute symptoms.

Results for mobilization and manipulation were similar, and both might work best in combination with exercise. "Across our different Cochrane reviews, we can say that probably the combination of manual therapy and exercise seems to be a dominant piece that's coming out as being a wise choice," Gross says.

In acute and subacute neck pain, cervical manipulation was more effective than various combinations of analgesics, muscle relaxants, and nonsteroidal anti-inflammatory drugs for improving pain and function in the short and intermediate term. The evidence for treating neck pain with cervical spinal manipulation was not as strong as the evidence for treating it with thoracic spinal manipulation, Gross and her colleagues found.[1]

But the research left many gaps. Spinal manipulation is difficult to study because patients and practitioners can't be effectively blinded to the treatment. Most effects are subjective. And it's hard to standardize treatments from one practitioner to another. "This is more complicated than looking at whether acetaminophen works, for example," says Dr Chou.

In part for this reason, the researchers couldn't find much evidence for the superiority of any particular spinal manipulation technique or any category of practitioner. Nor could they determine the optimum frequency or duration. "In the trials that have been done, it's hard to see clear differences, whether it's chiropractic or osteopathy, or whether somebody is doing it once vs five times a week," Dr Chou says.

Dr Chou doesn't practice any manual therapies, and his research has extended to all noninvasive therapies for low back pain. He considers exercise and cognitive-behavioral therapy as first-line therapies for chronic low back pain. "I view manipulation and such things as acupuncture as being more passive" on the part of the patient, he says. "Active treatments get people engaged and involved in their care."

When to Refer, and to Whom

Many people with low back pain are afraid to move. But bed rest causes deconditioning that can actually increase the risk for further injury, Dr Chou says. By prescribing both exercise and cognitive-behavioral therapy, a physician can "get the muscles and soft tissues moving, and get people to understand that if they have some pain, that's not a bad thing."

When he does refer patients for spinal manipulation, Dr Chou tries to make sure the practitioner is not going to apply additional therapies that are unproven. "There are some chiropractors who do manipulation, and they are also doing things that may be counterproductive, such as getting radiography that isn't necessary and telling people there is something wrong with their alignment that makes people worry about things they shouldn't be worried about," says Dr Chou. "Those are folks I try to avoid if I can."

He advises patients to try spinal manipulation for 3-4 weeks, then move on to something else if it isn't helping. But he acknowledges that he has no research to support that recommendation.

Gross, who practices manual therapy, refers practitioners to an online "neck pain toolkit" developed by a collaboration of physiotherapists.[7] For low back pain, she recommends "Low Back Pain Strategy," a similar resource developed by the Ontario Ministry of Health and Long-Term Care.[8] But she adds that no literature review or evidence-based algorithm can provide all of the guidance a practitioner needs to treat a patient's back or neck pain.

The decision to use spinal manipulation "always has to be based on more than just research evidence," Gross insists. "It has to be based on good sound clinical reasoning, biology, the psychosocial elements around you, and the individual you are helping."

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Postmenopausal hormone therapy exceeding ten years may protect from dementia

Postmenopausal estrogen-based hormone therapy lasting longer than ten years was associated with a decreased risk of Alzheimer's disease in a large study carried out at the University of Eastern Finland.

"The protective effect of hormone therapy may depend on its timing: it may have cognitive benefits if initiated at the time of menopause when neurons are still healthy and responsive," says Bushra Imtiaz, MD, MPH, who presented the results in her doctoral thesis.

The study explored the association between postmenopausal hormone replacement therapy, Alzheimer's disease, dementia and cognition in two nation-wide case-control studies and two longitudinal cohort studies. The largest study comprised approximately 230,000 Finnish women and the follow-up time in different studies was up to 20 years.

Menopause may explain women's higher dementia risk

Alzheimer's disease is the most common cause of dementia, and two out of three Alzheimer's cases are women. One possible explanation for women's higher dementia risk is the postmenopausal depletion of sex steroid hormones estrogen and progesterone. Estrogen receptors are present throughout the body including brain areas primarily affected in Alzheimer's disease. In in vitro and animal studies, estrogen has showed neuroprotective effects. However, studies on humans have yielded inconsistent results on the association between postmenopausal estrogen-based hormone replacement therapy and dementia risk.

Hormonal therapy may protect cognition if started at the onset of menopause

In the present study, long-term use of hormonal replacement therapy was associated with a better performance in certain cognitive domains - global cognition and episodic memory - and a lower risk of Alzheimer's disease. Short-term use was not significantly linked to dementia risk, but in one cohort, dementia risk was higher among short-term users who had started hormone therapy in the late postmenopausal period. The results were adjusted for various lifestyle, socioeconomic and demographic variables.

"In the light of these findings, hormonal replacement therapy may have a beneficial effect on cognition if started early, around the time of menopause. The protective effect of hormonal therapy may depend on the health status of neurons at baseline and may be lost if therapy starts years after menopause," Dr Imtiaz concludes.

The study also showed that the postmenopausal removal of ovaries, uterus or both was not significantly linked to the risk of Alzheimer's disease, irrespective of the indication of surgery or hormone therapy use.

The research data was from the MEDALZ (Medication use and Alzheimer's disease), OSTPRE (Kuopio Osteoporosis Risk Factor and Prevention Study) and CAIDE (Cardiovascular Risk Factors, Aging and Dementia) studies. The newest results were published recently in Neurology and Maturitas and the earlier results in the Journal of Alzheimer's disease.

Bushra Imtiaz's doctoral thesis Hormone therapy and the risk of dementia, cognitive decline and Alzheimer's disease is available for download at:
http://epublications.uef.fi/pub/urn_isbn_978-952-61-2403-2/index_en.html
Postmenopausal hormone therapy and Alzheimer's disease, a prospective cohort study. Bushra Imtiaz, Marjo Tuppurainen, Toni Rikkonen, Miia Kivipelto, Hilkka Soininen, Heikki Kröger, Anna-Maija Tolppanen. Neurology, published online 15 February 2017. doi: 10.1212/WNL.0000000000003696
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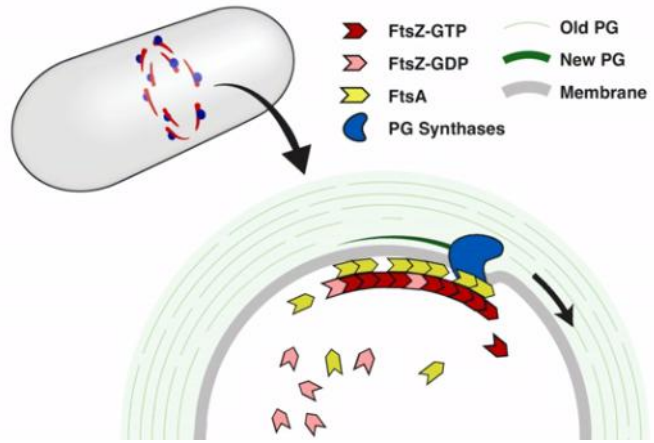
Cells divide by 'bricklaying on moving scaffolding'

Bacteria appear to build a new cell wall working from the outside in with the help of multiple molecular 'bricklayers

It is the most crucial mechanism in life - the division of cells. For 25 years, it has been known that bacteria split into two by forming a Z ring at their centre. They use this to cut themselves into two daughter cells. Using advanced microscopes, researchers from the universities of Harvard, Indiana, Newcastle, and Delft have succeeded in finding out how bacteria do this. The bacteria appear to build a new cell wall working from the outside in with the help of multiple molecular 'bricklayers', in about a quarter of an hour¬¬. What was completely unexpected was that the 'bricklayers' move along the inside of the wall under construction by 'treadmilling'; the building of the cell wall is performed from scaffolding that is continuously being moved at the front, while at the rear it is continuously being dismantled. The scientists will be publishing an article on the topic in Science on 17 February.



Video: ***Bacteria appear to build a new cell wall working from the outside in with the help of multiple molecular 'bricklayers'. The engine that drives all of this is FtsZ, a protein that makes an arched -haped piece of polymer, and which appears to move via a phenomenon known as 'treadmilling', named after the old treadmills from the Middle Ages.*** **TU Delft/Scixel**

Colours

They investigated the process by viewing individual bacteria through advanced microscopes. This involved putting coloured labels on the cell wall material. By changing the colours every time, they were able to see that the bacteria were building the cell walls from the outside in. And by changing the colours of the building material with breaks of just a few seconds, they were also able to see that this is not a gradual process, but one that takes place in a different location each time. The engine that drives all of this is FtsZ, a protein that makes an arched -shaped piece of polymer, and which appears to move via a phenomenon known as 'treadmilling', named after the old treadmills from the Middle Ages.

Protein as scaffolding

"With treadmilling, you create movement by adding something on the front, while removing something from the rear," explains Professor Cees Dekker of TU Delft, a co-author on the article. "Our research shows that a cell also uses this phenomenon for building a cell wall."

Cell walls are built with the help of a number of collaborating proteins, with FtsZ playing the most important part. "Our new discovery has solved the 25-year-old puzzle of how FtsZ coordinates cell division. The protein appears to work like a kind of scaffolding, on which the building work takes place. However, it is not rolling scaffolding, but fixed scaffolding that is continuously renovating itself: all the time, the cell is building new scaffolding boards for the work on the cell wall on, let's say, the right-hand side of the FtsZ scaffolding, while breaking up the now-superfluous scaffolding on the left-hand side, at the rear end of the work. This way, the scaffolding shifts along the cell wall. The building machine that produces the cell wall is controlled from the scaffolding, therefore moving neatly in tandem with the slowly moving scaffolding. The cell does this with different sets of scaffolding along the cell wall simultaneously, resulting in the construction of a partition wall in ten or fifteen minutes. Meanwhile, other proteins make sure that the DNA is divided properly between the two halves, for example, or that the membrane is properly closed

off, and so on. The division of cells is a complex and fascinating process."

Nanoboxes

The study was a collaborative project involving researchers from four scientific groups, in the US, the UK, and Delft. The most significant contribution from Delft consisted of the production of nanostructures in which exactly one bacterium fits, lengthwise. "By placing the nanoboxes upright on the microscope, we were able to see in very sharp focus a cross-section of the cell. This gave us an excellent view of the dynamics of the FtsZ molecules. An important technical contribution." explains Dekker.

Although the study is fundamental in nature, Dekker believes that this type of research may be of practical benefit in the future. "Once we have a thorough understanding of how bacterial cells divide, it could pave the way towards alternative antibiotics. That is still some way off, but if we are able to disrupt bacterial cell division in a targeted manner, we may have new weapons in the future that we can use to fight bacteria that cause disease."

Article: 'Treadmilling by FtsZ filaments drives peptidoglycan synthesis and bacterial cell division,' Science, 17 February 2017

Authors: Alexandre W. Bisson-Filho[1‡] Yen-Pang Hsu,[2‡] Georgia R. Squyres,[1‡] Erkin Kuru,[2‡] Fabai Wu,[3†] Calum Jukes,[4] Yingjie Sun,1 Cees Dekker,[3§] Seamus Holden,[4§] Michael S. VanNieuwenhze,[2,5§] Yves V. Brun,[6§] Ethan C. Garner[1§]*

http://bit.ly/2ldWBxQ

A case where smoking helped

Rice University scientists help understand mechanics of rare hemoglobin mutation

There's at least one person in the world for whom smoking has a beneficial effect, and it took an international collaboration of scientists led by a Rice University professor to figure out why.

Rice biochemist John Olson and collaborators in Germany and France helped a young woman and her father understand why she has anemia but her father, who is a smoker, does not.

The woman, who was in her 20s when diagnosed, and her father share a mutation in the gene that encodes hemoglobin, the protein in red blood cells responsible for taking up and delivering oxygen to cells around the body. The mutation is one of more than 1,000 discovered so far in adult human hemoglobin. Most appear to have no effect on people, but when medical problems occur, the disease is called a hemoglobinopathy and often named after the city or hospital where it was discovered. In this case, the family was living in Mannheim, Germany, but the father was born in the Turkish city of Kirklareli.

The Kirklareli mutation did not affect the iron content of her dad's blood, but did appear to be the root cause of the young woman's chronic anemia, according to the researchers. Further investigation revealed that absorbing carbon monoxide from cigarette smoke is therapeutic for those with this rare genetic disorder.

A paper on the research appeared this month in the Journal of Biological Chemistry.

The mutation is in the alpha subunit of human hemoglobin (H58L) and causes it to rapidly auto-oxidize, or rust, which causes the protein to fall apart, lose heme and precipitate. As a result, the protein loses its ability to carry oxygen. Eventually, Olson said, the red cells themselves become deformed and are destroyed.

Remarkably, this same mutation gives the protein an 80,000-fold higher affinity for carbon monoxide than for oxygen. Carbon monoxide from a cigarette will be selectively taken up by the mutant hemoglobin and prevent it from oxidizing and denaturing. This high affinity for carbon monoxide explained why the father showed no signs of anemia, Olson said.

"He may never be an athlete because his blood can't carry as much oxygen, but smoking has prevented him from being anemic," he said. "And there's a side benefit. People with this trait are more resistant to carbon monoxide poisoning."

Olson said he does not know how or if the doctors treated the young woman. He doesn't even know her name. But he suspected her iron-

deficient anemia was more an annoyance than a threat to her life and would not recommend she start smoking to relieve it.

"She shouldn't smoke," he said. "But she could take antioxidants, such as a lot of vitamin C, which would help prevent oxidation of her mutant hemoglobin. Her anemia is not that severe. At the same time, she shouldn't worry too much about secondhand smoke, which might have a positive effect."

After ruling out common causes like blood loss, gastritis or congenital defects, her doctors were curious enough about her ailment to call upon Emmanuel Bissé, a researcher at the Institute for Clinical Chemistry and Laboratory Medicine at the University of Freiburg, who discovered the mutation after sequencing her DNA.

Bissé in turn recruited Olson and his team to help determine why the histidine-to-leucine change caused anemia in the daughter but not the father. Ironically, Ivan Birukou, a graduate student in Olson's lab, had already generated the same mutation in human hemoglobin (one of several hundred made at Rice) to study how the protein rapidly and selectively binds oxygen. "Emmanuel wrote to me and said, 'I know you've been making all these mutants in hemoglobin, and you've probably done the H58L mutation in (alpha) chains. Does this phenotype make sense?'" Olson recalled.

"I said, 'We can do a really neat study here, because we've already made the mutant hemoglobin in a recombinant system.' We actually had a crystal structure (matching Kirklareli) that Ivan and (staff scientist) Jayashree Soman never published but had deposited in the Protein Data Bank. We had made this mutation to try to understand what the distal histidine was doing in alpha subunits."

They found in their 2010 study that replacing the histidine, which forms a strong hydrogen bond to oxygen, with leucine caused a dramatic decrease in oxygen affinity and an increase in carbon monoxide binding. Olson and Birukou realized back then that histidine played a key role in discriminating between oxygen and carbon monoxide in hemoglobin. "When Emmanuel wrote to me about his discovery, I already 'knew' what was happening with respect to carbon monoxide binding," Olson said.

He said that the normal hydrogen bond causes bound oxygen to stick more tightly to hemoglobin in the same way hydrogen bonds cause spilled soda to feel sticky. "When you touch it, the sugar oxygens and hydrogens make hydrogen bonds with the polysaccharides on your finger," Olson said. "That stickiness helps hold onto oxygen. But leucine is more like an oil, like butane or hexane, and oxygen does not stick well inside hemoglobin. In contrast, bound carbon monoxide is more like methane or ethane and can't form hydrogen bonds."

Andres Benitez Cardenas, a postdoctoral researcher in Olson's laboratory, did the crucial experiment in which he put carbon monoxide on the mutant alpha subunit of hemoglobin Kirklareli. The bound carbon monoxide slowed down oxidation of the protein and prevented loss of heme and precipitation. "In effect, Andres did the 'smoking experiment' to show why the father's hemoglobin didn't denature and cause anemia," Olson said.

He said the effect caused by Kirklareli, though unusual, is not unique.

"There is another 'smoking is good for you' mutation," he said, noting discoveries in Zurich in the late 1970s and early '80s. That case mirrored the current collaboration, as the researchers looking for answers then sought help from Nobel Laureate Max Perutz, whose pioneering work on hemoglobin structures won him the prize in 1968. Olson himself served as a reviewer on some of the papers for hemoglobin Zurich in the 1980s.

"Emmanuel knew that we had worked on these histidine-to-leucine mutations in myoglobin and hemoglobin, which is why he contacted us," he said. "This type of collaboration is how science and medicine should work together."

Bissé is lead author of the paper. Co-authors are Christine Schaeffer-Reiss, Alain Van Dorsselaer and Tchilabalo Dilezitoko Alayi of the University of Strasbourg, France, and the Hubert CURIEN Multidisciplinary Institute, Strasbourg; Thomas Epting and Karl Winkler of the Institute for Clinical Chemistry and Laboratory Medicine at the University of Freiburg; and Birukou, Benitez Cardenas, Soman and graduate student Premila Samuel at Rice.

Birukou is now a technical expert at Syngenta Crop Protection, North Carolina. Olson is the Ralph and Dorothy Looney Professor of Biochemistry and Cell Biology at Rice.
Read the abstract at http://www.jbc.org/content/early/2016/12/23/jbc.M116.764274.abstract

http://bit.ly/2kZTCL2

Can we grow woolly mammoths in the lab? George Church hopes so

Back from extinction one day?

By Penny Sarchet in Boston and Press Association

Maverick geneticist George Church, at Harvard University, has announced that he believes he is just two years away from creating a hybrid woolly mammoth embryo. The end goal is to develop a mammoth embryo into a fetus, and to take it to full term, he told New Scientist.

However, resurrecting a pure woolly mammoth this way is still many years away. First, Church's team is adding key genetic traits – such as shaggy long hair, thick layers of fat and cold-adapted blood – to the genome of the Asian elephant.

So far, 45 mammoth-like edits of DNA have been spliced into the Asian elephant genome. "We're working on ways to evaluate the impact of all these edits," says Church. "The list of edits affects things that contribute to the success of elephants in cold environments. We already know about ones to do with small ears, subcutaneous fat, hair and blood."

Church says the next step would be to produce a hybrid embryo, although in reality this would really be more like an elephant embryo carrying a handful of mammoth genetic traits. "We're not there yet, but it could happen in a couple of years."

Lab-grown mammoth

This would just be a first step towards the tricky goal of making a pure woolly mammoth embryo, and then developing it to make a grown, living mammoth. This is still many years away, if it ever happens.

Cloning can be a difficult business, even when working on an animal that hasn't been extinct for more than 4000 years. When scientists cloned Dolly the sheep, she was the only lamb born out of 277 attempts.

Asian elephants are endangered, making it impractical – and to some minds unethical – to try using living elephants as surrogates for any mammoth embryo. Church told New Scientist that instead, he would hope be able to develop fetuses in the lab, with no need for a living surrogate – technology that doesn't exist yet, but that may one day be available. However, Church acknowledges the fact that, because he has no intention of using live elephants, it may mean that he won't be able to resurrect the mammoth.

As for why we would want to bring back the woolly mammoth, Church says the move could secure an alternative future for endangered Asian elephant, and could also help combat global warming. "They keep the tundra from thawing by punching through snow and allowing cold air to come in," says Church.

http://bbc.in/2ldQXLZ

Zealandia: Is there an eighth continent under New Zealand?

You think you know your seven continents? Think again, as there's a new contender hoping to join that club.

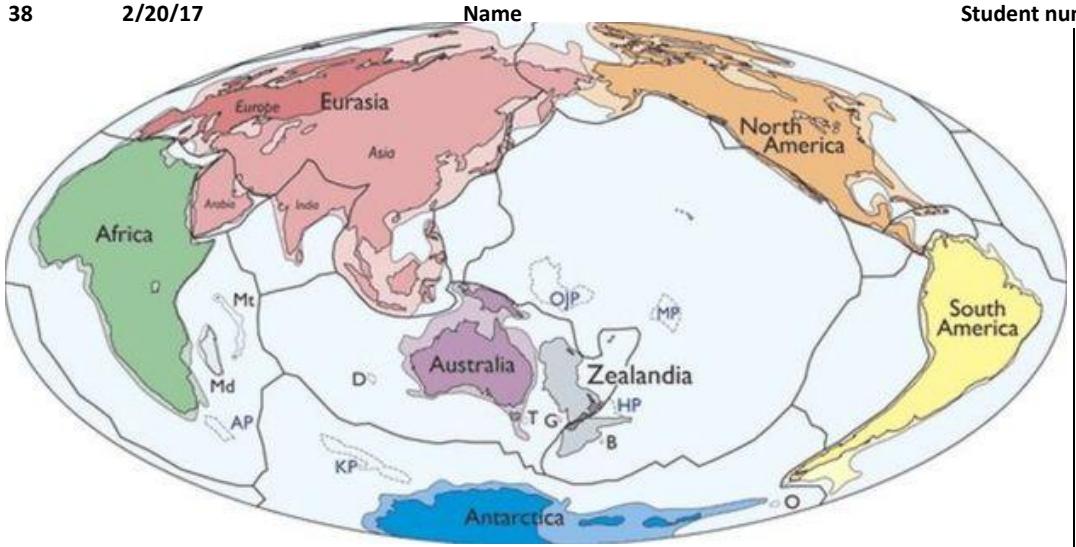
Say hello to Zealandia, a huge landmass almost entirely submerged in the southwest Pacific.

It's not a complete stranger, you might have heard of its highest mountains, the only bits showing above water: New Zealand.

Scientists say it qualifies as a continent and have now made a renewed push for it to be recognised as such.

In a paper published in the Geological Society of America's Journal, researchers explain that Zealandia measures five million sq km (1.9m sq miles) which is about two thirds of neighbouring Australia.

Some 94% of that area is underwater with only a few islands and three major landmasses sticking out above the surface: New Zealand's North and South Islands and New Caledonia.



You might think being above water is crucial to making the cut as a continent, but the researchers looked at a different set of criteria, all of which are met by the new kid in town.

elevation above the surrounding area
distinctive geology
a well-defined area
a crust thicker than the regular ocean floor

The main author of the article, New Zealand geologist Nick Mortimer, said scientists have been researching data to make the case for Zealandia for more than two decades.

"The scientific value of classifying Zealandia as a continent is much more than just an extra name on a list," the researchers explained.

"That a continent can be so submerged yet unfragmented" makes it useful for "exploring the cohesion and breakup of continental crust".

So how then to get Zealandia into the canon of continents? Should text books authors get nervous again? After all, just a few years ago, Pluto got kicked off the list of planets, changing what had been taught in schools for decades. There is in fact no scientific body that formally recognises continents. So it could only change over time if future research accepts Zealandia on par with the rest so that eventually we might be learning about eight, not seven, continents.

http://bit.ly/2kAEVzc

Is the human brain hardwired to appreciate poetry?

Demonstrating we do indeed appear to have an unconscious appreciation of poetic construction

In 1932 T.S. Eliot famously argued, "Genuine poetry can communicate before it is understood."

In a recent article published in the journal Frontiers in Psychology, Professor Guillaume Thierry and colleagues at Bangor University have demonstrated that we do indeed appear to have an unconscious appreciation of poetic construction.

"Poetry", explains Professor Thierry "is a particular type of literary expression that conveys feelings, thoughts and ideas by accentuating metric constraints, rhyme and alliteration."

However, can we appreciate the musical sound of poetry independent of its literary meaning?

To address this question the authors created sentence sample sets that either conformed or violated poetic construction rules of Cynghanedd - a traditional form of Welsh poetry. These sentences were randomly presented to study participants; all of whom were native welsh speakers but had no prior knowledge of Cynghanedd poetic form.

Initially participants were asked to rate sentences as either "good" or "not good" depending on whether or not they found them aesthetically pleasing to the ear. The study revealed that the participants' brains implicitly categorized Cynghanedd-orthodox sentences as sounding "good" compared to sentences violating its construction rules.

The authors also mapped Event-Related Brain Potential (ERP) in participants a fraction of a second after they heard the final word in a poetic construction. These elegant results reveal an electrophysiological response in the brain when participants were exposed to consonantal repetition and stress patterns that are characteristic of Cynghanedd, but not when such patterns were violated.

Interestingly the positive responses from the brain to Cynghanedd were present even though participants could not explicitly tell which of the sentences were correct and which featured errors of rhythm or sound repetitions.

Professor Thierry concludes, "It is the first time that we show unconscious processing of poetic constructs by the brain, and of course, it is extremely exciting to think that one can inspire the human mind without being noticed!"

So when you read a poem, if you feel something special but you cannot really pinpoint what it is, make no mistake, your brain loves it even if you don't really know why.

http://loop.frontiersin.org/people/2933/overview
http://journal.frontiersin.org/article/10.3389/fpsyg.2016.01859/full#

http://bit.ly/2lj2U30

The reasons for our left or right-handedness

Unlike hitherto assumed, the cause is not to be found in the brain.

It is not the brain that determines if people are right or left-handed, but the spinal cord. This has been inferred from the research results compiled by a team headed by private lecturer Dr Sebastian Ocklenburg, Judith Schmitz, and Prof Dr H. C. Onur Güntürkün. Together with colleagues from the Netherlands and from South Africa, the biopsychologists at Ruhr-Universität Bochum have demonstrated that gene activity in the spinal cord is asymmetrical already in the womb. A preference for the left or the right hand might be traced back to that asymmetry.

“These results fundamentally change our understanding of the cause of hemispheric asymmetries,” conclude the authors. The team report about their study in the journal “eLife”.

Preference in the womb

To date, it had been assumed that differences in gene activity of the right and left hemisphere might be responsible for a person's handedness.

A preference for moving the left or right hand develops in the womb from the eighth week of pregnancy, according to ultrasound scans carried out in the 1980s. From the 13th week of pregnancy, unborn children prefer to suck either their right or their left thumb.

Arm and hand movements are initiated via the motor cortex in the brain. It sends a corresponding signal to the spinal cord, which in turn translates the command into a motion.

The motor cortex, however, is not connected to the spinal cord from the beginning. Even before the connection forms, precursors of handedness become apparent. This is why the researchers have assumed that the cause of right respective left preference must be rooted in the spinal cord rather than in the brain.

The influence of environmental factors

The researchers analysed the gene expression in the spinal cord during the eighth to twelfth week of pregnancy and detected marked right-left differences in the eighth week -- in precisely those spinal cord segments that control the movements of arms and legs. Another study had shown that unborn children carry out asymmetric hand movements just as early as that.

The researchers, moreover, traced the cause of asymmetric gene activity. Epigenetic factors appear to be at the root of it, reflecting environmental influences.

Those influences might, for example, lead to enzymes bonding methyl groups to the DNA, which in turn would affect and minimise the reading of genes.

As this occurs to a different extent in the left and the right spinal cord, there is a difference to the activity of genes on both sides.

For the study, the team from Ruhr-Universität Bochum collaborated with the Max Planck Institute for Psycholinguistics in the Netherlands as well as the Dutch Radboud University and the South-African Wellenberg Research Centre at Stellenbosch University.
The study was funded by the German Research Foundation (Gu227/16-1).
Sebastian Ocklenburg et al.: Epigenetic regulation of lateralized fetal spinal gene expression underlies hemispheric asymmetries, in: eLife, 2017, DOI: 10.7554/eLife.22784 *https://elifesciences.org/content/6/e22784*

http://bit.ly/2lZx3Vc

The Surprisingly Early Settlement of the Tibetan Plateau

Scientists thought people first set foot on the frozen Tibetan Plateau 15,000 years ago. New genomic analyses suggest multiplying that figure as much as fourfold

By Jane Qiu | Scientific American March 2017 Issue

The first humans who ventured onto the Tibetan Plateau, often called the "roof of the world," faced one of the most brutal environments our species has ever confronted. At an average elevation of more than 4,500 meters, it is a cold and arid place with half the oxygen present at sea level. Although scientists had long thought no one set foot on the plateau until 15,000 years ago, new genetic and archaeological data indicate that this event may have taken place much earlier—possibly as far back as 62,000 years ago, in the middle of the last ice age. A better understanding of the history of migration and population growth in the region could help unravel the mysteries of Tibetans' origin and offer clues as to how humans have adapted to low-oxygen conditions at high altitudes.

As reported in a recent study in the American Journal of Human Genetics, researchers got a better grasp of the plateau's settlement history by sequencing the entire genomes of 38 ethnic Tibetans and comparing the results with the genomic sequences of other ethnic groups. "It has revealed a complex patchwork of prehistoric migration," says Shuhua Xu, a population geneticist at the Chinese Academy of Sciences' Shanghai Institutes for Biological Sciences. "A big surprise was the antiquity of Tibetan-specific DNA sequences," Xu says. "They can be traced back to ancestors 62,000 to 38,000 years ago, possibly representing the earliest colonization of the plateau."

As an ice age tightened its grip after that first migration, genetic mixing between Tibetans and non-Tibetans ground to a halt for tens of thousands of years—suggesting that movement into Tibet dropped to a minimum. "The migration routes were probably cut off by ice sheets," Xu says. "It was simply too harsh even for the toughest hunter-gatherers." But about 15,000 to 9,000 years ago—after the so-called last glacial maximum (LGM), when the ice age was at its harshest and Earth's ice cover had reached its peak—thousands flocked to Tibet en masse. "It's the most significant wave of migration that shaped the modern Tibetan gene pool," Xu says. This meshes well with several independent lines of evidence showing that Tibetans began to acquire genetic mutations that protected them from hypoxia 12,800 to 8,000 years ago.

Xu's team was the first to sequence the entire Tibetan genome, and "the resolution is really impressive," says archaeologist Mark Aldenderfer of the University of California, Merced, who was not involved in the research. The study, he adds, "provides fine details of how different populations from various directions may have combined their genes to ultimately create the people that we call Tibetans." It shows that 94 percent of the present-day Tibetan genetic makeup came from modern humans—possibly those who ventured into Tibet in the second wave of migration—and the rest came from extinct hominins. The modern part of the Tibetan genome reflects a mixed genetic heritage, sharing 82 percent similarity with East Asians, 11 percent with Central Asians and 6 percent with South Asians.

In addition, Xu's team identified a Tibetan-specific DNA segment that is highly homologous to the genome of the Ust'-Ishim Man (modern humans living in Siberia 45,000 years ago) and several extinct human species, including Neandertals, Denisovans and unknown groups. The segment contains eight genes, one of which is known to be crucial for high-altitude adaptation. Xu suspects that a hybrid of all these species may have been the common ancestor of the pre-LGM population on the plateau.

The study also reveals a startling genetic continuity since the plateau was first colonized. "This suggests that Tibet has always been populated—even during the toughest times as far as climate was concerned," Xu says. That idea contradicts the commonly held notion that early plateau dwellers would have been eliminated during harsh

climate intervals, including the LGM, says David Zhang, a geographer at the University of Hong Kong, who was not involved in Xu's work. Aldenderfer and others contend that parts of the plateau could have provided a refuge for people to survive the ice age. “There were plenty of places for [those early populations] to live where local conditions weren't that bad, such as the big river valleys on the plateau,” he says.

Also supporting the antiquity of the peopling of Tibet is a study presented at the 33rd International Geographical Congress last summer in Beijing, where a team unveiled the plateau's earliest archaeological evidence of human presence—dating to 39,000 to 31,000 years ago. The site, rich with stone tools and animal remains, lies on the bank of the Salween River in the southeastern Tibetan Plateau.

Different lines of evidence are now converging to point to much earlier and much more persistent human occupation of the plateau than previously thought, Aldenderfer says. But he notes that pieces are still missing from the puzzle: “More excavations are required to close those gaps.”

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Bill Gates warns tens of millions could be killed by bio-terrorism

Microsoft founder and philanthropist tells Munich security conference genetic engineering could be terrorist weapon

A chilling warning that tens of millions of people could be killed by bio-terrorism was delivered at the Munich security conference by the world’s richest man, Bill Gates

Gates, who has spent much of the last 20 years funding a global health campaign, said: “We ignore the link between health security and international security at our peril.”

Gates, the co-founder of Microsoft who has spent billions in a philanthropic drive to improve health worldwide, said: “The next epidemic could originate on the computer screen of a terrorist intent on using genetic engineering to create a synthetic version of the smallpox virus ... or a super contagious and deadly strain of the flu.”

US and UK intelligence agencies have said that Islamic State has been trying to develop biological weapons at its bases in Syria and Iraq. However, they have played down the threat, saying that the terrorists would need people with the necessary skills, good laboratories and a relatively calm environment free from the confusion and chaos of conflict zones.

Yet other security specialists say the threat from bio-terrorism has become more realistic over the past decade, particularly the past five years, with changes in molecular biology that make development of biological weapons more accessible.

Gates, making his first appearance at the Munich security conference on Saturday, said: “Whether it occurs by a quirk of nature or at the hand of a terrorist, epidemiologists say a fast-moving airborne pathogen could kill more than 30 million people in less than a year. And they say there is a reasonable probability the world will experience such an outbreak in the next 10 to 15 years.”

He added: “It’s hard to get your mind around a catastrophe of that scale, but it happened not that long ago. In 1918, a particularly virulent and deadly strain of flu killed between 50 million and 100 million people.

“You might be wondering how real these doomsday scenarios really are. The fact that a deadly global pandemic has not occurred in recent history shouldn’t be mistaken for evidence that a deadly pandemic will not occur in the future. And even if the next pandemic isn’t on the scale of the 1918 flu, we would be wise to consider the social and economic turmoil that might ensue if something like ebola made its way into urban centres.”

Gates said advances in biotechnology, new vaccines and drugs could help prevent epidemics spreading out of control. “Most of the things we need to do to protect against a naturally occurring pandemic are

the same things we must prepare for an intentional biological attack," he said.

"Getting ready for a global pandemic is every bit as important as nuclear deterrence and avoiding a climate catastrophe. Innovation, cooperation and careful planning can dramatically mitigate the risks presented by each of these threats."

The international community, Gates told the conference, needed to prepare for epidemics the way the military prepared for war: "This includes germ games and other preparedness exercises so we can better understand how diseases will spread, how people will respond in a panic and how to deal with things like overloaded highways and communications systems."

The Bill and Melinda Gates Foundation published an Ipsos Mori poll saying that 71% of Britons aged between 16 and 75 are more concerned about the spread of infectious diseases such as Ebola or Zika than war with other nations. Just over two-thirds said they were concerned about war, while 83% said violent terrorist attacks were their main concern.

http://bit.ly/2lj2E41

Smartphones are revolutionizing medicine

Researchers are finding new benefits to smartphone features such as camera and flash, which can help examine and diagnose patients

February 18, 2017 by Jean-Louis Santini

Researchers are finding new benefits to smartphone features such as camera and flash, which can help examine and diagnose patients

Smartphones are revolutionizing the diagnosis and treatment of illnesses, thanks to add-ons and apps that make their ubiquitous small screens into medical devices, researchers say.

"If you look at the camera, the flash, the microphone... they all are getting better and better," said Shwetak Patel, engineering professor at the University of Washington. "In fact the capabilities on those phones are as great as some of the specialized devices," he told the American Association for the Advancement of Science (AAAS) annual meeting this week.

Smartphones can already act as pedometers, count calories and measure heartbeats. But mobile devices and tablets can also become tools for diagnosing illness. "You can use the microphone to diagnose asthma, COPD (chronic obstructive pulmonary disorder)," Patel said. "With these enabling technologies you can manage chronic diseases outside of the clinic and with a non-invasive clinical tool."

It is also possible to use the camera and flash on a mobile phone to diagnose blood disorders, including iron and hemoglobin deficiency.

"You put your finger over the camera flash and it gives you a result that shows the level of hemoglobin in the blood," Patel said.

An app called HemaApp was shown to perform comparably well as a non-smartphone device for measuring hemoglobin without a needle. Researchers are seeking approval from the US Food and Drug Administration for its wider use.

Smartphones can also be used to diagnose osteoporosis, a bone disorder common in the elderly. Just hold a smartphone, turn on the right app in hand and tap on your elbow. "Your phone's motion picture sensor picks up the resonances that are generated," Patel said. "If there is a reduction in density of the bone, the frequency changes, which is the same as you will have in an osteoporosis bone."

Such advances can empower patients to better manage their own care, Patel said. "You can imagine the broader impact of this in developing countries where screening tools like this in the primary care offices are non-existent," he told reporters. "So it really changes the way we diagnose, treat and manage chronic diseases."

Lower costs

Mobile smartphone devices are already helping patients manage cancer and diabetes, says Elizabeth Mynatt, professor at the Georgia Institute of Technology. "Someone who is newly diagnosed with diabetes really needs to become their own detectives," she said. "They need to learn the changes they need to make in their daily lifestyle."

For women newly diagnosed with breast cancer, researchers provided a tablet that allows them real-time access to information on the diagnosis, management of their treatment and side effects.

The technique also helps patients who may not be able to travel to a medical office for regular care, reducing their costs. "Our tool becomes a personal support system," Mynatt said. "They can interact to get day-to-day advice."

Research has shown this approach "changes dramatically their behavior," she added. "The pervasiveness of the adoption of mobile platform is quite encouraging for grappling with pervasive socio-economic determinants in terms of healthcare disparities."

A growing number of doctors and researchers are turning to smartphones for use in their daily work, seeing them as a useful tool for managing electronic health data and figuring out the most effective clinical trials, said Gregory Hager, professor of computer science at Johns Hopkins University.

Clinical trials currently cost around $12 million to run from start to finish, he said. "The new idea is micro-randomized trials, which should be far more effective, with more natural data," he said.

Although the costs could be dramatically lower, too, the field is still new and more work needs to be done to figure out how to fully assess the quality and the effectiveness of such trials.