http://bit.ly/2pOCV9N

Are childhood blood lead levels associated with criminal behavior?

No consistent association between childhood lead exposure and adult criminal behavior

Bottom Line: Researchers found no consistent association between childhood lead exposure and adult criminal behavior in New Zealand where low socioeconomic status, which confuses the association in settings with socioeconomic disparities, is less of a factor.

Why the Research Is Interesting: Lead has well-documented effects on the brain and there is no safe level of exposure. Some research suggests lead may be linked to criminal behavior but that association may be explained by low socioeconomic status, which is associated with both lead exposure and criminal behavior. This study removed low socioeconomic status as a factor because high blood lead levels were observed among children from all socioeconomic groups in New Zealand.

Who and When: 553 individuals from New Zealand born between 1972-1973 who were followed up to age 38.

What (Study Measures): Blood lead levels measured at age 11 (exposure); cumulative criminal conviction, self-reported criminal offending, recidivism, and violence up to age 38 (outcomes).

How (Study Design): This is an observational study. Researchers were not intervening for purposes of the study and they cannot control the natural differences that could explain the study findings.

Authors: Amber L. Beckley, Ph.D., of Duke University, Durham, North Carolina, and coauthors

Results: Childhood lead exposure was weakly associated with conviction and self-reported criminal offending up to age 38; lead exposure was not associated with recidivism or violence.

Study Limitations: Childhood blood lead levels were measured only one time at age 11.

Study Conclusions: There is no clear association between higher childhood blood lead levels and a greater risk for criminal behavior (a dose-response relationship) in settings where blood lead levels are similar across low and high socioeconomic status.

Related Material: *The following material also is available on the For The Media website: The editorial, "The Need to Include Biological Variables in Prospective Longitudinal Studies of the Development of Criminal Behavior," by David P. Farrington, Ph.D., of Cambridge University, England* JAMA Pediatrics *Patient Page, "What Parents Need to Know About the Risks of Lead Exposure for Children"*

http://bit.ly/2BNT0xS

Calcium, vitamin D supplements not associated with lower risk of fractures

Bottom Line: ***Supplements containing calcium, vitamin D or both did not appear to protect against hip fracture and other bone breaks in older adults.***

Why the Research Is Interesting: Practice guidelines recommend calcium and vitamin D supplements for older people to prevent fractures in those with osteoporosis; previous studies have come to mixed conclusions about an association between supplements and fracture risk.

Who and What: 51,145 adults over 50 who lived in their communities and not institutions, such as nursing homes and residential care facilities; the adults participated in 33 randomized clinical trials comparing supplement use (calcium, vitamin D or both) with placebo or no treatment and new fractures.

How (Study Design): This was a meta-analysis. A meta-analysis combines the results of multiple studies identified in a systematic review and quantitatively summarizes the overall association between the same exposure (supplements containing calcium, vitamin D or both) and outcomes (fracture) across all studies.

Authors: Jia-Guo Zhao, M.D., Tianjin Hospital, Tianjin, China, and coauthors

Results: Supplements were not associated with less risk for new fractures, regardless of the dose, the sex of the patient, their fracture

history, calcium intake in their diet or baseline vitamin D blood concentrations.

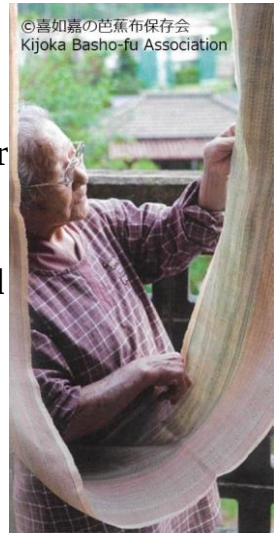
Study Limitations: Some trials included in the analysis didn't test baseline vitamin D blood concentration for all participants; the results for some subgroups might have been different if all individuals were tested.

Study Conclusions: These findings do not support routine use of supplements containing calcium, vitamin D, or both by older community-dwelling adults for prevention of fracture.

http://bit.ly/2C525qs

Traditional secrets to keeping cool: Investigating Okinawan textiles

Discovering a traditional secret to keeping cool: a material called Basho-fu



When Yoko Nomura moved from warm, dry California to the subtropical island of Okinawa, she was struck by the stifling heat and humidity.

Searching for ways to survive the Okinawan summer months, Nomura, from the Science and Technology Group at the Okinawa Institute of Science and Technology Graduate University (OIST), discovered a traditional secret to keeping cool: a material called Basho-fu.

Basho-fu is an Okinawan textile fabric made from banana plant fibers. Originating from the 13th or 14th century, Basho-fu was used to make traditional Okinawan kimonos.

Toshiko Taira, a living national treasure who made great efforts in the conservation of Basho-fu for the Kijoka Basho-fu Association, was herself certified as an Important Intangible Cultural Heritage. **Kijoka Basho-fu Association**

Basho-fu kimonos were popular among all classes of people in the Ryukyu Kingdom, which ruled Okinawa from 1429 to 1879. Basho-fu textiles were highly durable for hard labor such as farming and fishing, and were comfortable to wear in the hot and humid subtropical climate of Okinawa.

The skill and expertise required to make Basho-fu textiles have been passed down through generations of craftspeople in Okinawa. However, the traditional craft is now under threat from a shortage of banana plant materials and an infiltration of modern methods.

In an effort to rescue and document this important part of Okinawan folk culture, researchers from OIST, in collaboration with the University of the Ryukyus and the Kijoka Basho-fu Association, have used scientific techniques to characterize Basho-fu materials and to compare traditional and laboratory Basho-fu production processes.

In their paper, recently published in the *Journal of Fiber Science and Technology*, the researchers used one of OIST's Scanning Electron Microscopes to observe the structure of the Basho-fu materials in high-resolution. They also used other analytical techniques, such as X-ray diffraction, to investigate aspects of the chemical structure of the material, including crystallinity and molecular bonds.

"Our first finding was that the outer part of the harvested leaf sheaths, which is the part of the plant used to make Basho-fu textiles, contains many vascular bundles," says Nomura, lead author of the paper. Vascular bundles are collections of conducting vessels used to transport water and nutrients in the plant. The presence of vascular bundles in Basho-fu material makes it highly breathable, keeping the wearer cool on hot days by allowing sweat to evaporate through pore-like structures.

"Next, we compared Basho-fu materials that had been made using the traditional degumming process with those made using modern laboratory methods," says Nomura. Degumming is one of the refining steps in the long and complicated traditional Basho-fu production process. The researchers found that, although the vascular bundles remained in the material after both traditional and laboratory degumming processes, the laboratory-made materials were lower in quality.

Material that had been subject to laboratory degumming showed some additional changes compared with material that had been traditionally degummed. For instance, some of the vascular bundles in the laboratory-treated material were flattened, with fewer air voids. This shows that the traditional process of degumming is milder than the laboratory process, retaining more air voids and therefore maintaining greater breathability. Although the traditional method is more difficult and time-consuming, it is more delicate and produces Basho-fu textiles of better quality.

The next step is to analyze other features of the Basho-fu fibers and other steps in the long production process. Present and future studies of banana tree fibers will help to conserve the traditional Okinawan craft of Basho-fu, and may also aid the development of new textile materials.

http://nyti.ms/2lmje3H

Measles Deaths Fall to a Record Low Worldwide

For the first time in history, annual deaths around the globe from measles have fallen below 100,000

By DONALD G. McNEIL Jr. DEC. 26, 2017

For the first time in history, annual deaths around the globe from measles have fallen below 100,000, the World Health Organization announced this year. As recently as the 1980s, measles killed 2.6 million people a year.

The decline — a public health triumph, as measles has long been a leading killer of malnourished children — was accomplished by widespread donor-supported vaccination that began in the early 2000s.

A child receiving measles vaccine in a refugee camp in Bangladesh last month. Annual deaths from measles have fallen below 100,000 worldwide, according to the World Health Organization. **Mohammad Ponir Hossain/Reuters**

The estimated number of deaths fell to 89,780 in 2016, but the figure was released by the W.H.O. only in October.

Measles vaccines were invented in the 1960s. Since 2000, 5.5 billion doses have been given out, according to Gavi, the Geneva-based organization through which most donors support the vaccination effort. The group works with the W.H.O., the United Nations Children's Fund, the Centers for Disease Control and Prevention, the American Red Cross, the United Nations Foundation and others.

Many developing countries that first rolled out vaccines in mass campaigns with donor help are now buying their own for routine children's immunization.

"Sadly, this excellent progress threatens to be undermined by low coverage, not only in many developing countries, but also in some wealthy ones," Dr. Seth Berkley, Gavi's chief executive officer, said in his year-end letter.

Because measles is so contagious — one child can infect a dozen others in a classroom or at a playground, even before the telltale rash appears — outbreaks in any community or school can be prevented only by pushing vaccination rates to 95 percent.

Outbreaks crop up in many countries. More than 30 children died of measles in Romania this year, and in the last two months, the C.D.C. has issued Watch Level 1 travel alerts regarding measles outbreaks in England, Greece, the Democratic Republic of Congo, Romania, Italy, Indonesia and Ukraine. (The alerts encourage travelers to "practice usual precautions," meaning vaccination before departure.)

The Disneyland measles outbreak of 2014-15 led California to pass tough new laws requiring vaccination, and vaccination rates among Southern California kindergartners are now close to 98 percent.

In wealthy countries, deaths from measles are rare — only about one case in 5,000 is fatal. More common complications include encephalitis, which can cause brain damage in about one in 1,500 measles cases, and pneumonia, which occurs in about one in 16 cases. About one child in 12 with measles will get a related ear infection; some lead to deafness. In unvaccinated pregnant women, the virus can kill the fetus, leading to miscarriage.

The disease kills up to 6 percent of malnourished children in poor countries, the W.H.O. estimates, and up to 30 percent in some outbreaks among refugees. Half of the world's unvaccinated children live in six countries: Congo, Ethiopia, India, Indonesia, Nigeria and Pakistan.

http://bit.ly/2ldH2Yl

Footstrike Hemolysis: How Running Changed One Man's Blood Cells

Running long distances can be hard on the body, but as one ultramarathoner found out, it can also take a toll on an individual's red blood cells.

By Cari Nierenberg, Live Science Contributor

According to a recent case report, all the pounding that happens when a runner's feet hits the pavement could directly injure that person's red blood cells.

In the case, which was published Dec. 13 in the journal BMJ Case Reports, a 41-year-old man who regularly trained for and competed in 50- to 100-mile ultramarathons was diagnosed with a condition called "footstrike hemolysis." (An ultramarathon is any race longer than marathon distance, or 26.2 miles [42.2 kilometers].)

Oleg Troino/Shutterstock.com

This phenomenon — which is diagnosed mostly in endurance athletes — occurs when people repeatedly land on their feet with the force of their body weight, such as when they're running. This causes a small amount of red blood cells to rupture within the small blood vessels, or capillaries, in the soles of the feet, said case report co-author Dr. Katharine DeGeorge, an assistant professor of family medicine at the University of Virginia School of Medicine in Charlottesville, who treated the man.

The man in the case felt fine and had no physical complaints, such as fatigue or a lack of energy. Rather, he went to see his doctor because he was concerned about a blood test result from a recent health screening. The blood test showed that the man had a mild case of "macrocytic anemia," and he wanted to know why he had this deficiency and whether it might affect his performance at an ultramarathon, according to the case report.

Macrocytic anemia means that a person's red blood cells are abnormally large in size, and, in addition, they do not carry enough oxygen, according to Medscape. Red blood cells help transport oxygen throughout the body.

Foot-strike hemolysis

Even though the ultramarathoner had no symptoms, to ease the man's worry, his doctors investigated what might have been causing his mild anemia.

After a physical exam and additional testing, his doctors ruled out minor gastrointestinal blood losses, which long-distance runners sometimes experience. They also eliminated another cause, "runner's pseudoanemia," which is a mild anemia that runners have; it can occur with regular physical training.

Although the man's medical history revealed he had "Gilbert's syndrome, an inherited, but harmless, liver condition that may sometimes cause jaundice, his doctors determined that this condition was not causing damage to his red blood cells.

Eventually, they decided the most likely explanation for the man's mild anemia was the repetitive and forceful striking that occurred to the bottom of the man's feet.

Such constant foot strikes increase the likelihood and extent of red blood cell destruction within the blood vessels of the feet, DeGeorge told Live Science.

Footstrike hemolysis is not only seen in long-distance runners: It has also been observed in other types of athletes, such as cyclists and

swimmers, and in nonathletes, such as soldiers after a strenuous march, DeGeorge said.

Because the man's mild anemia was considered "clinically insignificant" — in other words, it did not affect his body's functioning, and it did not impact his athletic performance or endurance in any way — he did not need to make any changes to his workouts, training or lifestyle, DeGeorge said.

For example, the man didn't have to reduce the number of miles he ran or switch from the surface he typically ran on, which was pavement, DeGeorge said. Other changes to his routine were also unnecessary: He was already wearing properly fitting running shoes, which he replaced at the recommended intervals; eating a healthy diet; and sticking to a good training schedule, she noted.

The man continues to run long distances without the need for any treatment, the report authors wrote.

http://nyti.ms/2llPt2T

North Korean Defectors Show Signs of Possible Radiation Exposure

Four defectors from the area near North Korea's nuclear testing site showed symptoms that could be attributed to radiation exposure

By CHOE SANG-HUN DEC. 27, 2017

SEOUL, South Korea — Four defectors from the area near North Korea's nuclear testing site showed symptoms that could be attributed to radiation exposure, but scientists said they could not conclude that the health problems had been caused by a nuclear test, the South Korean government said on Wednesday.

South Korean scientists monitored seismic waves in September after the North conducted a nuclear test. **Chung Sung-Jun/Getty Images**

The four arrived in South Korea from Kilju, a county in northeastern North Korea that includes Punggye-ri, where the North has conducted all six of its nuclear tests in tunnels dug deep beneath the mountains. South Korea began conducting medical exams of defectors from that region in October, a month after the North conducted its biggest test explosion yet.

The size of that detonation on Sept. 3, which the North claimed was produced by a hydrogen bomb, raised fears of a possible escape of radioactive material into the environment.

Those fears were compounded by a series of small earthquakes reported from Kilju in recent weeks that have been attributed to underground cave-ins caused by the powerful test. Commercial satellite images have also found evidence of landslides near the test site, increasing fears of a further release of radioactive fallout if the North were to conduct another nuclear test there.

Unconfirmed news reports claimed that some residents in Kilju had fallen sick from radiation exposure. Earlier this month, an official newspaper in a Chinese province adjoining North Korea offered its readers tips on how to protect themselves from nuclear fallout.

Such fears prompted the South Korean government to commission the exams of North Korean defectors from Kilju, to see if they showed signs of exposure.

Researchers said the results, released on Wednesday, could not produce any definitive findings because of a lack of data.

According to the study, there were 114 North Koreans from Kilju living in South Korea who have defected since the North's first nuclear test in 2006.

However, all of them arrived in the South before the North's most recent nuclear tests, including the September blast. This prevented researchers from studying the effects of the large nuclear test.

Moreover, only 30 defectors volunteered for the government-funded checkups, which were not mandatory.

In their report on Wednesday, the researchers said they could not find any statistically meaningful amount of radioactive substance inside the bodies of the 30 defectors they examined.

But researchers said they did find alterations in the chromosomes of four defectors. They said these could have been caused by exposure to radiation, though they also cautioned that such abnormalities could also have other causes, like heavy smoking. They said they did not have enough medical data from the defectors to produce any conclusive findings.

On Wednesday, the Unification Ministry, a South Korean government agency in charge of North Korean affairs, said it would try to run tests on more defectors and offer medical help if any were determined to suffer from radiation exposure.

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Cracking the Brain's Enigma Code

Neuroscientists are taking cues from cryptography to translate brain activity into movements

By Helen Shen on December 27, 2017

Brain-controlled prosthetic devices have the potential to dramatically improve the lives of people with limited mobility resulting from injury or disease. To drive such brain-computer interfaces, neuroscientists have developed a variety of algorithms to decode movement-related thoughts with increasing accuracy and precision.

David Malin *Getty Images*

Now researchers are expanding their tool chest by borrowing from the world of cryptography to decode neural signals into movements.

During World War II, codebreakers cracked the German Enigma cipher by exploiting known language patterns in the encrypted messages. These included the typical frequencies and distributions of certain letters and words. Knowing something about what they expected to read helped British computer scientist Alan Turing and his colleagues find the key to translate gibberish into plain language.

Many human movements, such as walking or reaching, follow predictable patterns, too. Limb position, speed and several other movement features tend to play out in an orderly way. With this regularity in mind, Eva Dyer, a neuroscientist at the Georgia Institute of Technology, decided to try a cryptography-inspired strategy for neural decoding. She and her colleagues published their results in a recent study in *Nature Biomedical Engineering*.

“I’ve heard of this approach before, but this is one of the first studies that’s come out and been published,” says Nicholas Hatsopoulos, a neuroscientist at the University of Chicago, who was not involved in the work. “It’s pretty novel.”

Existing brain-computer interfaces typically use so-called ‘supervised decoders.’ These algorithms rely on detailed moment-by-moment movement information such as limb position and speed, which is collected simultaneously with recorded neural activity. Gathering these data can be a time-consuming, laborious process. This information is then used to train the decoder to translate neural patterns into their corresponding movements. (In cryptography terms, this would be like comparing a number of already decrypted messages to their encrypted versions to reverse-engineer the key.)

By contrast, Dyer’s team sought to predict movements using only the encrypted messages (the neural activity), and a general understanding of the patterns that pop up in certain movements. Her team trained three macaque monkeys to either reach their arm or bend their wrist to guide a cursor to a number of targets arranged about a central point. At the same time, the researchers used implanted electrode arrays to record the activity of about 100 neurons in each monkey’s motor cortex, a key brain region that controls movement.

Over the course of many experimental trials, researchers gathered statistics about each animal’s movements, such as the horizontal and vertical speed. A good decoder, Dyer says, should find corresponding

patterns buried in the neural activity that map onto patterns seen in the movements. To find their decoding algorithm, the researchers performed an analysis on the neural activity to extract and pare down its core mathematical structure. Then they tested a slew of computational models to find the one that most closely aligned the neural patterns to the movement patterns.

When the researchers used their best model to decode neural activity from individual trials, they were able to predict the animals' actual movements on those trials about as well as some basic supervised decoders. "It's a very cool result," says Jonathan Kao, a computational neuroscientist at the University of California, Los Angeles, who was not involved in the study. "My prior thought would have been that having the moment-by-moment information of the precise reach, knowing the velocity at every moment in time, would have allowed you to build a better decoder than if you just had the general statistics of reaching."

Because Dyer's decoder only required general statistics about movements, which tend to be similar across animals or across people, the researchers were also able to use movement patterns from one monkey to decipher reaches from the neural data of another monkey—something that is not feasible with traditional supervised decoders. In principle, this means that researchers could reduce the time and effort involved in collecting meticulously detailed movement data. Instead, they could acquire the information once, and re-use or distribute those data to train brain-computer interfaces in multiple animals or people. "It could be very useful to the scientific community and to the medical community," Hatsopoulos says.

Dyer calls her work a proof of concept for using cryptographic strategies to decode neural activity, and notes that much more work must be done before the method can be used widely. "By comparison to state-of-the-art decoders, this is not yet a competitive method," she says. The algorithm could potentially be strengthened by feeding it signals from even more neurons, or providing additional known features of movements, such as the tendency of animals to produce smooth motions. To be practical for guiding prosthetic devices, the approach would also have to be adapted to decode more complex, natural movements—a non-trivial task. "We've only kind of scratched the surface," Dyer says.

http://bit.ly/2liXbuC

Callous and unemotional traits show in brain structure of boys only

Callous-unemotional traits have been linked to deficits in development of the conscience and of empathy.

Children and adolescents react less to negative stimuli; they often prefer risky activities and show less caution or fear. In recent years, researchers and doctors have given these personality traits increased attention, since they have been associated with the development of more serious and persistent antisocial behavior.

However, until now, most research in this area has focused on studying callous-unemotional traits in populations with a psychiatric diagnosis, especially conduct disorder. This meant that it was unclear whether associations between callous-unemotional traits and brain structure were only present in clinical populations with increased aggression, or whether the antisocial behavior and aggression explained the brain differences.

Using magnetic resonance imaging, the researchers were able to take a closer look at the brain development of typically-developing teenagers to find out whether callous-unemotional traits are linked to differences in brain structure. The researchers were particularly interested to find out if the relationship between callous-unemotional traits and brain structure differs between boys and girls.

Only boys show differences in brain structure

The findings show that in typically-developing boys, the volume of the anterior insula - a brain region implicated in recognizing emotions in others and empathy - is larger in those with higher levels of callous-

unemotional traits. This variation in brain structure was only seen in boys, but not in girls with the same personality traits.

"Our findings demonstrate that callous-unemotional traits are related to differences in brain structure in typically-developing boys without a clinical diagnosis," explains lead author Nora Maria Raschle from the University and the Psychiatric Hospital of the University of Basel in Switzerland. "In a next step, we want to find out what kind of trigger leads some of these children to develop mental health problems later in life while others never develop problems."

This study is part of the FemNAT-CD project, a large Europe-wide research project aiming at investigating neurobiology and treatment of adolescent female conduct disorder.

Nora Maria Raschle et al. Callous-unemotional traits and brain structure: Sex-specific effects in anterior insula of typically-developing youths Neuro Image: Clinical (2018) | doi: 10.1016/j.nicl.2017.12.015

http://bit.ly/2lnGA8P

Guideline: Exercise may improve thinking ability and memory

Exercising twice a week may improve thinking ability and memory in people with mild cognitive impairment

MINNEAPOLIS - Exercising twice a week may improve thinking ability and memory in people with mild cognitive impairment (MCI), according to a guideline released by the American Academy of Neurology.

The recommendation is an update to the AAN's previous guideline on mild cognitive impairment and is published in the December 27, 2017, online issue of Neurology®, the medical journal of the American Academy of Neurology. The guideline is endorsed by the Alzheimer's Association.

Mild cognitive impairment is a medical condition that is common with aging. While it is linked to problems with thinking ability and memory, it is not the same as dementia. People with MCI have milder symptoms. They may struggle to complete complex tasks or have difficulty understanding information they have read, whereas people with dementia have trouble with daily tasks, such as dressing, bathing and eating. However, there is strong evidence that MCI can lead to dementia.

"It's exciting that exercise may help improve memory at this stage, as it's something most people can do and of course it has overall health benefits," said lead author Ronald C. Petersen, MD, PhD, of the Mayo Clinic in Rochester, Minn., and a Fellow of the American Academy of Neurology.

"Because MCI may progress to dementia, it is particularly important that MCI is diagnosed early."

According to the guideline, doctors should recommend that people with MCI exercise regularly as part of an overall approach to managing their symptoms. Although long-term studies have not been conducted, six-month studies suggest twice-weekly workouts may improve memory.

The guideline states that there are no FDA-approved medications for the treatment of MCI. Moreover, there are no high-quality, long-term studies that suggest drugs or dietary changes can improve thinking ability or delay memory problems in people with MCI.

The guideline states that doctors may recommend cognitive training for people with MCI. There is weak evidence that cognitive training may be beneficial in improving measures of cognitive function.

The American Academy of Neurology's guideline authors developed the recommendations after reviewing all available studies on MCI. Worldwide, more than 6 percent of people in their 60s have MCI, and the condition becomes more common with age. More than 37 percent of people age 85 and older have it.

"If you or others have noticed that you are forgetful and are having trouble with complex tasks, you should see your doctor to be evaluated and not assume that it is just part of normal aging," said Petersen. "Sometimes memory problems are a side effect of medications, sleep disturbances, depression, or other causes that can be treated. It is important to meet with your doctor to determine the root cause. Early action may keep memory problems from getting worse."

http://bit.ly/2llTnJa

Does dosing of drug for mom make a difference for baby's risk of cleft lip, palate?

Higher dose of topiramate during the first three months of pregnancy may increase a baby's risk of cleft lip or cleft palate

MINNEAPOLIS - Taking a higher dose of topiramate during the first three months of pregnancy may increase a baby's risk of cleft lip or cleft palate more than when taking a lower dose, according to a study published in the December 27, 2017, online issue of Neurology®, the medical journal of the American Academy of Neurology.

Topiramate is prescribed to prevent seizures in people with epilepsy. It is also used to prevent migraine headaches or treat bipolar disorder. In combination with phentermine, it may be prescribed for weight loss.

"While topiramate is not recommended for pregnant women, unplanned pregnancies are common, so it's important to fully examine any possible risk," said Sonia Hernandez-Diaz, MD, DrPH, of the Harvard T.H. Chan School of Public Health in Boston.

"Our study found that when pregnant women took topiramate during the first trimester, baby's risk of cleft lip or palate was three times greater than if mom was not taking the drug. The risk was higher when the mother took high doses of the drug than when she took lower doses."

For the study, researchers looked at Medicaid data and identified nearly 1.4 million women who gave birth to live babies over a 10-year period. Women who filled a prescription for topiramate during their first three months of pregnancy were compared with women who did not fill a prescription for any anti-seizure drug.

They were also compared to women who filled a prescription for lamotrigine, another drug used to reduce seizures in epilepsy.

There were 2,425 pregnancies in the topiramate group, 2,796 in the lamotrigine group, and more than 1.3 million in the group not taking anti-seizure drugs. Researchers then looked at how many women in each group gave birth to a baby diagnosed with cleft lip or cleft palate.

Researchers found that among the more than 1.3 million pregnancies in the group not taking anti-seizure drugs, 1,501 babies had cleft lip or cleft palate which translates to a risk of 1.1 per 1,000.

For the 2,425 babies born to mothers who filled a prescription for topiramate during the first trimester of pregnancy, the risk of cleft lip or cleft palate was 4.1 per 1,000. The risk was 1.5 per 1,000 in the babies born to the 2,796 women taking lamotrigine.

Compared to the group not taking anti-seizure medications, women with epilepsy on topiramate had an eight times greater risk of giving birth to a baby with cleft lip or cleft palate, while the women taking the drug for other conditions had a 50 percent higher risk.

Women with epilepsy took a higher dose of the drug than those with other conditions. The average daily dose for women with epilepsy was 200 milligrams, while the average for women without epilepsy was 100 milligrams.

Additionally, the risk of cleft lip or cleft palate for those taking more than 100 milligrams for any reason was five times greater than those not taking anti-seizure drugs, while those taking less than 100 milligrams had a 60 percent greater risk than those not taking anti-seizure drugs.

Results were similar when women taking topiramate were compared with those taking lamotrigine.

"Our results suggest that women with epilepsy on topiramate have the highest relative risk of giving birth to a baby with cleft lip or cleft palate, likely due to the higher doses of topiramate when used for controlling seizures," said Hernandez-Diaz. "The best course may be to avoid prescribing high doses of topiramate to women of childbearing age unless the benefits clearly outweigh the risks."

A limitation of the study is that topiramate doses were not randomly assigned to patients and therefore women on high doses may be different from those on low doses for reasons incompletely measured by the investigators, such as severity of epilepsy.

The study was supported by the National Institute of Mental Health.

http://bit.ly/2C2Ltzs

China's First Emperor Ordered Official Search for Immortality Elixir

The first emperor of China, Qin Shi Huang, wanted to live forever.

By Megan Gannon, Live Science Contributor

Newly discovered documents reveal that 2,200 years ago, he even put out an executive order to search for a potion that would give him eternal life, China's Xinhua news agency reported. Qin Shi Huang was born in 259 B.C., and by the time of his death in 210 B.C., he had conquered all six warring states of China to create a unified nation, of which he proclaimed himself emperor.

About 8,000 Terracotta Warriors were buried in three pits less than a mile to the northeast of the mausoleum of the First Emperor of China, Qin Shi Huangdi. They include infantryman, archers, cavalry, charioteers and generals. Now new research, including newly translated ancient records, indicates that the construction of these warriors was inspired by Greek art. Lukas Hlavac | Shutterstock

During his reign, strips of bamboo or wood known as slips were common writing materials. In 2002, more than 36,000 slips containing ancient calligraphy were discovered in an abandoned well in central China's Hunan province, according to Xinhua.

The news agency reported that Zhang Chunlong, a researcher at the Hunan Institute of Archaeology, analyzed 48 medicine-related slips from that collection and found that the emperor's decree to search for immortality potions reached frontier regions and remote villages.

"It required a highly efficient administration and strong executive force to pass down a government decree in ancient times, when transportation and communication facilities were undeveloped," Zhang told Xinhua.

The wooden slips even contained some responses from villages. One town called "Duxiang" reported back to the emperor that its inhabitants hadn't yet found the elixir of life, while another town in the modern-day Shandong Province in eastern China offered an herb from a local mountain.

Archaeologists and historians already had some idea that Qin Shi Huang was obsessed with immortality.

According to Chemistry World, the emperor was thought to have consumed cinnabar (or mercury sulfide) in the hopes it would prolong his life. As scientists know now, mercury is poisonous. Ironically, Qin Shi Huang's supposed cures may have helped bring on his death at the age of 39.

If he couldn't live forever, Qin Shi Huang wanted to at least ensure that he would be well-equipped in the afterlife. For his tomb, the emperor built a sprawling underground mausoleum that's never been excavated, though 8,000 ceramic soldiers and horses known as the Terracotta Army have been discovered since the 1970s near the burial mound.

Ancient writings claim the underground palace had a ceiling mimicking the night sky with pearls as stars and rivers of mercury. It's not clear how many of the ancient descriptions are exaggerations, though soil samples around the tomb have indicated high levels of mercury contamination.

http://bit.ly/2ldQSsU

Electronic nose developed to sniff out colon diseases

Prototype electronic nose can distinguish between patients with Crohn's disease and ulcerative colitis

A team of researchers from the Gandia campus of Valencia's Polytechnic University and the La Fe Health Investigation Institute have developed a prototype of an electronic nose that can distinguish between patients with Crohn's disease and ulcerative colitis.

The device, called Moosy 32 eNose, can also tell whether the disease is active, with close to 90 percent accuracy. According to the researchers, this type of equipment could be available for digestive system

specialists who could determine the state of the patient via a simple, three-minute stool analysis.

Non-invasive detection

It is common today to use invasive tests to diagnose and evaluate inflammatory activity as a result of colon-related illnesses such as Crohn's disease and ulcerative colitis, both classified as inflammatory bowel diseases (IBD). With the new prototype, the UPV and IIS La Fe teams want to contribute to the creation of non-invasive diagnosing systems. It is believed that as many as 200,000 people currently suffer from these illnesses in Spain and the rise in incidence continues to increase annually by over 3 percent.

The sensor designed by the Valencian researchers can detect volatile organic compounds that act as diagnostic markers or to reveal the intensity level of the disease's activity. "Volatile organic compounds are created by physiological processes of human metabolism and are expelled as waste through faeces. The concentration of these components can be a differentiating marker between certain bowel diseases, and their accurate detection by way of non-invasive devices such as the electronic nose would be a great step forward for the detection and monitoring of the evolution of these diseases," says Dr. Pilar Nos, head of the Digestive System Medicine Department at La Fe hospital.

Researchers have performed tests with 445 samples and obtained positive results. "However, it is paramount to continue working to improve the detection algorithms," says José Pelegrí, who works for the Sensors and Magnetism group within the Gandia Campus Investigation Institute, IGIC.

The system is being tested for further medical uses, such as detecting prostate cancer. Other studies are also being performed, such as detecting the microbial contamination of water or determining the maturity level of fruit, which could have key applications within the agro-food industry.

http://theatln.tc/2pRsAty

The Dark Horse in the Search for Dark Matter

China is proving to be a formidable participant in the hunt for elusive, invisible particles in the universe.

20 years ago, China launched a space probe into orbit around Earth. Scientists nicknamed it Wukong, or Monkey King, after the hero of a 16th-century novel about a Buddhist monk's long journey to India to secure religious texts.

The probe's job was to track and record cosmic rays, the streams of high-energy particles that constantly bombard Earth's atmosphere from all corners of the universe.

In its first 530 days of operation, the probe recorded more than 2.8 billion cosmic rays. When scientists looked at data, they found something unusual. Some of the cosmic rays—at least 1.5 million of them—were recorded at a different and higher energy level than the others. Plotted on a chart, they appeared as a cluster of tiny outliers suspended above the curve.

Though they don't look like much, this blip is incredibly important to astrophysicists around the world who are trying to solve one of the biggest mysteries in science: the existence of dark matter. Scientists believe that dark matter makes up about a quarter of everything in the universe, but the tricky thing is that we can't see dark matter. In fact, we don't even know what it's made of. The existence of dark matter is inferred indirectly from observational data. It shapes some important phenomena in the cosmos—like why galaxies form in the first place, and stick together instead of flying apart—that the physics we already understand cannot.

The top theory for dark matter suggests that the mysterious stuff is made of WIMPs, weakly interacting massive particles. Wukong, known

formally as the Dark Matter Particle Explorer (DAMPE), is designed to detect the signal that comes from WIMPs. WIMPs are lazy, slow-moving particles that collide rarely, but when they do, they could form pairs of electrons and positrons—the antimatter counterparts of electrons—the particles that make up cosmic rays. An uptick in the number of these pairs would be detected as a distinct bump in a survey of cosmic rays—like the one Wukong identified.

The DAMPE findings, which were released last month in *Nature*, line up nicely with other space-based experiments on dark matter in the last decade, an exciting prospect in a field that depends on measuring the same thing more than once. But "that is not to say that this is an indication of dark matter," said Douglas Finkbeiner, an astrophysicist at Harvard who studies dark matter. There are many possible interpretations. The signal detected by DAMPE and others come from all directions in the sky, so scientists can't pinpoint a source. The unusual cosmic rays could come from supernovae, the powerful death of stars, or pulsars, bright, fast-rotating stars.

For now, the DAMPE result, while tantalizing, is inconclusive. For scientists, it provides another datapoint in the search for dark matter. But for China in particular, the findings mean something more. DAMPE is the country's first mission dedicated exclusively to astronomy and astrophysics, and within two years it has returned a promising result. The successful showing makes China a fierce participant—or, depending on whom you ask, competitor—in the field. "The way I see it, we are making strides towards solving this big cosmic puzzle," said Priyamvada Natarajan, a theoretical astrophysicist at Yale. "I don't feel restricted by international borders in that sense. But it doesn't go unnoticed that it is a Chinese satellite that did it."

When people talk about China's ambitions in space, the discussion usually focuses on activities that have some military implications—like the launch of spy satellites—rather than scientific ones. Headlines shout about a "space race" between China and the United States, and some American defense officials rattle their sabers alongside calls for increased capabilities in low-Earth orbit. The thought of Chinese spacecraft near U.S. assets in orbit is, from a national-security perspective, far more unnerving than a science mission for a particle that may not even exist.

"Unless you're in a really intense Star Trek fantasy, it's not going to lead you into a weapons capability," said Joan Johnson-Freese, a national-security affairs professor at the U.S. Naval War College who has studied space security for 20 years.

China has invested heavily in space science in recent years. The country started building the world's most powerful radio telescope in 2011, edging the famed Arecibo Observatory in Puerto Rico out of the top spot. In the fall of 2016, the telescope, the Five-hundred-meter Aperture Spherical radio Telescope (FAST) started making observations. It discovered two new pulsars in its first year of operations, and stands to be the leading instrument in the search for intelligent extraterrestrial life for years to come. In 2013, China landed a rover on the moon to poke around the surface. In June of this year, the Hard X-ray Modulation Telescope (HXMT), a space observatory to study black holes and neutron stars, joined DAMPE in orbit.

The choice to invest in these particular fields have been very deliberate, according to Johnson-Freese. "China likes to be in the record books like everyone else," she said, but the country can't compete in areas of space exploration where the U.S. and other countries have long dominated. Instead, the Chinese have gone after realms in which no country has yet made a definitive triumph—like the search for dark matter.

In March 2016, a few months after DAMPE launched, Chang Jin, the mission's chief scientist, said the search for the mysterious substance is "tops the basic frontier projects of science listed by the U.S., Europe, China, and Japan." "Any progress in dark matter research will probably bring a breakthrough in physics," Chang said.

While a breakthrough by the Chinese—a breakthrough by any group of scientists in any nation, really—would be cause of celebration in the astrophysical community, the merriment would feel thorny for some.

"If China were to get a Nobel prize in science, would that mean that the U.S. suddenly lost all of its lead? No," Johnson-Freese said. "But I can see that there would be a lot of scientists who would say, well, this is going to become a Chinese matter of expertise. We're going to depend on their science for us to do work."

The isolation from a potential breakthrough likely will be felt most by American scientists, thanks to a law passed in 2011 that prohibits NASA from working with China's space agency. There's some irony there, given that one of the earlier experiments that noticed the same, strange blip in a survey of cosmic rays—the signal that scientists hope betrays the existence of dark matter—came from a collaboration between China, the U.S., and other countries, the Alpha Magnetic Spectrometer, mounted on the International Space Station just one month the Congress approved the ban.

China has found opportunities for collaboration elsewhere. Scientists from institutions in Geneva and Italy are working on the DAMPE mission, and Chinese officials are in talks with the European Space Agency about building an outpost on the moon together. "These congressional restrictions presume that forbidding contact will slow the pace of Chinese progress," Gregory, a senior analyst and China project manager at the Union of Concerned Scientists, an American nonprofit group, said in an email. "Projects like FAST and DAMPE prove beyond a shadow of a doubt that presumption is mistaken.

Eventually, even China's ambitions in particle physics will be subject to the scrutiny usually reserved for its more secretive, space-based military operations. "It seems no matter what China does in space, even if it is to make a significant scientific contribution to our understanding of the universe, some people in the United States will perceive it as a threat," Kulacki said. But science is not a zero-sum game, he said, and the scientists themselves "understand who is to blame."

After decades of looking for elusive dark-matter particles, the effort feels like it is at an impasse, Natarajan said. The hunt for WIMPs, the leading candidates, has repeatedly turned up empty, and astrophysicists are trying to broaden their search methods. Scientists are hopeful about more results from DAMPE, which is expected to last five years.

"We've all been thinking about this for so long, it's such an embarrassment that anyone making progress is super exciting," Natarajan said.

http://bit.ly/2E7WjBG

Tokyo chemist's breakthrough could lead to self-healing glass

A Japanese researcher has developed — by accident— a new type of glass that can be repaired simply by pressing it back together after it cracks.

The discovery opens the way for super-durable glass that could triple the life span of construction materials and products like car windows, fish tanks and even toilet seats. Yu Yanagisawa, a chemist at the University of Tokyo, made the breakthrough by chance while investigating adhesives that can be used on wet surfaces.

Does this mean you will soon be able to repair those cracks in your smartphone with a quick press of the fingers? Or effortlessly piece together a shattered beer glass dropped after one pint too many?

Not quite. Not now and in fact, not in the near future. But it does open a window of opportunity, so to speak, for researchers to explore ways to make more durable, lightweight, glass-like items like car windows.

In a lab demonstration, Yanagisawa broke a glass sample into two pieces. He then held the cross sections of the two pieces together for about 30 seconds until the glass repaired itself, almost resembling its original form. To demonstrate its strength, he then hung a nearly full bottle of water from the piece of glass — which stayed intact.

The organic glass, made of a substance called polyether thioureas, is closer to acrylic than mineral glass, which is used for tableware and smartphone screens.

Other scientists have demonstrated similar properties by using rubber or gel materials, but Yanagisawa was the first to demonstrate the self-healing concept with glass.

The secret lies in the thiourea, which uses hydrogen bonding to make the edges of the shattered glass self-adhesive, according to Yanagisawa's study. But what use is all this if it cannot produce a self-healing smartphone screen?

"It is not realistically about fixing what is broken, more about making longer-lasting resin glass," Yanagisawa said.

Glass products can fracture after years of use due to physical stress and fatigue. "When a material breaks, it has already had many tiny scars that have accumulated to result in major destruction," Yanagisawa said. "What this study showed was a path toward making a safe and long-lasting resin glass," which is used in a wide range of everyday items.

"We may be able to double or triple the life span of something that currently lasts for 10 or 20 years," he said.

http://bit.ly/2Ckp7qa

UCLA researchers report novel complementary effects of estrogen treatment in MS

FINDINGS ***A study by UCLA researchers reveals the cellular basis for how the hormone estrogen protects against damage to the central nervous system in people with multiple sclerosis (MS).***

The researchers found that estrogen treatment exerts positive effects on two types of cells during disease --immune cells in the brain and also cells called oligodendrocytes. Complementary actions on these two types provide protection from disease.

BACKGROUND

Multiple sclerosis is a chronic autoimmune, neurodegenerative disease marked by visual impairment, weakness and sensory loss, as well as cognitive decline. These symptoms emerge when inflammatory immune cells destroy the myelin sheath that surrounds nerve processes called axons. Loss of that protective insulation disrupts electrical communication between nerve cells.

The third trimester of pregnancy has been previously shown to reduce relapse rates by approximately 70 percent as compared to before pregnancy, and other studies have shown benefit over the long term due to multiple pregnancies. An estrogen unique to pregnancy that is made by the fetus and placenta has been proposed by Dr. Rhonda Voskuhl and colleagues to mediate this pregnancy protection in both the MS mouse model as well as in two successfully completed clinical trials of estriol treatment in MS patients.

How that happens has remained a critical question. Voskuhl, who led the latest study, reported mouse studies showing that estrogen protected the brain from damage by activating a protein called estrogen receptor beta (ERb). Her new research identifies which cells within the brain are mediating this protective effect.

METHOD

The researchers first genetically eliminated ERb in either immune cells of the brain or in oligodendrocytes, the cells that make the myelin sheath, as a way of making cells unresponsive to estrogen during the MS like disease in mice. They then treated mice without or with ERb in these cells to ask if disease protection was lost or not. Loss of protection during treatment meant that the treatment was acting on the cell that had the receptor removed. Results showed that the estrogen-like treatment was acting on both immune cells of the brain as well as on oligodendrocytes, together resulting in repair of myelin and less disability.

IMPACT

Drug developers often optimize therapies by targeting only one single cell type. By contrast, this study confirms that this estrogen-like compound can combat MS via complementary effects on two distinct cell types. Voskuhl and other UCLA researchers are in fact now developing a next-generation estrogen-like compound with robust biochemical effects on oligodendrocytes and immune cells in the brain.

AUTHORS

Voskuhl, who is a professor of neurology and directs UCLA's Multiple Sclerosis Program, is the study's senior author. Others include first author Roy Y. Kim, a graduate student in Voskuhl's lab; Darian Mangu, Alexandria S. Hoffman, Rojan Kovash, and Eunice Jung--all UCLA

undergraduates; and Noriko Itoh, all of the Department of Neurology at UCLA's David Geffen School of Medicine.

JOURNAL

The study was published online in *Brain* on Dec. 8. It will appear in the January print issue.

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http://bit.ly/2E9myrz

Study: High-stakes tests a likely factor in STEM performance gap

Findings suggest that changing how instructors assess students could help close the achievement gap in introductory STEM courses

Male students tend to do better on high-stakes tests in biology courses, but it's not because they are better students. Gaps in performance change based on the stakes of the test. A new study published in *PLOS ONE* confirms this, finding that performance gaps between male and female students increased or decreased based on whether instructors emphasized or de-emphasized the value of exams.

Sehoya Cotner, associate professor in the College of Biological Sciences at the University of Minnesota, and Cissy Ballen, a postdoctoral associate in Cotner's lab, base their findings on a year-long study of students in nine introductory biology courses. They found that female students did not underperform in courses where exams count for less than half of the total course grade. In a separate study, instructors changed the curriculum in three different courses to place higher or lesser value on high-stakes exams (e.g., midterms and finals) and observed gender-biased patterns in performance.

"When the value of exams is changed, performance gaps increase or decrease accordingly," says Cotner.

These findings build on recent research by Cotner and Ballen that showed that on average, women's exam performance is adversely affected by test anxiety. By moving to a "mixed model" of student assessment -- including lower-stakes exams, as well as quizzes and other assignments -- instructors can decrease well established performance gaps between male and female students in science courses.

"This is not simply due to a 'watering down' of poor performance through the use of easy points," says Cotner. "Rather, on the exams themselves, women perform on par with men when the stakes are not so high."

The researchers point to these varied assessments as a potential reason why the active-learning approach, which shifts the focus away from lectures and lecture halls to more collaborative spaces and group-based work, appears to decrease the performance gap between students.

"As people transition to active learning, they tend to incorporate a diversity of low-stakes, formative assessments into their courses," Cotner says. "We think that it is this use of mixed assessment that advantages students who are otherwise underserved in the large introductory science courses."

Cotner and Ballen also see their findings as a potential to reframe gaps in student performance.

"Many barriers students face can be mitigated by instructional choices," says Cotner. "We conclude by challenging the *student deficit model*, and suggest a *course deficit model* as explanatory of these performance gaps, whereby the microclimate of the classroom can either raise or lower barriers to success for underrepresented groups in STEM."

http://bit.ly/2zJSVcA

Alternative therapies for mild infections could help combat antibiotic resistance

Avoiding antibiotics to treat mild bugs may help preserve drug effectiveness for severe infections

Resistance to antibiotics poses a serious and sometimes deadly challenge to the treatment of severe bacterial infections. In a new Essay publishing 28 December in the open access journal PLOS Biology, Kristofer Wollein Waldetoft and Sam P. Brown of Georgia Institute of Technology propose that development of alternative therapies for mild infections could help slow the development and spread of antibiotic

resistance, thereby preserving the drugs' effectiveness for use in severe infections.

Antibiotic resistance occurs when bacterial pathogens change in ways that reduce the drugs' effectiveness and becomes a serious problem when these resistant strains multiply.

Alternative therapies for mild infections could slow the development of antibiotic resistance. **oliver.dodd, Flickr**

Each year, over 20,000 people die from antibiotic-resistant infections in the U.S. alone. Most research to identify alternatives to antibiotics, such as bacteria-killing viruses, has focused on targeting bugs responsible for severe infections using alternative therapies. However, such efforts have met with limited success.

To identify approaches that might be more effective, Waldetoft and Brown reviewed previous studies of antibiotics use. They used an evolutionary framework to analyze data from these studies and determined that widespread use of antibiotics against certain mild infections may contribute significantly to the development of antibiotic resistance. This is, in part, because antibiotics can select for resistance in any bacteria present in a patient, not just in the target bug. And since many antibiotics operate in similar ways, a single antibiotic can promote resistance to many drugs. As a result, they concluded that research efforts to develop alternative therapies should shift focus from severe infections to milder ones.

The analysis suggests that alternative therapies for certain mild infections--which may be easier to develop--could indirectly slow development of antibiotic resistance in more dangerous bugs. This could help maintain the ability to use antibiotics against severe infections for which new drugs have been difficult to develop.

The authors note that development of non-antibiotic alternatives for mild infections is just one strategy to combat antibiotic resistance. Other strategies include shorter courses of antibiotic treatment and use of antibiotics that act against a narrower range of species.

Citation: Wollein Waldetoft K, Brown SP (2017) Alternative therapeutics for self-limiting infections--An indirect approach to the antibiotic resistance challenge. PLoS Biol 15(12): e2003533. https://doi.org/10.1371/journal.pbio.2003533 http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2003533

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Competing Interests: The authors have declared that no competing interests exist.

http://bit.ly/2C7tKXw

Gene therapy using CAR T-cells could provide long-term protection against HIV

Engineered cells not only destroy infected cells, but persist over two years, suggesting long-term immunity from the AIDS virus

FINDINGS

Through gene therapy, researchers engineered blood-forming stem cells (hematopoietic stem/progenitor cells, or HSPCs) to carry chimeric antigen receptor (CAR) genes to make cells that can detect and destroy HIV-infected cells. These engineered cells not only destroyed the infected cells, they persisted for more than two years, suggesting the potential to create long-term immunity from the virus that causes AIDS.

BACKGROUND

Antiviral drugs can suppress the amount of HIV in the body to nearly undetectable levels, but only an effective immune response can eradicate the virus. Researchers have been seeking a way to improve the body's ability to combat the virus by engineering blood-forming stem cells to specifically target and kill HIV-infected cells for the life of the individual. Although chimeric antigen receptor (CAR) T-cells have emerged as a powerful immunotherapy for various forms of cancer - and show promise in treating HIV-1 infection - the therapy may not impart long-lasting immunity. Researchers, physicians and patients

need T cell-based products that can respond to malignant or infected cells that may reappear months or years after treatment.

METHOD

Because HIV uses CD4 to infect cells, the researchers used a CAR molecule that hijacks the essential interaction between HIV and the cell surface molecule CD4 to make stem cell-derived T-cells target infected cells. When the CD4 on the CAR molecule binds to HIV, other regions of the CAR molecule signal the cell to become activated and kill the HIV infected cell. The researchers found that, in test animals, modification of the blood-forming stem cells resulted in more than two years of stable production of CAR-expressing cells without any adverse effects. In addition, these cells were widely distributed throughout the lymphoid tissues and gastrointestinal tract, which are major anatomic sites for HIV replication and persistence in infected people. Most important, engineered CAR T-cells showed efficacy in attacking and killing HIV-infected cells.

IMPACT

These findings are the first to show that blood-forming stem cells can be modified with a CAR therapy that can safely engraft in the bone marrow, mature and become functional immune cells throughout the body. This could lead to the development of an approach allowing for safe, lifelong immunity to HIV. Such an approach is likely to work best when performed in combination with other treatment strategies, such as antiretroviral therapy. Researchers hope that this type of therapy could reduce infected individuals' dependence on antiviral medications, lower the cost of therapy, and permit the possible eradication of HIV from its hiding places in the body. The approach also has potential against other infections or malignancies.

AUTHORS

Study authors are Anjie Zhen, Mayra Carrillo, Cindy Youn, Brianna Lam, Nelson Chang, Heather Martin, Jonathan Rick, Jennifer Kim, Nick Neel, Valerie Rezek, Masakazu Kamata, Irvin Chen, Jerome Zack, and Scott Kitchen of UCLA; Christopher W. Peterson and Hans-Peter Kiem of the Fred Hutchinson Cancer Research Center and the University of Washington in Seattle; and Sowmya Somashekar Reddy of the Hutchinson Center.

JOURNAL

The study will be published in the peer-reviewed PLOS Pathogens

FUNDING

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http://bit.ly/2C7Lh23

Carfilzomib can lead to cardiovascular toxicity in multiple myeloma patients

Penn study finds proteasome inhibitor leads to higher than expected rates of cardiovascular adverse events

PHILADELPHIA - The proteasome inhibitor carfilzomib has taken on an increasing role in the treatment of multiple myeloma, but new research from the Abramson Cancer Center of the University of Pennsylvania shows the therapy comes with the risk of cardiovascular problems in a higher than expected percentage of patients. An analysis of past studies shows 18 percent of multiple myeloma patients receiving carfilzomib experience cardiovascular adverse events (CVAE) such as hypertension, heart failure, heart attacks, or arrhythmia. More than eight percent of patients experience high-grade CVAEs that are more severe, which is more than twice as common as with other drugs for treating relapsed myeloma. Researchers published their findings today in *JAMA Oncology*.

Multiple myeloma (MM) is a bone marrow cancer that affects plasma cells. Normal plasma cells work as part of the immune system, but in MM these cells become cancerous and grow out of control, leading to multiple painful bone tumors, as well as anemia, kidney failure, and recurrent infections. The American Cancer Society estimates there were more than 30,200 new cases of MM in 2017. Standard treatments include chemotherapy and radiation. Survival of these patients has improved with the use of proteasome inhibitors.

Carfilzomib is one of three proteasome inhibitors currently approved for use by the U.S. Food and Drug Administration. Proteasomes are essentially garbage workers that break down and eliminate proteins inside a cell. Diseases that require more protein turnover to survive, like

MM, need more proteasomes. The inhibitor drugs block them from doing their job, causing the cells to fill up with protein and die.

"Like any cancer therapy, the concern with this approach is that it may have an effect on an otherwise healthy part of the body - in this case, the heart," said the study's lead author Adam J. Waxman, MD, a Hematology Oncology fellow in the Perelman School of Medicine at the University of Pennsylvania.

Brendan M. Weiss, MD, an adjunct professor of Hematology Oncology at Penn, is the study's senior author. Weiss also works in research and development at Janssen Pharmaceuticals, which does not manufacture or support any of the drugs involved in this analysis.

Researchers gathered data from 24 studies reported from 2007 through 2017, which included information on 2,594 MM patients. They found 18.1 percent of patients who took carfilzomib experienced CVAE, with 8.2 percent of those cases being grade three or higher, meaning they are categorized as severe. For comparison, a similar review of bortezomib, another proteasome inhibitor, found just 3.8 percent of patients experienced CVAE and only 2.3 percent were severe.

The most common CVAEs were hypertension (12.2 percent) and heart failure (4.1 percent). Arrhythmias (2.4 percent) and ischemic events (1.8) - in which there isn't enough blood flow to the heart leading to the death of heart muscle - were observed less commonly. Researchers also found that higher doses of carfilzomib are associated with higher rates of CVAE, and that carfilzomib was associated with an elevated risk of CVAE compared to control groups who did not receive carfilzomib.

"Taken together, these findings argue that carfilzomib is responsible for an elevated risk, and anyone who is treating patients with this drug needs to be aware that this is a common event," Waxman said.

Researchers say these findings are particularly important since there are already overlapping risk factors for both MM and cardiovascular disease, such as older age and obesity. Previous studies have shown nearly two-thirds of MM patients had cardiovascular disease at baseline, and 70 percent experienced cardiovascular events within six years.

"Clinicians should be paying attention to who may be at highest risk for these events so they can tailor their therapy accordingly," Waxman said.

Researchers also called for further clinical trials to specifically evaluate this connection, arguing that it may be underrepresented by current data.

"If you're not specifically looking for this, you might report it differently,"

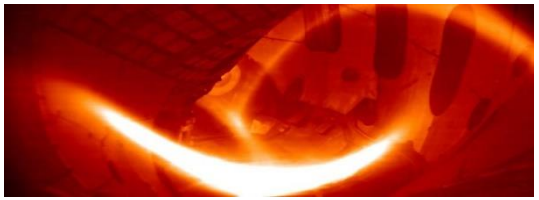
The study was supported by the National Institutes of Health (T32-GM075766).

http://bit.ly/2ChkmQn

Nuclear Sphere: Weird Globe Could Revolutionize Fusion Energy

A team of researchers has a plan to achieve nuclear fusion that actually produces energy, and their proposal looks very different from the fusion projects the world has already seen.

If the team is right, its strange, spherical hydrogen-boron reactor could be built in useful form before any ongoing conventional fusion projects reach completion.



Hydrogen plasma inside a fusion reactor called the Wendelstein 7-X. **Max Planck Institute for Plasma Physics**

The secret behind the new reactor design? It relies on completely different elements than older projects do, and it uses different methods to heat up its core. [The 8 Hottest Places on Earth]

Elusive power source

There's a lot of energy locked away inside atoms.

Much of that energy makes up the binding forces that hold atoms together. Physicists have known for most of the last century that they could tap into that energy by splitting those bonds. That reaction, atomic fission, has been deployed to destroy the cities of Hiroshima and Nagasaki, as well as to power every nuclear reactor that exists in the world today.

But it turns out that the reverse reaction, atomic fusion, is even more powerful (it is the reaction that powers the sun, after all). While fission

reactors usually split very large atoms, like uranium or plutonium, fusion reactors aim to smash very light atoms together. Typically, those nuclei are heavy isotopes of hydrogen, such as deuterium and tritium, meaning they have extra neutrons. They fuse to form helium, releasing massive amounts of energy in the process.

All the largest known weapons in the human arsenal are fusion bombs, also known as hydrogen bombs, that smash deuterium and tritium together to release massive explosions and flashes of radiation. However, no useful fusion reactors exist. Every model that has been built uses up more energy sustaining the hot plasma necessary for the fusion reaction than the model produces in electricity.

Still, many researchers argue that once net-positive nuclear fusion is achieved, it will offer a source of functionally unlimited energy, with transformative effects for the global energy economy.

Game changer?

The new hydrogen-boron reactor is potentially a game changer for a simple reason: efficiency.

A deuterium-tritium reactor faces two challenges on the way to producing electricity: A lot of the energy gets wasted as atoms shed neutrons during the reaction, and the remaining energy can't be converted directly to electricity. Instead, it's used to heat up water, which turns a turbine, which produces electricity. So, most of the energy put into the reaction can't be efficiently translated into usable electricity.

But in the new study, which was published Dec. 12 in the journal Laser and Particle Beams, Heinrich Hora, a physicist at the University of New South Wales in Australia, and colleagues argued that they can sidestep these challenges by using a completely different fusion reaction.

If you fuse hydrogen-0 (just a single proton with no neutrons or electrons) and boron-11 (a version of boron with six neutrons) to make three helium-4 nuclei (each containing two protons and two neutrons), the researchers wrote, no neutrons get wasted. The atoms combine cleanly without losing any of their core particles. And in the reactor Hora proposes, the energy of the plasma could be converted directly into electricity without wastefully heating up water along the way, because the fusion's energy is released as a stream of electronically charged particles, which can relatively easily be turned into current in a wire.

Unlike deuterium-tritium reactors, which hold superheated plasma in place using magnets inside donut-shaped chambers, Hora's spherical hydrogen-boron reactor uses lasers to trigger and sustain the reaction. Those lasers are critical, Hora said: They waste much less energy heating up the atoms in the plasma and use less energy keeping the atoms in place. [5 Everyday Things that Are Radioactive]

The lasers allow the hydrogen-boron plasma to reach temperatures of 5 billion degrees Fahrenheit (3 billion degrees Celsius) and densities 100,000 times greater than those of the plasmas inside a deuterium-tritium reactor. Those are much more intense reaction conditions than other projects aim for, but Hora and his team wrote that it should be easier to achieve these conditions given current technology, at least according to the researchers' early experiments and simulations.

The spherical shape, meanwhile, would allow the superhot plasma to retain a more efficient cylindrical shape at its core, which makes it an ideal target for the cylindrical laser. A spherical shape also efficiently retains the energy produced by the fusion reaction, the researchers said.

No energy-positive fusion reactor of any kind yet exists. But this is the type of early work that might one day make it happen.

http://bit.ly/2C5sGn8

Bacteria under pressure run reaction in reverse to sequester carbon

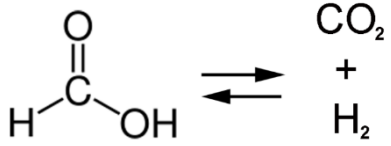
An enzyme that normally digests formic acid will happily make it.

John Timmer - 12/29/2017, 2:55 AM

Life performs many astonishing feats of chemistry, building complex molecules that can take us years to figure out how to synthesize. And the thermodynamics of these reactions are often fascinating—in many

cases, life lives on the edge, at risk of seeing critical reactions bog down and run in reverse.

Now, some researchers have figured out a way to force bacteria to run a chemical reaction in reverse.



Rather than breaking down a simple molecule into carbon dioxide, the bacteria will ingest carbon dioxide and spit out formic acid, a chemical that already has lots of uses—and could be used as fuel or to sequester carbon. The secret? Force-feed the bacteria the raw ingredients for the chemical reaction.

Enzymes and catalysis

The proteins that act as enzymes are nothing more than catalysts. The complex three-dimensional shapes of these proteins stabilize intermediate states of chemical reactions, lowering the energy required to reach them. This essentially lowers the energetic hill that has to be climbed to get between a set of reactants and a set of products. But if the overall energy of the reactants and products isn't very different, then that smaller hill will also let things run in the opposite direction: the enzyme will happily form a reaction intermediate from the product and spit out the original reactants.

Life has all sorts of ways of avoiding this. In many cases, the reactants end up being used rapidly, keeping them from lingering about and running into the enzyme again. In others, an energy-carrying molecule gets used to force the reaction to only run in a single direction. But there are plenty of cases where a build-up of the products can take place, causing the enzyme to idle, catalyzing forward and reverse reactions at equal rates. Purified enzymes, given a large supply of the products, can run the reaction in reverse, producing lots of the normal reactants.

That's the intellectual backdrop for the new work. The researchers were presumably looking for an enzyme-catalyzed reaction that normally produces some carbon dioxide as a product. There are a lot of these, but the authors then filtered the list down by looking for those reactions where the energy difference between the reactants and products is small. One of these is the digestion of formic acid, the small molecule shown above. Formic acid is essentially carbon dioxide with two hydrogens attached, and *E. coli* has an enzyme that starts with formic acid and spits out CO_2 and H_2. In this case, the energy difference between formic acid and CO_2 is about the same as the energy content of H_2, so the reaction could run in reverse, converting CO_2 into formic acid.

Running in reverse

But running the reaction in reverse would require lots of the end products, hydrogen and carbon dioxide. To do that, the authors reasoned, simply requires a bit of pressure. Putting a gas at pressure into water increases the rate at which it dissolves. Since these two gases are very small molecules, they should diffuse readily from a watery solution into cells, where they can reach the enzyme.

So the authors set up a bioreactor and put some *E. coli* into it. They then sealed the reactor and pumped the gases in at high pressure. Formic acid started to appear in the liquid the bacteria were in—apparently they eject it from the cell—at rates proportional to the pressure. So, everything they reasoned out in principle appeared to have worked.

From there on out, it was largely a matter of optimizing the yield. One of the problems is that formic acid is, as its name implies, acidic, and levels could eventually reach the point where they'd damage the bacteria.

So, the bioreactor was modified to read the pH of the reaction and inject chemicals that could balance the acidity. *E. coli* also has two other pathways that can digest formic acid, so the team knocked out key genes in those pathways, which increased the yield.

By the time they were done, the yield was over 100 percent—not only was the enzyme converting all the carbon dioxide that the researchers were feeding it, it was apparently scavenging some from other cellular processes and converting that as well.

So it's clear we can do this. Do we want to?

Obviously, supplying hydrogen is the big issue with this reaction. But formic acid has already been given consideration as a hydrogen storage

mechanism and can be made to work in fuel cells. So if production of hydrogen from spare renewable energy ever becomes economical, formic acid has a lot of things going for it. It's a liquid at room temperature, and while it will burn, the probability of it burning is somewhat less than that of gasoline. While this won't remove carbon dioxide from the atmosphere, it will at least avoid putting more into it.

We've also engineered a different strain of *E. coli* to grow using formic acid as a carbon source.

So, it's possible to combine these two bits of engineering and force the cells to ingest carbon dioxide and hydrogen in order to survive. This should allow evolution to optimize this enzyme system to work in reverse. But it also opens up the door to using carbon dioxide to feed bacteria that produce useful chemicals, including drugs, more complex biofuels, and the raw materials for plastics. Plastics in particular might go some way toward starting to remove some of the carbon we've been putting into the atmosphere.

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http://bit.ly/2DtqMc9

AI is learning from our encounters with nature - and that's a concern

Concern whether apps change what it means to be human

Andrew Robinson Communications Scientist and Scholar, Australian National University

The idea seems wonderful - a phone app that allows you to take a photo of a plant or animal and receive immediate species identification and other information about it. A "Shazam for nature" so to speak.

We are building huge repositories of data related to our natural environments, making this idea a reality.

But there are ethical concerns that should be addressed: about how data is collected and shared, who has the right to share it and how we use public data for machine learning.

And there's a bigger concern – whether such apps change what it means to be human.

Encounters with dandelions

Oliver Sacks, the brilliant neurologist and author, once arranged to take a group of his patients on a field trip to the New York Botanic Garden. One of his patients, a severely autistic young man named Steve, hadn't stepped outside the facility for years. He never spoke; indeed, the doctors believed him incapable of speech.

In the gardens with Sacks, however, the invigorated Steve plucked a flower, and to the surprise of everyone, uttered the word "dandelion."

Over the last decade, this affinity so many of us feel for nature – what the famed biologist Edward Wilson termed "biophilia" – has resulted in an explosion of big data. In the Global Biodiversity Information Facility (GBIF, an online database run out of Copenhagen) there are 682,447 records of human encounters with dandelions. Overall, the database holds more than 850 million observations of over a million different species of flora and fauna.

***The whale shark is the world's largest fish species.* from www.shutterstock.com**

It's an impressive achievement, a gestating, global catalogue of life. It allows us to see the world in new ways. For example, just this year, thanks to the more than 42,000 recorded sightings from more than 5,000 participants using WhaleShark.org, we've gained unprecedented insight into the behaviour of the world's largest fish species. Or on a bigger scale, the millions of bird observations generated through an app called eBird have allowed us to visualise the precise migratory routes of over a hundred different bird species.

At the same time, in an outcome largely unforeseen by its early collectors, info-engineers are using the data to train artificial intelligence (AI), particularly computer vision apps to help us interpret the plants and animals we see around us. And these tools are raising some interesting, sometimes troubling questions.

Joseph Banks in your pocket

In one sense, of course, such tools are magical. The fictional tricorder of Star Trek is a magnificent device, scanning alien life forms, making them familiar. If we had a version on Earth, it'd be the equivalent of a pocket-sized Joseph Banks, a trusty sidekick of discovery, filling us with a sense of confidence and control.

In China the latest version of the Baidu browser (a so-called Chinese Google) comes with a plant recognition feature built into it. Point your camera at a dandelion and you'll see the Chinese name for it - 蒲公英. Such apps are triggering a new wave of botanical interest among the general population in China.

But there are also questions about these AI tools interfering with our ability - perhaps a human need - to easily transfer our unique nature expertise to, or gain expertise from, other people. Is the amount of resources going into developing AI matched by what we invest in developing ecological literacy within the billions of supercomputers in peoples' skulls?

There are questions about data bias. A disproportionate number of data collectors - often called "citizen scientists" - are first world hobbyists, birdwatchers, camera geeks. Typically then, the data comes from a relatively non-diverse sector of society.

There are questions about ownership, data appropriation, human agency. Who's going to own and control the AI? Will the people whose expertise has trained the AI be fairly acknowledged, respected, rewarded?

***What plant is that?* from www.shutterstock.com**

Or is all that data, as the US economist Philip Mirowski recently argued, nothing more than "the donation of unpaid work to privately owned entities" - entities who will digest and then regurgitate the information into yet another online product we can't live without? If you search the terms of popular citizen science apps, you're unlikely to find any mention of how your data might be used to train AI systems.

Empire building

There's a sense of *déjà vu* here. The botanical classification conducted by such scientific luminaries as Carl Linnaeus and Joseph Banks – the book Systema Naturae was a sort of GBIF of its day – is often associated with the big data activity of empire building. As explained by the essayist Anne Fadiman in Collecting Nature, botanists would travel to remote parts of the world, find a species which had been known by a local name for centuries: […] rechristen it with a Latin binomial, and presto! It became a tiny British colony.

Subsequent generations, meanwhile, would grow up in a world where the only meaningful descriptions of nature existed in empire-approved systems of classified truth: museums, libraries, the biology labs of universities.

"The real danger [of AI]," writes the philosopher Daniel C. Dennett, "is that we will overestimate the comprehension of our latest thinking tools, prematurely ceding authority to them far beyond their competence".

Perhaps we'll cede control; perhaps we'll have it wrested away. For the developer of nature identification apps, what incentive exists to disabuse us of the Star Trek Tricorder illusion?

The Colorado-based PlantSnap, for example, claims to be training its AI on "50,000 new species per month, and will have every species on Earth covered by the end of 2017". You could argue this is not just misleading, it's impossible. A significant portion of plants are yet to be discovered, and far more have yet to be photographed in the wild.

What is human perception?

According to a developer of the Merlin BirdID app, a computer vision tool trained on eBird's collection of more than 70 million bird photos, the state-of-the-art in computer vision is rapidly approaching that of human perception.

But what is human perception? It's easy to forget that each record in all that training data represents - like Sack's autistic patient in New York - a special act of observation, a sudden spark of curiosity, a unique moment of seeing that belongs to the individual.

One thing's for sure: when it comes to developing AI, there's an urgent need for more thinking, more consideration, a broader diversity of viewpoints. In developing AI tools, can we program them to value the creative act of human perception - the authentic, the spontaneous, the unpredictable?

Or maybe as Amy Webb, a tech futurist at New York University, has recently proposed, we should establish data sanctuaries. Here, like in nature reserves, our data could roam wild and free, forever untouched by AI, governments, corporate interests. Perhaps a similar space - or a duration of time between data input and response - is needed to protect our unique relationship with the natural world.

The scent of violet 'makes you want everything' but 'makes you sick of things a minute later.' **from www.shutterstock.com**

In Shakespeare's Twelfth Night, the lovelorn bachelor Orsino, makes an interesting observation of violets. Their scent, he declares, is like romantic love, it makes you want everything, but it makes you sick of things a minute later, no matter how good they are.

It's an astonishing insight, and four centuries later, this insight was scientifically confirmed: the beta-ionone in violets, researchers discovered, produces an anosmic affect in the human olfactory system, allowing you to perceive the scent one moment, only for it to vanish (like romantic love) the next.

This exploration of the natural world - this observing, comparing, playing, discovering, loving - is an impulse that's core to our humanity, and one, I'd suggest, we should be careful not to lose.

Disclosure statement *Andrew Robinson is co-founder and CEO of the QuestaGame app.*
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http://bit.ly/2Cl7CGb

Want to Lower Health Care Costs? Stop Wasting Our Money.

This year ProPublica documented the many ways waste is baked into our health care system, from destroying perfectly good medication to junking brand new supplies. Eliminating the waste could insure millions of Americans.

by Marshall Allen

This story was co-published with The Washington Post.

In Maine, there's a warehouse the size of a middle school gymnasium, stuffed with brand-new medical supplies and gently used medical equipment. Several pallets are piled with boxes of surgical sutures, still in their shrink wrap, each box worth hundreds of dollars. Tubs overflow with diabetes supplies and surgical instruments that may run hundreds of dollars apiece. There are bins of bandages and gauze and saline and ostomy bags and every other medical supply you can imagine.

Unused medical supplies sit in storage at a Partners for World Health facility in Portland, Maine. **(Tristan Spinski, special to ProPublica)**

These materials, unexpired, could easily stock any hospital or clinic. But each item has actually been thrown away by a local medical facility. The cost of health care has been rising for decades, and Americans are paying the price. In a recent Gallup poll, people cited the high cost of care as their No. 1 financial concern. It's an enormous problem, and trying to solve it all at once brings on panic and paralysis. But after reporting for a year on the ways the medical industry blows through our

money, I have one idea: Let's end the egregious waste that's draining our health care system.

The National Academy of Medicine has estimated the health care system wastes around $765 billion a year — about a quarter of what we spend. Eliminating all the waste could allow us to insure 150 million Americans, the Academy of Medicine said, and saving half of it could provide groceries for every household in the country for a year. Eliminating the waste would also stop our rising health care costs from eating up our wage increases. My premiums go up 9 percent next year. Same thing happened last year. Odds are your costs are rising, too.

It's hard to downplay what I found when I began investigating the issue. Hospitals throw out so many valuable supplies that a cottage industry of charities has sprung up to collect this stuff and ship it to the developing world — otherwise, all those goods in that Maine warehouse would be headed for a landfill.

Nobody tracks how much hospitals waste rather than donate, and I couldn't track down where each item came from. But experts told me when hospitals change vendors for a type of supply, they often toss the old stuff. Or, if they take over a clinic or facility, they get rid of the items that come with it, even if they are unused and unexpired.

The operating room is a major source of wasted spending. One hospital tracked the value of unused items that went to waste during neurosurgery procedures in a single year. The total: $2.9 million — for one type of surgery at just one hospital. In that case, the surgeons hadn't updated their system of telling the staff which supplies to prep for each operation. They were opening many items they didn't need, which then had to be thrown away even though they were unused. The hospital updated its approach to make sure they aren't setting up for operations with excess supplies.

I learned that nursing homes throw away hundreds of millions of dollars' worth of valuable medication every year. They typically dispense drugs a month at a time for patients and often have them discontinued if the patient dies or transfers. The excess drugs get trashed, incinerated or even flushed down the toilets, contaminating our water supply. The chief executive of a pharmacy that serves nursing homes in Florida told me that his company alone throws away about $2.5 million a year in valuable medication.

In Iowa, the state government funded a program to recover these castoff nursing home meds and donate them to needy patients, for free. This year, they're on pace to recover and redistribute $6 million in medication. My story led policymakers in Florida and New Hampshire to introduce legislation to try to replicate the Iowa program.

Drugs are a huge source of waste, partly because drug expiration dates don't mean what we think they mean. The Food and Drug Administration makes pharmaceutical companies show their medication is safe and effective until its expiration date. It doesn't make them find out how long they actually last.

Studies show it's common for a drug to be safe after its expiration date. The FDA runs a program that tests and then extends expiration dates on drugs in the federal government's stockpiles. Those same drugs get thrown away in pharmacies when they "expire," even though many of them are in short supply. How much of our money does it waste? One midsize hospital in Boston throws away about $200,000 worth of drugs a year that hit their expiration date. If that's true for other hospitals, the total would be about $800 million a year for hospital pharmacies alone.

Read More

A Prescription for Reducing Wasted Health Care Spending

A ProPublica series has illustrated the many ways the U.S. health care system leaks money. Health care leaders and policymakers suggest ways to plug the holes.

Meanwhile, drug companies are making eyedrops two or three times larger than what the eye can even contain. We are paying for the wasted medicine running down our cheeks. I spoke to the former head of research for Alcon Laboratories, a global leader in the eye care industry now owned by Novartis. He told me that in the early 1990s his team created a "microdrop" that eliminated the waste. The microdrops were effective and reduced the burning caused by larger drops. But Alcon's

leaders killed the project because they were worried it could reduce sales.

Vials of cancer drugs are also made too large, which one study said wastes about $1.8 billion a year in the valuable medication. Earlier this year, one drug company switched from a multiuse vial, which could be shared by patients, to a single-use vial that could not be shared, thereby increasing the amount of wasted cancer medication. The change would make the supply chain more reliable worldwide, the company said. But one cancer center calculated that the change would cost each patient an average of $1,000 in waste per infusion. Imagine: You're fighting cancer and then get billed an extra thousand dollars for medication they toss in the trash. Two U.S. senators responded to my story by introducing legislation to solve the problem of oversized eyedrops and cancer drug vials.

These are not isolated examples or small sums being squandered. Let's say my reporting identified about $10 billion in wasted spending. That's a rough estimate because no one is actually tracking how much we're wasting. What else could we be doing with that money? The Kaiser Family Foundation says it costs an average of $6,690 to pay one person's insurance premium in 2017. At that rate, the $10 billion saved could insure about 1.5 million people for a year. Tell those people it isn't important to reduce our wasted health care spending.

The Academy of Medicine did something smart when it reframed our health care overspending as waste. We may be a wasteful country, but we still teach our kids to eat everything on their plates. "Waste not, want not," is baked into our cultural DNA. It's a powerful concept because it's a moral one. It's wrong to squander the hard-earned dollars Americans are paying into the health care system and then demand they pay more.

We can't be naive and think it will be easy to fix this problem. Our wasted spending represents revenue and profit for the medical industry. But our health care spending should not be an entitlement program for the medical industrial complex. I put together a prescription for reducing the wasted spending I identified. Our policymakers should stand up to the medical industry and stamp out the waste.

http://bit.ly/2lqLNwV

Will Uterus Transplants Change the Way We Perceive Gender?

The medical viability of uterine transplantation is challenging long-held notions about our bodies.

By *Chris Sosa* / *AlterNet*

This year, the United States passed a medical milestone: the first baby in the nation born through a transplanted uterus. Reports on the specific number of successful births via transplanted uterus vary, but all place the count at fewer than 30 births.

However, the number is expected to rise exponentially in the immediate future.

"We're hoping that in a decade or so, this will become mainstream," Dr. Zaraq Khan, a Mayo Clinic reproductive endocrinologist and infertility surgeon, told HuffPost.

The procedure is currently limited to a specific set of patients who fit narrow medical criteria for eligibility.

"As of right now, when uterus transplantation is still in its infancy, it will be limited to patients with absolute uterine factor infertility," Khan said. This excludes women who, for example, are able to conceive but routinely miscarry.

While bioethical questions remain, some wonder if the technology may one day allow men to eventually carry and birth children.

Dr. Richard Paulson, the outgoing president of the American Society for Reproductive Medicine, believes such procedures are already within the scope of immediate possibility for transgendered women.

"You could do it tomorrow. There would be additional challenges, but I don't see any obvious problem that would preclude it," Paulson told the Telegraph. "I personally suspect there are going to be trans women who are going to want to have a uterus and will likely get the transplant."

But Arthur Caplan, a professor of bioethics and head of the Division of Medical Ethics at New York University's School of Medicine, told LiveScience that performing such a procedure now would violate ethical standards.

“Surgically, could you put [a uterus] in a man tomorrow? Yeah, but it would be completely irresponsible," he said, citing unknown medical risks that require further study before performing what would be an experimental operation.

That said, no one is ruling out the possibility that uterine transplants could become a possibility not for just transwomen, but for men as well. Dr. Saima Aftab, medical director of the Fetal Care Center at Nicklaus Children's Hospital, explains that such a procedure isn’t medically feasible today, but represents a very real possibility for the future.

As contemporary society renegotiates the most basic understandings of gender, the medical development of uterine transplants may come to represent one of the most profound changes in the way we perceive human bodies.

http://bit.ly/2llezje

New guidelines on clinical trial design for patients with brain metastases

New guidelines describe how to most appropriately address cancer patients with CNS involvement in clinical trials of anti-cancer drugs

Clinical trials of new anti-cancer therapies have often excluded patients whose disease has spread to the brain or central nervous system (CNS) or, if such patients were allowed on trial, trials have often failed to clearly capture information on the drug's effect in the brain. Today new guidelines from an international, multidisciplinary group published in the journal Lancet Oncology describe how to most appropriately address cancer patients with CNS involvement within clinical trials of anti-cancer drugs.

"Two major situations needed to be optimized. Firstly, as we've actually started to see some new anti-cancer drugs working well inside the brain, we needed to find a way to appropriately include these patients in clinical trials so that the trials could accurately capture that benefit. And secondly, for drugs that would be unlikely to work in the brain, we needed to limit risks to patients and to the drug development process," says D. Ross Camidge, MD, PhD, Joyce Zeff Chair in Lung Cancer Research at the University of Colorado Cancer Center, director of Thoracic Oncology at the CU School of Medicine and the lead author of the trial design guidelines.

The expert working group which developed these guidelines, called the Response Assessment in Neuro-Oncology - Brain Metastases (RANO-BM) group, also includes researchers from Dana-Farber Cancer Institute, City of Hope National Medical Center, Cleveland Clinic, University of Heidelberg in Germany, University of California at San Francisco, Queen's University in Canada, University of Groningen and Erasmus University Medical Center in the Netherlands, University of Turin in Italy, Massachusetts General Hospital, University of Virginia, M.D. Anderson Cancer Center, and Columbia University Medical Center.

"Historically, patients with brain metastases were excluded from the majority of systemic therapy trials for a number of reasons, including the misperception that they are poor clinical trial candidates. However, many studies show that select patients with brain metastases can safely enroll on clinical trials, without harm to the patient or to the drug development process," says Eudocia Lee, MD, MPH, assistant professor of Neurology at the Center for Neuro-Oncology at the Dana-Farber Cancer Institute and co-lead author of the guidelines.

The guidelines adopt a pragmatic approach, suggesting one of three specific strategies based on initial understanding of a drug's possible activity in the brain. First, when a new drug is considered very unlikely to have activity in the brain, patients with stable CNS disease should be permitted, while those with active CNS disease should be excluded from trials of systemic therapy. Second, if there is some initial evidence that a drug may have activity in the brain, the guidelines propose including patients with both stable and active CNS disease in a way that

will capture data defining a drug's activity in the brain separate from its activity in the rest of the body. Third, when it's unclear whether a drug may have activity in the brain (as is often the case at the start of any new drug development process), the guidelines suggest including a dedicated cohort of patients with brain metastases very early in drug development to generate the data that would allow trial designers to adopt one of the other two trial designs.

The new guidelines reflect the contributors' firsthand experiences developing new targeted therapies across cancer subtypes.

"For some subtypes of breast cancer, including HER2-positive or triple-negative, the incidence of brain metastases in patients who have recurrent/metastatic disease approaches 50 percent. Making progress against these subtypes of breast cancer very much depends on developing new and better treatments for brain metastases. Our hope is that by providing investigators with a roadmap for clinical trial design, we can encourage more studies focused on this challenging clinical problem. These new guidelines aim to fundamentally change drug development for advanced cancers," says Nancy U. Lin, MD, clinical director of the Breast Oncology Center at the Susan F. Smith Center for Women's Cancers at Dana Farber Cancer Institute.

"Brain metastases are also very common in lung cancer and it would be very frustrating to have a patient with controlled brain disease excluded from a trial that could benefit them," says Camidge, who has been intimately involved with the development of targeted therapies against non-small cell lung cancer, including crizotinib, alectinib and brigatinib. "Similarly, we have also started to see anecdotal evidence of new targeted therapies working against metastases in the brain, but current clinical trial design leaves holes in the data. For example, many trials don't standardize capturing information on the use of prior radiotherapy in the brain and so in such cases it has been very hard to tell whether benefit in a patient's CNS disease was due to radiotherapy or to the drug. When trying to choose between treatments, it was clear that we needed to get serious about demanding better data quality with respect to the brain."

The new guidelines may be especially important for clinical trials addressing patients with cancer types that commonly spread to the brain, including non-small cell lung cancer, small cell lung cancer, HER2+ and triple-negative breast cancer, and melanoma, all of which become especially dangerous once reaching the central nervous system. In these conditions, the guidelines write that, "Exclusion of [brain metastasis] patients could remove half to two-thirds of the stage IV population."

"We all hope that these guidelines will represent a turning point in cancer drug development," Camidge says. "Over the next few years, changes in clinical trial design centered around generating and acting on early signals of a drug's CNS activity or lack thereof should radically decrease risk and increase the therapeutic potential of new drugs across many different cancers."

http://bit.ly/2CiDHkp

Full Wolf Moon: New Year's Supermoon Is the Biggest of the Year

New Year's Day is a time for resolutions and hangovers, but this year, it also provides a chance to see the moon in all its glory.

By Tia Ghose, Associate Editor | December 29, 2017 10:15am ET

Editor's Note: This story was updated at 12 p.m. E.T.

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The first day of 2018 brings a "Full Wolf Moon" — the biggest of two supermoons that will rise in January.

Skywatchers, take note! On Jan. 1, 2018, Earth will be closest to the moon at 4:54 p.m. EST (2154 GMT), according to EarthSky.org. The moon will be full at 9:24 p.m. EST (0224 GMT on Tuesday Jan. 2).

New Year's supermoon

A supermoon occurs when the moon is at perigee — its closest point to Earth in its monthly orbit — around the same time as a full moon. The moon looks slightly larger and brighter than average at these times.

The moon that will be visible on New Year's Day will appear bigger than usual, but most people will not notice the difference. However, thanks to a phenomenon called the "moon illusion," the moon may appear bigger when it's close to the horizon, so this New Year's supermoon may be most impressive when it's rising.

Moon myths

The Full Wolf Moon gets its name from the hungry wolves that would howl outside Native American villages during these January full moons, according to the Farmer's Almanac. However, some people argue that the names for the full moons actually come from Anglo-Saxon culture, according to timeanddate.com.

In any case, wolves do not howl more during the supermoon, studies show. In fact, wolves do not howl at the moon at all, but rather at each other to communicate, according to "The Wolf Almanac, New and Revised: A Celebration of Wolves and Their World" (Lyons Press, 2007).

Many supermoon myths have tied the unusually bright celestial object to a variety of spooky outcomes. Some believe supermoons make people go crazy. Others claim supermoons trigger natural disasters. The vast majority of these supposed effects (such as increased emergency-room visits) have not been borne out by studies, Live Science previously reported.

Though the moon will be at its closest point to Earth on Jan. 1, the moon will gradually appear bigger and brighter over the coming days. And those who were too busy working out or still nursing a hangover on the evening of Jan. 1 shouldn't despair: Another supermoon (this one a Blue Moon, or the second full moon in a calendar month), will occur Jan. 31, Space.com reported. That later supermoon will also be involved in a total lunar eclipse, in which the Earth's shadow totally covers the moon, making it a Blood Moon as well.

http://bit.ly/2CjInY3

The Bizarre Reason for a Man's Worsening Anxiety

A British man's symptoms of anxiety were eventually traced to an unusual cause: his repeated exposure to a toxic substance while in the navy, a recent report of the man's case suggests.

By Cari Nierenberg, Live Science Contributor

The man worked as a naval engineer for five years. During this time, he was exposed almost daily to trichloroethylene (TCE), or "trike," a solvent used for cleaning and degreasing ships and aircraft, according to the case report, which was published Dec. 23 in the journal BMJ Case Reports.

Trichloroethylene is a colorless liquid with a sweet odor, and one of its main uses is to remove grease from metal parts, according to the U.S. Centers for Disease Control and Prevention.

In this case, the man said he and other members of the naval engineering crew would spray trichloroethylene from a can onto a cloth, and everyone who used it "seemed to get high from the fumes," the researchers wrote in the case report. He also said he "was regularly overcome to the point of feeling dizzy by trike."

These minor symptoms of dizziness and feeling "high" did not last long, but that feeling was probably the man's first clue that this was not a safe solvent to be using, said the case report author, Dr. Joshua Au Yeung, who treated the man 20 years later at Pennine Acute Hospitals NHS Trust in Manchester, England.

The man's exposure to trichloroethylene was made worse because the ships were not well ventilated, and the navy did not provide any protective equipment, such as masks, to limit the crew's ability to breathe in the vapors, Au Yeung told Live Science.

Identifying the culprit

The 24-year-old man first went to the hospital following a weeklong binge of alcohol in the navy — and not because he was concerned about his exposure to trichloroethylene.

When he went to the hospital, he was feeling extremely anxious, he was shaking (tremors) and he was breathing quickly. In addition, he told doctors he had a dull headache and blurry vision, and that he felt a tingling sensation on the right side of his face.

As doctors spoke with the man, they found out that he had graduated at the top of his naval class and that he had no history of regular or excessive use of alcohol before this incident. Doctors did not ask him detailed questions about his work, so his exposure to TCE never came up.

At the time, he was treated by a psychiatrist, who thought the man's symptoms had resulted from a withdrawal from alcohol, Au Yeung said. But over the next few months, his symptoms of anxiety became more frequent, until they wouldn't go away, according to the case report.

That's why the man's psychiatrist decided to send him to a toxicologist, a scientist who can detect exposure to poisonous substances, and a neuropsychiatrist, a psychiatrist who specializes in neurological illnesses, for a more comprehensive evaluation. These tests revealed that the man's symptoms of anxiety were linked to an unexpected culprit: his exposure to trichloroethylene as a naval engineer.

Regular exposure to trichloroethylene, which is a toxin, can affect every system in the body, Au Yeung said. Once the toxin is inhaled and gets into the blood, it can irritate and damage nerves directly, he said.

When nerves are irritated, they can cause pain, numbness and burning sensations, Au Yeung said. Damage to the nerves by a toxin can change the amount of neurotransmitters they release. For example, it can reduce levels of serotonin, which can lead to depression, he noted.

But, unfortunately for this man, the doctors identified the toxic culprit too late for them to reduce the man's absorption of TCE into his blood. He developed severe anxiety and depression from his exposure to the toxin, according to the report.

"The damage had been done in this case, so the man has not improved," Au Yeung said.

Twenty years later, the man has become dependent on alcohol — drinking two to three bottles of wine a day — and takes a variety of prescribed sedative medications to numb his anxiety, Au Yeung said.

http://bit.ly/2zVIjYy

Diabetes drug 'significantly reverses memory loss' in mice with Alzheimer's

A drug developed for diabetes could be used to treat Alzheimer's after scientists found it "significantly reversed memory loss" in mice through a triple method of action.

A drug developed for diabetes could be used to treat Alzheimer's after scientists found it "significantly reversed memory loss" in mice through a triple method of action.

The research, published in Brain Research, could bring substantial improvements in the treatment of Alzheimer's disease through the use of a drug originally created to treat type 2 diabetes.

Lead researcher Professor Christian Holscher of Lancaster University in the UK said the novel treatment "holds clear promise of being developed into a new treatment for chronic neurodegenerative disorders such as Alzheimer's disease."

Alzheimer's disease is the most common cause of dementia and the numbers are expected to rise to two million people in the UK by 2051 according to Alzheimer's Society, who part- funded the research.

Dr Doug Brown, Director of Research and Development at Alzheimer's Society, said: ""With no new treatments in nearly 15 years, we need to find new ways of tackling Alzheimer's. It's imperative that we explore whether drugs developed to treat other conditions can benefit people with Alzheimer's and other forms of dementia. This approach to research could make it much quicker to get promising new drugs to the people who need them."

Although the benefits of these 'triple agonist' drugs have so far only been found in mice, other studies with existing diabetes drugs such as liraglutide have shown real promise for people with Alzheimer's, so further development of this work is crucial."

This is the first time that a triple receptor drug has been used which acts in multiple ways to protect the brain from degeneration. It combines GLP-1, GIP and Glucagon which are all growth factors. Problems with growth factor signalling have been shown to be impaired in the brains of Alzheimer's patients.

The study used APP/PS1 mice, which are transgenic mice that express human mutated genes that cause Alzheimer's. Those genes have been found in people who have a form of Alzheimer's that can be inherited. Aged transgenic mice in the advanced stages of neurodegeneration were treated. In a maze test, learning and memory formation were much improved by the drug which also:

- ***enhanced levels of a brain growth factor which protects nerve cell functioning***
- ***reduced the amount of amyloid plaques in the brain linked with Alzheimer's***
- ***reduced both chronic inflammation and oxidative stress***
- ***slowed down the rate of nerve cell loss***

Professor Holscher said: "These very promising outcomes demonstrate the efficacy of these novel multiple receptor drugs that originally were developed to treat type 2 diabetes but have shown consistent neuro-protective effects in several studies." "Clinical studies with an older version of this drug type already showed very promising results in people with Alzheimer's disease or with mood disorders"

"Here we show that a novel triple receptor drug shows promise as a potential treatment for Alzheimer's but further dose-response tests and direct comparisons with other drugs have to be conducted in order to evaluate if this new drug is superior to previous ones."

Type 2 diabetes is a risk factor for Alzheimer's and has been implicated in the progression of the disease. Impaired insulin has been linked to cerebral degenerative processes in type 2 diabetes and Alzheimer's disease. Insulin desensitisation has also been observed in the Alzheimer's disease brain. The desensitisation could play a role in the development of neurodegenerative disorders as insulin is a growth factor with neuroprotective properties.

http://bit.ly/2lxyhHM

Why Swearing and Pain Go Hand in Hand

Screaming obscenities when you stub your toe makes perfect biological sense.

By Emma Byrne | January 1, 2018

It was pain that got me hooked on swearing.

I was working as a computational neuroscientist, based in London's Science Museum, and I was looking for interesting experiments to demonstrate to visitors. I read about a study that needed no more than a stopwatch, a bowl of ice water, and volunteers who were willing to keep their hands submerged as long as possible in the freezing water—once while saying a neutral word, and once while swearing.

My version of the study was due to be run at a late-night event that included access to a bar, so I already knew that our results would be a curiosity at best.

But in the original experiment, carried out under more-controlled (and less alcohol-soaked) conditions by Richard Stephens at Keele University in 2009, the results were nevertheless striking and similar to my own.

Using a swearword rather than a neutral word had two significant effects: it allowed the volunteers to keep their hands in ice water for about half again as long, and swearing subjects reported that the water actually felt less painful.

At that point, it was a toss-up whether I'd end up writing a book on the science of swearing or one on pain, because something about that experiment really intrigued me, and still does.

As my pile of research findings on strong language steadily grew higher, I decided Swearing Is Good for You was the book I wanted to write.

While writing the chapter on pain and swearing, I realized that pain is not a purely neurological phenomenon.

Sure, peripheral sensory neurons give you information about a stimulus, but the way you process that pain is as much psychologically constructed as it is neurologically formed.

Our anticipation of pain, our gender roles and social expectations, even whether we're feeling lonely or sad, all change the way we feel pain. Swearing is just one of those factors. So how does it work?

In Stephens's experiment, he took care to rule out some purely cognitive effects. He wanted to be sure that the volunteers weren't distracting themselves with more creativity or varied language in one trial versus the other, so he allowed them only one word on the swearing trial (such as "shit") and one word on the neutral trial (such as "wooden").

To try to minimize the effect of one word being more difficult to recall than the other, Stephens asked each volunteer for five words they would use if they dropped a hammer on their thumbs, and five words to describe a table. Then he took the first word on each list.

The study clearly showed that swearing affected the volunteers' perception of pain, reducing its intensity.

Stephens's lab is now using video games, measures of people's background levels of aggression, and different types of swearing to try to uncover why swearing is such a powerful analgesic.

Follow-up experiments suggest that "minced oaths"—those socially palatable curses we trot out when we think we might be overheard—just don't work as well as the real thing. Intriguingly, the same is true in patients with Tourette syndrome.

Using a softer form of swearing gives them much less relief from the urge to tic, like rubbing an itch instead of scratching it.

We're still not entirely certain what it is that makes swearing an effective painkiller, but in the research for Swearing is Good for You, I discovered that it is a unique part of our language, bound up with our emotions, our communication, our sensory experiences, and our societies.

http://bit.ly/2DHjQZ3

Skin "Remembers" Wounds, Heals Faster the Second Time Around

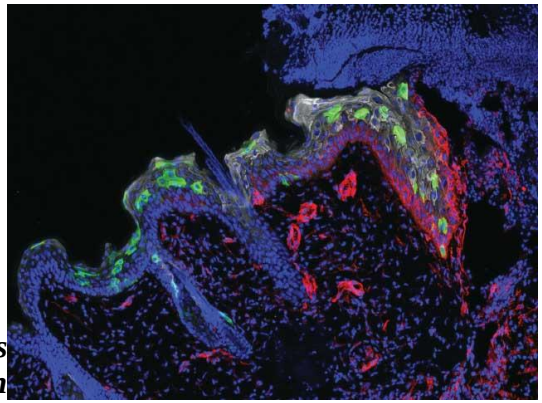
After an initial wounding, genes needed for repair remain ready for action.

By Katarina Zimmer | January 1, 2018

The Paper *S. Naik et al., "Inflammatory memory sensitizes skin epithelial stem cells to tissue damage," Nature, 550:475–80, 2017.*

Inflammatory Memory

Our body is routinely assaulted by ultraviolet radiation, irritants, and pathogens. Shruti Naik, an immunologist at Rockefeller University, wondered: "Do these stressors have any kind of lasting impact on cells?" Immune cells are known to "remember" infections and inflammatory events so that they can respond faster to future insults, but what about the epithelial stem cells that maintain the skin and promote wound healing?



FIX-IT-CREW: Epithelial stem cells (green) migrate into a wound in mouse skin to repair the damaged tissue barrier. **Samantha Larsen, Elaine Fuchs Lab/Rockefellar University Editor's Choice in Cell Biology**

Multiple Assaults

Naik and her colleagues induced inflammation in mice by exposing the animals' skin to chemicals, fungal infection, or mechanical wounding. Then they measured the time it took for the skin to heal after injuring it in the same place a second time. On average, regardless of the type of injury, skin that had been previously inflamed healed about 2.5 times faster than the skin of mice that were wounded for the first time.

Swift Repair

To uncover the genetic basis for an "inflammatory memory," the

researchers searched for genetic loci in the epithelial stem cells that were maintained in a chromosomally accessible state after the first injury. Multiple regions of chromatin were left "open" for up to 180 days after an assault, allowing rapid transcription of key stress response genes following a second injury.

Beneath the Skin

Epithelial stem cells are the first nonimmune cells found to have a memory, and the findings point to "a primitive basic response to jazz up the cells quickly and make them heal the wound," says George Cotsarelis, a dermatologist at the University of Pennsylvania's Perelman School of Medicine who was not involved in the study. "It changes the way people think about the skin now."

http://bit.ly/2lxOiOL

From stools to fuels: the street lamp that runs on dog do

Turning turds into power is not new but most of this energy still goes to waste. A host of innovative projects aim to maximise poo's full potential

Nic Fleming

A long winding road climbs into a gathering dusk, coming to an abrupt dead end in front of a house. Here, a solitary flickering flame casts out a warm glow, illuminating the nearby ridge line of the Malvern Hills.

Below the light sits a mysterious green contraption resembling a cross between a giant washing machine and a weather station. This is the UK's first dog poo-powered street lamp, and it is generating light in more ways than one.

The idea seems simple enough: dog walkers deposit the product of a hearty walk into a hatch and turn a handle. The contents are then broken down by microorganisms in the anaerobic digester, producing methane to fuel the light, and fertiliser.

Brian Harper, who started work on the machine three years ago after becoming fed up of seeing plump little bags hanging in trees and on grass verges, reckons that 10 bags will power the light for two hours each evening.

"The gas light captures people's imagination and shows them dog poo has a value," says Harper, who developed the system with funding from the Malvern Hills Area of Outstanding Natural Beauty. "As a result, we get it [poo] off the ground, into a receptacle, and producing something useful." The next step is to try to interest managers of urban parks in the technology.

Humans have used animal dung as fuel since the neolithic period, and have known how to get flammable gas from decaying organic matter since the 17th century. Small-scale anaerobic digesters are commonplace in many developing countries, while larger plants producing heat and electricity from animal manure and human sewage have long been used in the west.

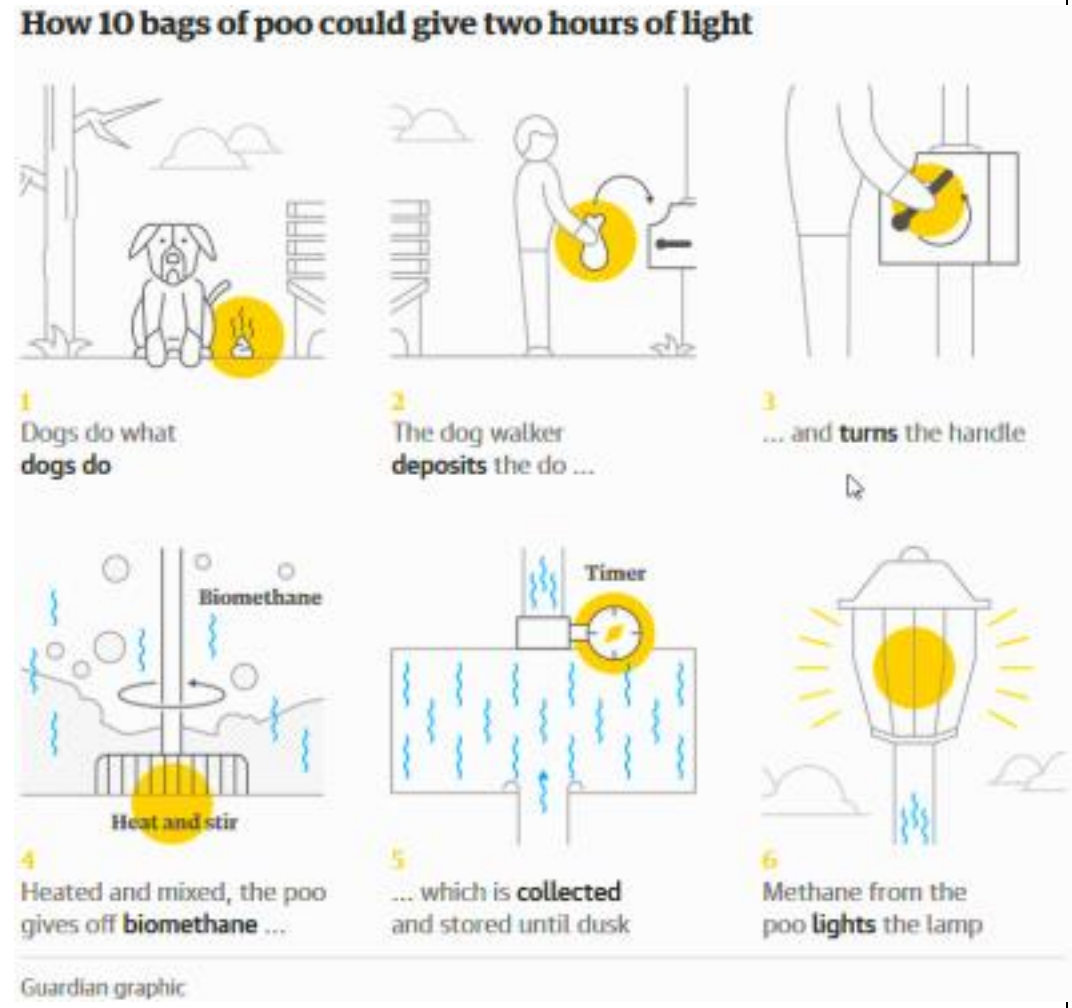
Yet the energy in most excrement still goes to waste. Greater exploitation of this most plentiful resource has been held back by the availability of artificially cheap fossil fuel. But now Harper is at the vanguard of a new movement of innovators finding ingenious, sustainable ways of harnessing the power of excrement.

Local politicians in Waterloo in Ontario, Canada, are thinking along similar lines to tackle a different problem. Dog walkers who use three parks in the city are being asked to drop their pet's poo into concrete storage units. These are periodically emptied by trucks that take it to a large central plant where it is broken down along with other forms of organic waste to produce methane and then electricity. The fertiliser byproduct is sold to farmers.

Analysis of the first five months of an 18-month trial suggests that at the current rate, the scheme would generate enough electricity to power 13 homes and remove 630kg of CO2 from the atmosphere. Modest returns perhaps – but not the main goals of the project.

"Collecting dog waste separately prevents it contaminating our recycling streams, allowing us to divert both away from our landfill

sites," says Jeff Silcox-Childs, Waterloo's director of environment and parks.



In India, the use of small household biodigesters to get gas for fuel from cow manure is common. One social enterprise is deploying the technology on a larger scale as part of a major initiative to end open defecation in the country by 2019.

Sanitation and Health Rights in India (SHRI) turned to biodigestion as a way to keep public toilets clean – a major issue with existing communal facilities. At an initial cost of $30,000, SHRI builds blocks of 16 free-to-use toilets, half for men and half for women. The resulting sewage is broken down in a biodigester to produce methane, which powers a groundwater pump. The water is filtered, bottled and sold for half a rupee (half a pence) per litre, to pay for approximately half of the maintenance costs.

"We are using existing technologies in ways they haven't been connected before to help people in India get the safe, well-maintained and hygienic toilets they deserve," says SHRI's cofounder Anoop Jain. The group opened its first community toilet block in 2014 and is currently building its seventh.

Back in the UK, the Bristol-based GENeco, a subsidiary of Wessex Water, ran its famous Bio-Bug trial in which a VW Beetle was converted to run on methane extracted from human waste. The use of biomethane from sewage plants to power cars is more widespread in other countries, such as Sweden.

In 2014 GENeco launched its Bio-Bus, the UK's first bus powered by gas generated from sewage and food waste. Capable of running for 300km on a full tank, it produces significantly less carbon dioxide and air pollution than fossil fuel-powered equivalents. It ran in trials between Bath and Bristol Airport and then, naturally, on Bristol's "Number 2" bus route.

GENeco also runs a facility that processes human sewage and food waste to generate enriched biomethane that is injected into the grid, providing fuel for some 5,000-6,000 homes. Severn Trent also opened an anaerobic digestion plant for sewage at Minworth near Birmingham in 2014.

"Our facility is no longer a traditional sewage treatment works but a factory, taking inputs including sewage and food waste and turning them into products including gas for cooking or transport and nitrogen- and phosphate-rich fertiliser," says Mohammed Saddiq, managing director of GENeco. "People talk about the circular economy, but what we are doing is putting that vision into practice."

While GENeco's gas-to-grid operation is certainly greener than traditional facilities, there is another input that muddies the water. It, and others like it, receive subsidies under the government's renewable heat incentive. Moreover some argue that large-scale operations involving transporting biomass to a central location are not necessarily the best of solutions.

This was the starting point for SEaB Energy, a Southampton-based company assembling modular, automated, odour-free anaerobic digesters in shipping containers. So far it has mainly sold units designed to process food waste, but it is currently assembling its first commercial Muckbuster units, due for installation in Japan and in Brazil in 2018.

Sandra Sassow, CEO and cofounder of SEaB, warns that some facilities that turn biomass, including excrement, into energy may not be as green as they appear, if, for example, they use fuel to transport waste a long way before it is turned into an energy source.

Right now, waste is collected, trucked, moved and processed, often ending up in landfill at worst or having some energy extracted from it at best, says Sassow.

"We want to disrupt that completely to incorporate decentralised, distributed, on-site appliances into farms and buildings around the world. A lot of things have been tried, but it's a case of finding a technology that produces an energy benefit over the full life cycle, not just an apparent energy benefit."