http://nyti.ms/1TyPw6S

Scientists Ponder the Prospect of Contagious Cancer

Several recent papers suggest that the eventual emergence of a contagious human cancer is in the realm of medical possibility

George Johnson RAW DATA **FEB. 22, 2016**

For all its peculiar horror, cancer comes with a saving grace. If nothing else can stop a tumor's mad evolution, the cancer ultimately dies with its host. Everything the malignant cells have learned about outwitting the patient's defenses — and those of the oncologists — is erased. The next case of cancer, in another victim, must start anew.

Imagine if instead, cancer cells had the ability to press on to another body. A cancer like that would have the power to metastasize not just from organ to organ, but from person to person, evolving deadly new skills along the way.

While there is no sign of an imminent threat, several recent papers suggest that the eventual emergence of a contagious human cancer is in the realm of medical possibility. This would not be a disease, like cervical cancer, that is set off by the spread of viruses, but rather one in which cancer cells actually travel from one person to another and thrive in their new location.

So far this is known to have happened only under the most unusual circumstances. A 19-year-old laboratory worker who pricked herself with a syringe of colon cancer cells developed a tumor in her hand. A surgeon acquired a cancer from his patient after accidentally cutting himself during an operation. There are also cases of malignant cells being transferred from one person to another through an organ transplant or from a woman to her fetus.

On each of these occasions, the malignancy went no further. The only known cancers that continue to move from body to body, evading the immune system, have been found in other animals. In laboratory experiments, for instance, cancer cells have been transferred by mosquitoes from one hamster to another. And so far, three kinds of contagious cancers have been discovered in the wild — in dogs, Tasmanian devils and, most recently, in soft shell clams.

The oldest known example is a cancer that spreads between dogs during sexual intercourse — not as a side effect of a viral or bacterial infection, but rather through direct conveyance of cancer cells. The state of the research is described in a review, "The Cancer Which Survived," published last year by Andrea Strakova and Elizabeth P. Murchison of the University of Cambridge.

The condition, canine transmissible venereal tumor disease, is believed to have sprung into existence 11,000 years ago — as a single cell in a single dog — and has been circulating ever since. (Why did this happen in dogs and not, say, cats? Perhaps because of what the authors demurely call the dogs' "long-lasting coital tie" — the half an hour or so that a male and female are locked in intercourse, tearing genital tissues and providing the cancer cells with a leisurely crossing.)

Every week, we'll bring you stories that capture the wonders of the human body, nature and the cosmos.

Normally a cancer evolves in a single body over the course of years or decades, accumulating the mutations that drive it to power. But to have survived for millenniums, researchers have proposed, canine cancer cells may have developed mechanisms — like those in healthy cells — to repair and stabilize their own malignant genomes.

Early on, cancer cells typically flourish by disabling DNA repair and ramping up the mutational frenzy. Somewhere along the way, the age-old canine cells may have reinvented the device to extend their own longevity. There is also speculation that this cancer may have learned to somehow modify canine sexual behavior in ways that promote the disease's spread and survival.

The second kind of contagious cancer was discovered in the mid-1990s in Tasmanian devils, which spread malignant cells as they try to tear off one another's faces. Though it may be hard to sympathize, devil facial tumor disease threatens the creatures with extinction.

With so few examples, transmissible cancer has been easy to dismiss as an aberration. But in December, scientists at the Universities of Tasmania and Cambridge reported in Proceedings of the National Academy of Sciences that Tasmanian devils are passing around another kind of cancer — genetically distinct from the first. It's weird enough that one such cancer would arise in the species. What are the chances that there would be two?

One theory is that the animals are unusually vulnerable. Driven so close to extinction — by climate change, perhaps, or human predators — the species is lacking in genetic diversity. The cells of another devil injected through a vicious wound may seem so familiar that they are ignored by the recipient's immune system. If some of the cells carry the mutations for the facial cancer, they might be free to flourish and develop into a new tumor.

But the scientists also proposed a more disturbing explanation: that the emergence of contagious cancer may not be so rare after all. "The possibility," they wrote, "warrants further investigation of the risk that such diseases could arise in humans."

Cancer has probably existed ever since our first multicellular ancestors appeared on Earth hundreds of millions of years ago. The life spans of even the longest-lived animals may be just too brief for cancers to easily evolve the ability to leap to another body. Otherwise, contagious cancer would be everywhere.

For now, at least, it remains a curiosity. Consider the case of a 41-year-old man in Medellin, Colombia, who was examined by doctors in 2013 because of fatigue, fever and weight loss. His lymph nodes were clogged with cancer cells that had also spread to his lungs and liver.

Yet the cells looked far too small and simple to be human. “This case posed a diagnostic conundrum,” the doctors wrote in November in The New England Journal of Medicine.

The solution to the puzzle came when the man was also found to be harboring a tapeworm called Hymenolepis nana. Further analysis concluded that the cancer cells had originated in the parasite and then metastasized through the man’s body.

There is no reason to think that tapeworm cancer is about to become a threat to public health. The patient’s immune system had been compromised by H.I.V., and he died several months later.

But nature is infinite in its surprises.

Correction: February 22, 2016

An earlier version of this article misstated one of the animals in which contagious cancer has been discovered in the wild. It was in soft shell clams, not crabs.

http://www.eurekalert.org/pub_releases/2016-02/nuos-fhp021816.php

Fewer heart problems in people who drink moderately and often

Moderation is key

Drinking a little alcohol every day may be part of a healthy lifestyle, according to Imre Janszky, a professor of social medicine at the Norwegian University of Science and Technology (NTNU). He says alcohol does more good than harm for your heart when consumed in moderation.

And, Janszky says, it doesn't matter much whether you drink wine, liquor or beer.

"It's primarily the alcohol that leads to more good cholesterol, among other things. But alcohol can also cause higher blood pressure. So it's best to drink moderate amounts relatively often," he says.

Decreased risk with each additional serving

Along with a number of colleagues from NTNU and the Karolinska Institute in Stockholm, Janszky has published two studies regarding the relationship between alcohol and heart health. One, published in the January 15 issue of the *International Journal of Cardiology*, is about heart failure. The second, from September 2015, is on acute myocardial infarction (AMI), and has been published in the Journal of Internal Medicine.

In both cases, research shows that people who regularly drink alcohol have better cardiovascular health than those who consume little or no alcohol.

The studies showed that those who drank three to five drinks per week were 33 per cent less prone to heart failure than those who abstained or drank infrequently. In the case of heart attacks, the risk appears to be reduced by 28 percent with each additional one-drink increment.

This does not surprise the researchers at all. A majority of researchers worldwide seem to think three to five drinks a week can be good for your heart.

Different drinking patterns

"The relationship between alcohol and heart health has been studied in many countries, including the USA and southern European nations. The conclusions have been the same, but the drinking patterns in these countries are very different than in Norway. In countries like France and Italy, very few people don't drink," says Janszky. "It raises the question as to whether earlier findings can be fully trusted, if other factors related to non-drinkers might have influenced research results. It may be that these are people who previously had alcohol problems, and who have stopped drinking completely," he says.

For this reason, the researchers wanted to examine the theory with a Norwegian population where a significant population drinks rarely or not at all. In the myocardial infarction study, 41 per cent of participants reported that they did not drink at all or that they consumed less than half of one alcoholic beverage per week.

Both studies are based on the longitudinal HUNT 2 Nord-Trøndelag Health Study conducted between 1995 and 1997.

The greater the drinking frequency, the lower the risk

The study, which looked at the relationship between heart failure and alcohol, followed 60,665 participants who enrolled in the HUNT study between 1995-1997 and who had no incidence of heart failure at that time. Of those, 1588 of them developed heart failure during the period of the study, which ended in 2008. The risk was highest for those who rarely or never drank alcohol, and for those who had an alcohol problem.

The more often participants consumed alcohol within normal amounts, the lower their risk of heart failure turned out to be. Those who drank five or more times a month had a 21 per cent lower risk compared to non-drinkers and those who drank little, while those who drank between one and five times a month had a two per cent lower risk.

Drinking isn't necessary for a healthy heart

"I'm not encouraging people to drink alcohol all the time. We've only been studying the heart, and it's important to emphasize that a little alcohol every day can be healthy for the heart. But that doesn't mean it's necessary to drink alcohol every day to have a healthy heart," says Janszky.

In the heart attack study, 58,827 participants were categorized by how much and how often they drank. 2966 of the participants experienced an acute myocardial

infarction (AMI) between 1995 and the end of 2008. The adjusted analyses showed that each additional one-drink increment decreased the risk of AMI by 28 percent.

Alcohol may increase other problems

The researchers stressed that few participants in the study drank particularly much, so they cannot conclude that high alcohol intake protects against heart attack or heart failure. They also encourage looking at the findings in a larger context, since the risk of a number of other diseases and social problems can increase as a result of higher alcohol consumption.

For example, the researchers observed that the risk of dying from various types of cardiovascular disease increased with about five drinks a week and up, while those who drank more moderate amounts had the lowest risk. High alcohol consumption was also strongly associated with an increased risk of death from liver disease.

References:

Katalin Gémes, Imre Janszky, Staffan Ahnve, Krisztina D. László, Lars E. Laugsand,Lars J. Vatten, Kenneth J. Mukamale. Light-to-moderate drinking and incident heart failure -- the Norwegian HUNT study. International Journal of Cardiology. Vol. 203, 15 January 2016, Pages 553-560.doi:10.1016/j.ijcard.2015.10.179

K. Gémes, I. Janszky, L. E. Laugsand, K. D. László, S. Ahnve, L. J. Vatten and K. J. Mukama. Alcohol consumption is associated with a lower incidence of acute myocardial infarction: results from a large prospective population-based study in Norway. Journal of Internal Medicine, early online edition. 14 September 2015. DOI: 10.1111/joim.12428

http://www.eurekalert.org/pub_releases/2016-02/niot-nbp021616.php

New bacterial pump could be used to remove cesium from the environment by light

Research group at Nagoya Institute of Technology (NITech) identifies a new molecular pump that could facilitate collection and storage of cesium

Nagoya, Japan - A novel cesium-transporting bacterial pump developed by researchers at the NITech could be beneficial in radioactivity decontamination efforts. These findings were recently reported in *The Journal of Physical Chemistry Letters*.

The NITech-led team, in collaboration with colleagues at The University of Tokyo, successfully induced a molecular pump found in bacteria to transport cesium. The process simply requires the presence of light to make it function. The finding could pave the way for a new means of extracting cesium from the environment, potentially speeding up decontamination efforts following the radioactive fallout from the Fukushima Daiichi nuclear disaster in 2011.

This work focused on rhodopsins, which are light-activated molecules found in the human eye as well as in bacteria. Rhodopsins have been found capable of pumping anions or cations into or out of cells, respectively--activity important for maintaining various cell functions.

In this study, the team worked on a rhodopsin from a marine bacterium, which normally pumps sodium, as well as lithium, across the cell membrane. Earlier studies had identified the particular building blocks within the middle of this pump that are vital for it to transport only those ions it is meant to transport. Subsequent works applied this information to induce the pumping of potassium instead of sodium. Further progress along this line of study has now led to production of a cesium pump. This is a major breakthrough--no light-driven cesium pumps have been found in nature.

"We were able to introduce a range of mutations at two positions within the rhodopsin protein from *Krokinobacter eikastus*, which are known to be important for its pump activity," lead author Masae Konno, from the Department of Frontier Materials at NITech, explains. "When the mutated protein was then expressed in *E. coli*, we were able to see the concentrations of different ions in solutions in which they were suspended. Changes in these concentrations indicated successful pump activity, and could be used to quantify the pumping efficiency."

The research team was also able to identify the exact mechanism of the pump's targeting and transport of particular ions. They found that the two mutated positions correspond to the narrowest part of the channel through which ions pass. When bulky amino acids are introduced at these positions, the channel width no longer corresponds to the size of sodium ions, and instead cesium ions are transported.

The authors are optimistic about the potential for using this finding in real-world applications. "Being able to use the pump to collect radioisotopes from the environment is truly significant," they say. "For example, a substantial amount of cesium-137 was released after the Fukushima nuclear disaster. This radioactive isotope has a half-life of 30 years. The large-scale production of this protein would be a great help in decontaminating the affected areas."

http://www.eurekalert.org/pub_releases/2016-02/ecjr-nec022216.php

New evidence confirms human activities drive global warming

New statistical technique, analysing data records for past 150 years, confirms man-made (CO2) and (CH4) emissions have led to global warming

A new statistical technique, analysing data records since measuring started 150 years ago, independently confirms that man-made carbon dioxide (CO2) and methane (CH4) emissions have led to global warming, according to a JRC-led article published *Nature Scientific Reports*. The analysis also shows that the most pronounced consequences of such emissions are being felt in localised regions

around the globe, such as Europe, North America, China, Siberia, the Sahel zone in Africa, and Alaska.

The authors investigated the causes of global warming using a new statistical method for quantifying causality to analyse the relation between time series data on greenhouse gas emissions and those on air temperatures in the last 150 years. The results confirm that recent global warming is mainly caused by increased anthropogenic (man-made) emissions and that further CO2 emissions to the atmosphere will lead to even stronger global warming.

This conclusion cannot be achieved through traditional, time-delayed correlations between temperature and GHG emissions changes or through ordinary least square regression analysis, as neither shows the causal relations. Being based on measured data, the results provide complementary support to model-based studies.

The authors applied the same technique to analyse historical air temperatures and CO2/CH4 data from the past 800,000 years, available thanks to the 3,000 meter deep ice core drilled in Antarctica more than a decade ago, which offers scientists a clue on a time scale of 800 millennia. They found a causal relationship between temperature increase and rising CO2/CH4 levels, which is the exact opposite of the results for the last 150 years. This also confirms the validity of the technique, as it is well known from the ice core data that in historical times, increase of temperatures had been followed by higher CO2/CH4 emissions. The causality relationship appears to have started reversing around 5000 years ago. The analysis confirms this opposite trend for the last 150 years, when unprecedented amounts of CO2 started being pumped into the atmosphere in the industrial age.

Looking into the effect of anthropogenic emissions on different regions, the authors found strong causality between greenhouse gas emissions and rising temperatures in Europe, North America and China, where densely populated and industrialised areas have shown signs of strong warming. However, a high degree of causality was seen also in Siberia, the Sahel zone in Africa and Alaska, where human presence and associated activities are far less intense. The reasons for this pattern are not yet understood and should therefore become the focus of research to better understand regional climate dynamics.

This observational data-based study, therefore, not only provides complementary support for the results of modelling activities on global climate, but also indicates that further research should be carried out in regions of increased sensitivity to global warming caused by anthropogenic activities. The study was carried out in cooperation with a colleague from China's School of Marine Sciences, Nanjing Institute of Meteorology, who developed the statistical method.

Further information ***On the causal structure between CO2 and global temperature***

http://www.eurekalert.org/pub_releases/2016-02/oupu-erd022216.php

Using sugar to detect malignant tumors

Ordinary sugar could become a contrast agent of the future for use in magnetic resonance tomography examinations of tumours.

Malignant tumours show higher sugar consumption than surrounding tissue.

"If sugar replaces metal as a contrast agent in the body, it can also have a positive psychological effect and make patients calmer," says Linda Knutsson, senior lecturer at Lund University in Sweden.

A tumour's properties can be examined by injecting a small amount of sugar into it, and then measuring how much sugar the tumour consumes. The more sugar the tumour consumes, the more malignant it is.

Linda Knutsson is working with a team from Johns Hopkins University in the USA, which has developed a new imaging technique for magnetic resonance tomography. The collaboration has resulted in the new imaging technique being combined with the testing of natural sugar as a replacement for metal in contrast agents.

There is no similar clinical research in this area. It is the first time a non-synthetic contrast agent has been used in human magnetic resonance tomography examinations, and the results are promising. The uptake of sugar is higher in the tumour than in healthy tissue according to the results of tests carried out by Linda Knutsson and the Johns Hopkins team in the USA. The tests were carried out on three persons with a brain tumour and four healthy persons and published in the research journal Tomography in December last year. A more detailed study on a large group of patients is to commence soon in Lund.

"Metal-based contrast agents cost more than sugar-based agents. Accordingly, this could lead to a reduction in medical care costs," says Linda Knutsson.

A disadvantage is that sugar-based contrast agents cannot be used in examinations of diabetes patients.

http://www.eurekalert.org/pub_releases/2016-02/wuso-iop021816.php

In obese patients, 5 percent weight loss has significant health benefits

Initial weight loss lowers risk for diabetes, cardiovascular disease

For patients with obesity trying to lose weight, the greatest health benefits come from losing just 5 percent of their body weight, according to a new study at Washington University School of Medicine in St. Louis.

Researchers found that the relatively small weight loss markedly lowered patients' risk for diabetes and cardiovascular disease and improved metabolic function in liver, fat and muscle tissue.

The study is published online Feb. 22 in the journal *Cell Metabolism*.

"Our findings demonstrate that you get the biggest bang for your buck with 5 percent weight loss," said principal investigator Samuel Klein, MD, director of Washington University's Center for Human Nutrition. "The current guidelines for treating obesity recommend a 5 to 10 percent weight loss, but losing 5 percent of your body weight is much easier than losing 10 percent. So it may make sense for patients to aim at the easier target."

Klein, the William H. Danforth Professor of Medicine and Nutritional Science and chief of the Division of Geriatrics and Nutritional Science, randomly assigned 40 obese individuals -- none of whom had diabetes -- to either maintain their body weight or go on a diet to lose 5, 10 or 15 percent of body weight. The researchers looked at whole body, organ system and cellular responses before and after the weight loss.

While other randomized clinical trials have evaluated the effects of varying weight loss in people with obesity, this is thought to be the first time a trial has separated weight loss outcomes in people who achieved a 5 percent weight loss from those who achieved a 10 percent or greater weight loss.

Among the 19 study volunteers who lost 5 percent of their body weight, the function of insulin-secreting beta cells improved, as did insulin sensitivity in fat tissue, liver and skeletal muscle tissue. A 5 percent weight loss also was associated with decreases in total body fat and with much less fat in the liver.

Meanwhile, nine of those study patients continued to lose weight, eventually reaching 15 percent weight loss. They experienced further improvements in beta cell function and insulin sensitivity in muscle tissue, but neither insulin sensitivity in the liver nor adipose (fat) tissue continued to improve with the greater weight loss.

"Continued weight loss is good, but not all organ systems respond the same way," Klein said. "Muscle tissue responds much more to continued weight loss, but liver and adipose tissue have pretty much achieved their maximum benefit at 5 percent weight loss."

Interestingly, markers of inflammation, which are elevated in people with obesity, didn't change much when study subjects lost a moderate amount of weight. Although scientists hypothesize that increased inflammation in fat tissue contributes to metabolic problems such as insulin resistance, this study found that metabolic function could improve while markers of inflammation remain unchanged.

That element of the research will require further study. Klein also wants to expand the study to people who have diabetes.

"We don't know whether people with diabetes will have the same response to this type of progressive weight loss, so it will be important in the future to repeat this type of study in people who have type 2 diabetes," he said.

In the meantime, Klein said people with obesity can benefit significantly from losing even a little bit of weight.

"If you weigh 200 pounds, you will be doing yourself a favor if you can lose 10 pounds and keep it off," he said. "You don't have to lose 50 pounds to get important health benefits."

Funding for this research comes from the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health (NIH), grant numbers DK 37948, DK 104995, DK 56341, DK 20579, RR 024992 and TR 000450; the Pershing Square Foundation and the Longer Life Foundation.

Magkos F, Fraterrigo G, Yoshino J, Luecking C, Kirbach K, Kelly SC, de las Fuentes L, He S, Okunade AL, Patterson BW Klein S. Effects of moderate and subsequent progressive weight loss on metabolic function and adipose tissue biology in humans with obesity. Cell Metabolism, *published online Feb. 22, 2016.* http://dx.doi.org/10.1016/j.cmet.2016.02.005

http://www.eurekalert.org/pub_releases/2016-02/cmaj-ncr021816.php

New Canadian recommendation against colonoscopy for routine screening of colorectal cancer

Colorectal cancer screening in low-risk adults aged 50 to 74 years every 2 years using fecal occult blood testing, or flexible sigmoidoscopy every 10 years

Physicians should screen for colorectal cancer in asymptomatic, low-risk adults aged 50 to 74 years every two years using fecal occult blood testing (FOBT), or flexible sigmoidoscopy every 10 years, rather than colonoscopy, according to a new Canadian guideline from the Canadian Task Force on Preventive Health Care in *CMAJ* (*Canadian Medical Association Journal*).

Flexible sigmoidoscopy inserts a flexible scope to view the lower portion of the colon and rectum rather than the entire tract.

"Although colonoscopy may offer clinical benefits that are similar to or greater than those associated with flexible sigmoidoscopy, direct evidence of its efficacy from randomized controlled trials in comparison to the other screening tests ... is presently lacking; however, ongoing clinical trials are working to address this research gap," states Dr. Maria Bacchus, chair of the guideline working group and a general internist in the Department of Medicine, University of Calgary, Alberta. "Wait lists for colonoscopy remain long in Canada and have increased over the years."

Colorectal cancer is the second most common cause of death from cancer in men and the third leading cause of death from cancer in women. In 2015, an estimated

25,000 Canadians were diagnosed with colorectal cancer, and approximately 9300 died from this cancer.

The new guideline is based on the latest available evidence and updates the Task Force's previous 2001 guideline, which recommended FOBT every year or two years and flexible sigmoidoscopy every five years in asymptomatic adults.

"Although flexible sigmoidoscopy is not frequently performed for screening in many jurisdictions, it may warrant further consideration because it can be completed in the same facilities as colonoscopy and using similar equipment, but without the requirement of a specialist, such as a gastroenterologist," write the guideline authors.

The guideline recommends against screening people age 75 and over for colorectal cancer if they are asymptomatic. It also recommends against using colonoscopy as a primary screening tool for colorectal cancer. The authors recommend that physicians should discuss screening preferences, values and local test availability with patients between the ages of 50 and 59 years because of the lower incidence in this age group. It is also recommended that physicians have a similar conversation with those over age 75 because of their reduced life expectancy and the lack of randomized controlled trials showing benefit or potential harms to determine the best option.

The Canadian guideline is similar to the US Preventive Services Task Force (USPSTF) recommendation, published in 2008, to screen adults aged 50 to 75 years with FOBT or flexible sigmoidoscopy. Although the USPSTF also recommended colonoscopy, the CTFPHC does not think there is sufficient evidence at this time to support this. Clinical trials are underway to address the role of colonoscopy as a screening tool.

The guideline, as well as materials to help physicians discuss screening choices with patients, is available at http://www.canadiantaskforce.ca.

http://www.eurekalert.org/pub_releases/2016-02/tjnj-aat021916.php

ARDS appears to be underrecognized, undertreated and associated with high risk of death

Acute respiratory distress syndrome (ARDS) appeared to be underrecognized, undertreated, and associated with a high mortality rate

Among nearly 460 intensive care units (ICUs) in 50 countries, acute respiratory distress syndrome (ARDS) appeared to be underrecognized, undertreated, and associated with a high mortality rate, according to a study that appears in the February 23 issue of *JAMA*, which is being released to coincide with the Society of Critical Care Medicine's 45th Critical Care Congress.

Acute respiratory distress syndrome is an acute inflammatory lung injury. Limited information exists about its epidemiology, recognition, management, and outcomes for patients. John G. Laffey, M.D., M.A., of St. Michael's Hospital, University of Toronto, and colleagues at the European Society of Intensive Care Medicine conducted a study of patients undergoing invasive or noninvasive ventilation during 4 consecutive weeks in the winter of 2014 in 459 ICUs from 50 countries across 5 continents.

Of 29,144 patients admitted to participating ICUs, 3,022 (10.4 percent) fulfilled ARDS criteria. Of these, 2,377 patients developed ARDS in the first 48 hours and received invasive mechanical ventilation. Clinical recognition of ARDS ranged from 51 percent in mild to 78.5 percent in severe ARDS. Hospital mortality was 35 percent for those with mild, 40 percent for those with moderate, and 46 percent for those with severe ARDS.

The authors write that the major findings in this study were the underrecognition of ARDS by clinicians, the low use of contemporary ventilatory and adjunctive treatment strategies, and the limited effect of physician diagnosis of ARDS on treatment decisions. "These findings indicate the potential for improvement in management of patients with ARDS."

To read the full article and an accompanying editorial by Brendan J. Clark, M.D., and Marc Moss, M.D., of the University of Colorado School of Medicine, Aurora, please visit the For The Media website. (doi:10.1001/jama.2016.0291)

http://www.eurekalert.org/pub_releases/2016-02/ca-b022116.php

Bat 'super immunity' could help protect people

For the first time researchers have uncovered a unique ability in bats which allows them to carry but remain unaffected by lethal diseases.

Unlike humans, bats keep their immune systems switched on 24/7 and scientists believe this could hold the key to protecting people from deadly diseases like Ebola.

Bats are a natural host for more than 100 viruses, some of which are lethal to people, including Middle Eastern Respiratory Syndrome (MERS), Ebola and Hendra virus, however, interestingly bats do not get sick or show signs of disease from these viruses. Published today in the journal *Proceedings of the National Academy of Sciences* (PNAS), this new research examines the genes and immune system of the Australian black flying fox, with surprising results.

"Whenever our body encounters a foreign organism, like bacteria or a virus, a complicated set of immune responses are set in motion, one of which is the defense mechanism known as innate immunity," leading bat immunologist at CSIRO's Australian Animal Health Laboratory Dr Michelle Baker said.

"We focused on the innate immunity of bats, in particular the role of interferons - which are integral for innate immune responses in mammals - to understand what's special about how bats respond to invading viruses.

"Interestingly we have shown that bats only have three interferons which is only a fraction - about a quarter - of the number of interferons we find in people.

"This is surprising given bats have this unique ability to control viral infections that are lethal in people and yet they can do this with a lower number of interferons."

The team also compared two type 1 interferons - alpha and beta.

The research showed that bats express a heightened innate immune response even when they were not infected with any detectable virus.

"Unlike people and mice, who activate their immune systems only in response to infection, the bats interferon-alpha is constantly 'switched on' acting as a 24/7 front line defence against diseases," Dr Baker said.

"In other mammalian species, having the immune response constantly switched on is dangerous - for example it's toxic to tissue and cells- whereas the bat immune system operates in harmony."

While we are familiar of the important role bats play in the eco-system as pollinators and insect controllers, they are also increasingly demonstrating their worth in potentially helping to protect people from infectious diseases.

"If we can redirect other species' immune responses to behave in a similar manner to that of bats, then the high death rate associated with diseases, such as Ebola, could be a thing of the past," Dr Baker said.

This work builds on previous research undertaken by CSIRO and its partners to better understand bat immunity to help protect Australia and its people from exotic and emerging infectious diseases.

Led by CSIRO, this international research effort included expertise from CSIRO, Duke-NUS Medical School and the Burnet Institute.

http://www.eurekalert.org/pub_releases/2016-02/uota-pop022216.php

Proven one-step process converts CO2 and water directly into liquid hydrocarbon fuels

Concentrated light, heat and high pressures drives the one-step conversion of CO_2 and water directly into useable liquid hydrocarbon fuels

A team of University of Texas at Arlington chemists and engineers have proven that concentrated light, heat and high pressures can drive the one-step conversion of carbon dioxide and water directly into useable liquid hydrocarbon fuels.

This simple and inexpensive new sustainable fuels technology could potentially help limit global warming by removing carbon dioxide from the atmosphere to make fuel. The process also reverts oxygen back into the system as a byproduct of the reaction, with a clear positive environmental impact, researchers said.

"Our process also has an important advantage over battery or gaseous-hydrogen powered vehicle technologies as many of the hydrocarbon products from our reaction are exactly what we use in cars, trucks and planes, so there would be no need to change the current fuel distribution system," said Frederick MacDonnell, UTA interim chair of chemistry and biochemistry and co-principal investigator of the project.

In an article published today in the *Proceedings of the National Academy of Sciences* titled "Solar photothermochemical alkane reverse combustion," the researchers demonstrate that the one-step conversion of carbon dioxide and water into liquid hydrocarbons and oxygen can be achieved in a photothermochemical flow reactor operating at 180 to 200 C and pressures up to 6 atmospheres.

"We are the first to use both light and heat to synthesize liquid hydrocarbons in a single stage reactor from carbon dioxide and water," said Brian Dennis, UTA professor of mechanical and aerospace engineering and co-principal investigator of the project.

"Concentrated light drives the photochemical reaction, which generates high-energy intermediates and heat to drive thermochemical carbon-chain-forming reactions, thus producing hydrocarbons in a single-step process."

Duane Dimos, UTA vice president for research commended the researchers on their success.

"Discovering a one-step process to generate renewable hydrocarbon fuels from carbon dioxide and water is a huge achievement," Dimos said. "This work strengthens UTA's reputation as a leading research institution in the area of Global Environmental Impact, as laid out in our Strategic Plan 2020."

The hybrid photochemical and thermochemical catalyst used for the experiment was based on titanium dioxide, a white powder that cannot absorb the entire visible light spectrum.

"Our next step is to develop a photo-catalyst better matched to the solar spectrum," MacDonnell said. "Then we could more effectively use the entire spectrum of incident light to work towards the overall goal of a sustainable solar liquid fuel."

The authors envision using parabolic mirrors to concentrate sunlight on the catalyst bed, providing both heat and photo-excitation for the reaction. Excess heat could even be used to drive related operations for a solar fuels facility, including product separations and water purification.

The research was supported by grants from the National Science Foundation and the Robert A. Welch Foundation. Wilaiwan Chanmanee, postdoctoral research associate in mechanical and aerospace engineering, and Mohammad Fakrul Islam,

graduate research assistant and Ph.D. candidate in the department of Chemistry and Biochemistry at UTA, also participated in the project.

MacDonnell and Dennis have received more than $2.6 million in grants and corporate funding for sustainable energy projects over the last four years.

MacDonnell and Dennis' investigations also are focused on converting natural gas for use as high-grade diesel and jet fuel. The researchers developed the gas-to-liquid technology in collaboration with an industrial partner in UTA's Center for Renewable Energy and Science Technology, or CREST, lab, and are now working to commercialize the process.

MacDonnell also has worked on developing new photocatalysts for hydrogen generation, with the goal of creating an artificial photosynthetic system which uses solar energy to split water molecules into hydrogen and oxygen. The hydrogen could then be used as a clean fuel.

http://nyti.ms/1QPJ2BD

Not Every Drop of a Person's Blood Is the Same, a Study Says

As diagnostic tests rely on ever-tinier amounts of blood, some scientists are striking a note of caution. As it turns out, not all drops of blood are identical.

By DONALD G. McNEIL Jr. FEB. 22, 2016

Vials of blood at an American Red Cross donation center in February. **Gary Cameron/Reuters**

Bioengineers at Rice University recently found that different drops from single fingerpricks on multiple subjects varied substantially on results for basic health measures like hemoglobin, white blood cell counts and platelet counts.

Their study was published in The American Journal of Clinical Pathology.

To get results as accurate as those achieved by the traditional method — inserting a needle into an arm vein — the investigators had to average the results of six to nine drops, said Rebecca Richards-Kortum, the director of Rice 360°: Institute for Global Health Technologies, which did the research.

The investigators were careful not to squeeze or "milk" the subjects' fingers, which has been known to invalidate results, said Meaghan Bond, the Rice bioengineering student who did the study with Dr. Richards-Kortum.

Instead, the researchers used long lancets. But some subjects still had to be excluded because they stopped bleeding too quickly.

In poor countries, clinics in remote areas are eager for tests that can be done rapidly and without electricity, especially when no one trained to pierce veins is available. Donors like the Bill & Melinda Gates Foundation support numerous "lab in a box" or "lab on a chip" efforts to detect diseases like sickle-cell anemia, H.I.V. and malaria.

For patients in wealthy countries who fear needles or could benefit from point-of-care tests, companies like Theranos are miniaturizing collection vials and trying to do numerous tests on them — not always successfully.

"If you're going to take a fingerprick stick to get your measures, you need to be aware that you're sacrificing some accuracy," Ms. Bond said.

http://nyti.ms/1QEROvQ

Seas Are Rising at Fastest Rate in Last 28 Centuries

The worsening of tidal flooding in American coastal communities is largely a consequence of greenhouse gases from human activity, and the problem will grow far worse in coming decades, scientists reported Monday.

By JUSTIN GILLIS FEB. 22, 2016

Those emissions, primarily from the burning of fossil fuels, are causing the ocean to rise at the fastest rate since at least the founding of ancient Rome, the scientists said. They added that in the absence of human emissions, the ocean surface would be rising less rapidly and might even be falling.

The increasingly routine tidal flooding is making life miserable in places like Miami Beach; Charleston, S.C.; and Norfolk, Va., even on sunny days.

Though these types of floods often produce only a foot or two of standing saltwater, they are straining life in many towns by killing lawns and trees, blocking neighborhood streets and clogging storm drains, polluting supplies of freshwater and sometimes stranding entire island communities for hours by overtopping the roads that tie them to the mainland.

Such events are just an early harbinger of the coming damage, the new research suggests.

"I think we need a new way to think about most coastal flooding," said Benjamin H. Strauss, the primary author of one of two related studies released on Monday. "It's not the tide. It's not the wind. It's us. That's true for most of the coastal floods we now experience."

In the second study, scientists reconstructed the level of the sea over time and confirmed that it is most likely rising faster than at any point in 28 centuries, with the rate of increase growing sharply over the past century — largely, they found, because of the warming that scientists have said is almost certainly caused by human emissions.

They also confirmed previous forecasts that if emissions were to continue at a high rate over the next few decades, the ocean could rise as much as three or four feet by 2100.

Experts say the situation would then grow far worse in the 22nd century and beyond, likely requiring the abandonment of many coastal cities.

The findings are yet another indication that the stable climate in which human civilization has flourished for thousands of years, with a largely predictable ocean permitting the growth of great coastal cities, is coming to an end.

"I think we can definitely be confident that sea-level rise is going to continue to accelerate if there's further warming, which inevitably there will be," said Stefan Rahmstorf, a professor of ocean physics at the Potsdam Institute for Climate Impact Research, in Germany, and co-author of one of the papers, published online Monday by an American journal, Proceedings of the National Academy of Sciences.

In a report issued to accompany that scientific paper, a climate research and communications organization in Princeton, N.J., Climate Central, used the new findings to calculate that roughly three-quarters of the tidal flood days now occurring in towns along the East Coast would not be happening in the absence of the rise in the sea level caused by human emissions. The lead author of that report, Dr. Strauss, said the same was likely true on a global scale, in any coastal community that has had an increase of saltwater flooding in recent decades.

The rise in the sea level contributes only in a limited degree to the huge, disastrous storm surges accompanying hurricanes like Katrina and Sandy. Proportionally, it has a bigger effect on the nuisance floods that can accompany what are known as king tides.

The change in frequency of those tides is striking. For instance, in the decade from 1955 to 1964 at Annapolis, Md., an instrument called a tide gauge measured 32 days of flooding; in the decade from 2005 to 2014, that jumped to 394 days.

Flood days in Charleston jumped from 34 in the earlier decade to 219 in the more recent, and in Key West, Fla., the figure jumped from no flood days in the earlier decade to 32 in the more recent.

The new research was led by Robert E. Kopp, an earth scientist at Rutgers University who has won respect from his colleagues by bringing elaborate statistical techniques to bear on longstanding problems, like understanding the history of the global sea level.

Based on extensive geological evidence, scientists already knew that the sea level rose drastically at the end of the last ice age, by almost 400 feet, causing shorelines to retreat up to a hundred miles in places. They also knew that the sea level had basically stabilized, like the rest of the climate, over the past several thousand years, the period when human civilization arose.

But there were small variations of climate and sea level over that period, and the new paper is the most exhaustive attempt yet to clarify them.

The paper shows the ocean to be extremely sensitive to small fluctuations in the Earth's temperature. The researchers found that when the average global temperature fell by a third of a degree Fahrenheit in the Middle Ages, for instance, the surface of the ocean dropped by about three inches in 400 years. When the climate warmed slightly, that trend reversed.

"Physics tells us that sea-level change and temperature change should go hand-in-hand," Dr. Kopp said. "This new geological record confirms it."

In the 19th century, as the Industrial Revolution took hold, the ocean began to rise briskly, climbing about eight inches since 1880. That sounds small, but it has caused extensive erosion worldwide, costing billions.

Due largely to human emissions, global temperatures have jumped about 1.8 degrees Fahrenheit since the 19th century. The sea is rising at what appears to be an accelerating pace, lately reaching a rate of about a foot per century.

One of the authors of the new paper, Dr. Rahmstorf, had previously published estimates suggesting the sea could rise as much as five or six feet by 2100. But with the improved calculations from the new paper, his latest upper estimate is three to four feet.

That means Dr. Rahmstorf's forecast is now more consistent with calculations issued in 2013 by the Intergovernmental Panel on Climate Change, a United Nations body that periodically reviews and summarizes climate research. That body found that continued high emissions might produce a rise in the sea of 1.7 to 3.2 feet over the 21st century.

In an interview, Dr. Rahmstorf said the rise would eventually reach five feet and far more — the only question was how long it would take. Scientists say the recent climate agreement negotiated in Paris is not remotely ambitious enough to forestall a significant melting of Greenland and Antarctica, though if fully implemented, it may slow the pace somewhat. "Ice simply melts faster when the temperatures get higher," Dr. Rahmstorf said. "That's just basic physics."

http://www.eurekalert.org/pub_releases/2016-02/uoc--bis022216.php

Body's immune system may play larger role in Alzheimer's disease than thought

UCI mouse study finds dramatic increase in brain plaques when key cells are lacking

Irvine, Calif.- Immune cells that normally help us fight off bacterial and viral infections may play a far greater role in Alzheimer's disease than originally thought, according to University of California, Irvine neurobiologists with the Sue & Bill Gross Stem Cell Research Center and the Institute for Memory Impairments and Neurological Disorders.

The researchers discovered this when Alzheimer's disease mice genetically modified to lack these key immune cells in their blood developed the distinctive brain plaques associated with the neurodegenerative disorder much more quickly.

According to Mathew Blurton-Jones, assistant professor of neurobiology & behavior, and doctoral student Samuel Marsh, their findings could lead to the creation of new techniques to help identify, or perhaps even treat, individuals at risk of developing the disease.

Alzheimer's is the leading cause of age-related dementia and is thought to be driven by the accumulation of a protein called beta-amyloid that aggregates to form amyloid plaques in the brain. Microglia, immune cells that reside in the brain, attempt to clear this buildup, but in Alzheimer's, they appear to be fighting a losing battle. While many studies have explored the role of microglia in Alzheimer's, very few researchers have asked whether a different set of immune cells called T-cells and B-cells that reside outside the brain and play a large part in autoimmune diseases might also impact Alzheimer's.

To test this idea, Blurton-Jones and Marsh bred genetically modified Alzheimer's disease mice to lack three key immune cell types: T-cells, B-cells and NK-cells. Six months later, when the brains of these mice were compared to those of Alzheimer's mice with intact immune systems, the scientists found a more than twofold increase in beta-amyloid accumulation. "We were very surprised by the magnitude of this effect," Blurton-Jones said. "We expected the influence of the deficient immune system on Alzheimer's pathology to be much more subtle."

To understand how the loss of these immune cells was increasing beta-amyloid, he and Marsh examined the interactions between these peripheral cells and microglia within the brain.

"We found that in Alzheimer's mice with intact immune systems, antibodies - which are made by B-cells - accumulated in the brain and associated with microglia. This, in turn, helped increase the clearance of beta-amyloid," Marsh said.

To further confirm the importance of this interplay between immune cells in the blood and those in the brain, the researchers transplanted healthy bone marrow stem cells into the immune-deficient Alzheimer's mice. Since T-, B- and NK-cells develop from bone marrow stem cells, this transplantation led to a reconstitution of the missing immune cells. This allowed the B-cells to produce antibodies that once again reached the brain and aided microglia in eradicating the beta-amyloid.

"We know that the immune system changes with age and becomes less capable of making T- and B-cells," Blurton-Jones said. "So whether aging of the immune system in humans might contribute to the development of Alzheimer's is the next big question we want to ask."

Study results appear in the early online edition of Proceedings of the National Academy of Sciences. Other researchers who contributed to this work are Edsel Abud, Anita Lakatos, Alborz Karimzadeh, Stephen Yeung, Hayk Davtyan, Gianna Fote, Lydia Lau, Jason Weinger, Thomas Lane, Matthew Inlay and Wayne Poon. The research was supported by the National Institutes of Health (grant RF1AG048099) and the Alzheimer's Association.

http://bit.ly/1XSZBw2

We Need to Educate the Public about Dirty Bombs

The fear of radiation such a weapon could spread is far more harmful than the radiation itself

Terrorism works not as much by causing death as by causing fear. Bombings and shootings kill a few, or a few dozen or few hundred or even a few thousand, but frighten millions. The unpredictable random attacks in public places leave us all feeling vulnerable, afraid, just what terrorists hope to achieve. So wouldn't you assume that among all the things that governments are doing to reduce the danger from terrorist attacks, that a big part of that effort would be to try and minimize the fear these attacks cause? You'd think so, but with one of the most fear-inducing weapon terrorists might use, you'd be wrong.

The weapon is a dirty bomb, a conventional explosive mixed with radioactive material that would be dispersed across a community (it's technically known as a radiological dispersal device). In the aftermath of the Paris attacks last November Belgian authorities discovered evidence that the terrorists involved in the Paris attacks were surveilling a high-level Belgian nuclear official who had access to radioactive material—not the kind that could be used to build a nuclear weapon, but perfect for a dirty bomb. And Reuters reported that radioactive material was stolen in Iraq last November from an oilfield company that was using the material to test the integrity of oil pipelines. No one knows who took it, or where it is.

The prospect of such a bomb seems terrifying, but anyone who knows the basic science of radiation biology knows that it wouldn't cause much health damage, because the dose of radioactivity to which most people might be exposed would be very low. And experts know, based on the 65 year Life Span Study of the survivors of *atomic bomb explosions* in Japan, that even at extraordinarily high doses, ionizing radiation only raises lifetime cancer mortality rates a little bit—just two thirds of one percent for survivors who were within three kilometers of ground zero. And despite popular belief, it causes no genetic damage that is passed on to future generations. At the low doses most people might get from a dirty bomb, the health risk is infinitesimal. Not zero, but tiny.

But most people *don't* know that. They believe that any exposure to nuclear radiation is really dangerous. Radiophobia is deeply carved into public belief. So

if a dirty bomb goes off, and the global media screams with dramatic alarms about the danger of radiation, fear will spread faster and further than the isotopes of iridium or cobalt or whatever nuclear material terrorists have used. And that fear will do immense harm.

Should such a weapon go off in a city, much of that city will be shut down, and major areas evacuated, for weeks or months. Tens of millions of people in the wider surrounding region, especially downwind, will be afraid. The economic costs will be vast. So will the health effects—not from radiation, but from the sweeping physical impacts of stress, including increased cardiovascular risk and weakened immune systems. A dirty bomb will likely produce a global cry for dramatic retaliation against known terrorist havens, and heads of state will find it hard to resist. Short of the disastrous physical harm of a nuclear weapon itself, it's hard to imagine a terrorist attack that could do more damage.

So what are governments doing to protect us? They're doing a great deal to keep such a device from going off in the first place. And thank goodness those efforts have been successful, so far. But compared to the hundreds of millions of dollars being spent to prevent such an attack, practically nothing is being done to proactively defuse the fear a dirty bomb would produce. There are no attempts to put the actual danger of nuclear radiation in perspective for the public or the news media.

The US Nuclear Regulatory Commission (NRC) and Centers for Disease Control (CDC) have websites about radiological emergencies. (The EPA, which has significant authority over the public and environmental health effects of radiological emergencies, has practically nothing on its site about such events.) The CDC site is mostly about what to do and how to decontaminate yourself, with little about how low the risk is. The NRC states

Just because a person is near a radioactive source for a short time or gets a small amount of radioactive dust on himself or herself does not mean he or she will get cancer. Any additional risk will likely be extremely small.

But posting information on a bureaucracy's web site is hardly proactive public outreach. Much more should be done. A coordinated, persistent, multi-faceted, multi-agency communication campaign should be conducted to reach the public with this information. A key part of this outreach should be the news media, so they understand in advance the actual threat of radiation should a dirty bomb be used. An information campaign could partner with a wide range of sources more trusted than the government; scientific, health, and medical authorities and organizations, local officials, well-known figures on social media and in popular culture, even faith leaders concerned about public well-being. The information could be embedded in the story lines of movies and TV shows that often feature terrorist attacks in their plots. And yes, this information could be presented simply, clearly, without the technical or bureaucratic language or scientific nuance that so often interferes with effective risk communication.

Would such a campaign totally dispel the excessive fear of nuclear radiation? Of course not. The roots of that fear run far too deep to dig up entirely. But a carefully researched and carefully designed risk communication campaign could help diminish that fear, and take at least some of the power of a dirty bomb to terrorize us out of the hands of terrorists. Governments that are working hard to protect us from such attacks must also take this important step. And soon.

http://bit.ly/1n7OVfs

The science behind facepalming: Why you make breathtakingly stupid mistakes

New research suggests there are three distinct types of action that bring palm to face

David Z. Hambrick, Scientific American

We all make stupid mistakes from time to time. History is replete with examples. Legend has it that the Trojans accepted the Greek's "gift" of a huge wooden horse, which turned out to be hollow and filled with a crack team of Greek commandos. The Tower of Pisa started to lean even before construction was finished—and is not even the world's farthest leaning tower. NASA taped over the original recordings of the moon landing, and operatives for Richard Nixon's re-election committee were caught breaking into a Watergate office, setting in motion the greatest political scandal in U.S. history. More recently, the French government spent $15 billion on a fleet of new trains, only to discover that they were too wide for some 1,300 station platforms.

We readily recognize these incidents as stupid mistakes—epic blunders. On a more mundane level, we invest in get-rich-quick schemes, drive too fast, and make posts on social media that we later regret. But what, exactly, drives our perception of these actions as stupid mistakes, as opposed to bad luck? Their seeming mindlessness? The severity of the consequences? The responsibility of the people involved? Science can help us answer these questions.

In a study just published in the journal *Intelligence*, using search terms such as "stupid thing to do", Balazs Aczel and his colleagues compiled a collection of stories describing stupid mistakes from sources such as*The Huffington Post* and *TMZ*. One story described a thief who broke into a house and stole a TV and later returned for the remote; another described burglars who intended to steal cell phones but instead stole GPS tracking devices that were turned on and gave police their exact location. The researchers then had a sample of university students rate

each story on the responsibility of the people involved, the influence of the situation, the seriousness of the consequences, and other factors.

Analyses of the subjects' ratings revealed three varieties of stupid mistakes. The first is when a person's confidence outstrips their skill, as when a Pittsburgh man robbed two banks in broad daylight without wearing a disguise, believing that lemon juice he had rubbed on his face would make him invisible to security cameras. Or, in what is widely regarded as one of the top mascot failures in history, when Wild Wing of the Anaheim Ducks caught himself on fire attempting to leap over a burning wall (cheerleaders pulled him from the flames and he returned to action later in the game, unhurt). "This story of Duck a l'Orange County is no canard. A duck could get fired for this, or at least demoted to the Rotisserie League," the *New York Times* reported.

The confidence-skill disconnect has been dubbed the Dunning-Kruger effect, after a study by social psychologists David Dunning and Justin Kruger. Dunning and Kruger had Cornell undergraduates perform tests of humor, logic, and grammar, and then rate how well they think they performed compared to other subjects in the study. The worst performing subjects, whose scores put them in the 12th percentile, estimated that they had performed in the 62nd percentile. Summarizing the findings, Dunning noted, "Poor performers—and we are all poor performers at some things—fail to see the flaws in their thinking or the answers they lack." When we think we are at our best is sometimes when we are at our objective worst.

As any number of political scandals illustrate, the second type of stupid mistake involves impulsive acts—when our behavior seems out of control. In the scandal that became known as Weinergate, former U.S. representative Anthony Weiner sent lewd texts and pictures of himself to women he met on Facebook. (After resigning, Weiner continued his cyber-dalliances under the nom de plume Carlos Danger, and then fell prey to the Dunning-Kruger effect when he overestimated his support in the 2013 New York City mayoral primary; he received 5% of the vote.) More recently, in Michigan, state representative Todd Courser, a Tea Party conservative, admitted to sending an anonymous email to Republican Party operatives and members of the media falsely claiming that he had been caught having sex with a male prostitute, with the aim of making expected revelations that he had an affair with fellow representative Cindy Gamrat seem like part of a smear campaign. In anaudio recording of a conversation secretly made by a staff member, Courser described his self-smear strategy as a "controlled burn of me" designed to "inoculate the herd" against the as-yet-unmade allegations.

The final variety of stupid mistake involves lapses of attention—Homer Simpsonesque D'oh moments. As arguably the best example from American sports history, in the 1929 Rose Bowl, University of California star Roy Riegels recovered a fumble and returned it 65 yards the wrong way. Riegel's blunder set up a safety for Georgia Tech, which turned out to be the deciding factor in the game. Minnesota Viking Jim Marshall, a two-time pro-bowler and team captain, duplicated the feat in a 1964 game against the San Francisco 49ers, prompting Vikings coach Norm Van Brocklin to remark after the game, "Jim, you did the most interesting thing in this game today." Aczel and colleagues' analyses revealed that subjects viewed this category of stupid mistake as the least stupid.

It is, of course, unrealistic to think that we could ever eliminate human error. To err will always be human. However, this research gives us a better description of our failings and foibles, and a place to start in thinking about interventions and prescriptions to help us err less. This research also reminds us of our shared human frailties. We are all prone to overestimating our abilities, to making impulsive decisions, and to lapses of attention. This simple realization makes stupid mistakes seem, perhaps, a little less stupid — and a little more human.

http://www.eurekalert.org/pub_releases/2016-02/mc-kma022416.php

Keeping mind active may delay Alzheimer's symptoms, but not underlying disease

Keeping the mind active may delay symptoms of Alzheimer's disease; however, the activity does not change the underlying disease in the brain for most people

ROCHESTER, Minn. -- Keeping the mind active may delay symptoms of Alzheimer's disease; however, the activity does not change the underlying disease in the brain for most people, according to a study published today in the online edition of *Neurology*, the medical journal of the American Academy of Neurology.

For people who are carriers of a gene linked to Alzheimer's, the findings differed. People with a gene called APOE4, who had at least 14 years of education and kept mentally active in middle age had lower levels of proteins called amyloid plaques. The proteins can build up in brain tissue and lead to Alzheimer's disease. People with the gene and a high level of education but did not keep mentally active in middle age had higher levels of amyloid plaques.

"When we looked specifically at the level of lifetime learning, we found that carriers of the APOE4 gene who had higher education and continued to learn through middle age had fewer amyloid deposition on imaging when compared to those who did not continue with intellectual activity in middle age," says study author Prashanthi Vemuri, Ph.D., a Mayo Clinic dementia researcher.

Dr. Vemuri said the overall findings for people who do not carry the gene should not discourage people from exercising and taking part in activities, such as reading books and magazines, playing games and using computers. "The

takeaway message for the general public is that keeping your mind active is very important in delaying symptoms of Alzheimer's disease," says Dr. Vemuri.

For the study, researchers evaluated 393 people without dementia who were part of the Mayo Clinic Study of Aging. Of those, 53 had mild cognitive impairment. All were 70 or older. They were divided into two groups: those with more than 14 years of education and those with less. Then, researchers used MRI and positron emission tomography scans to look for biomarkers of Alzheimer's disease and questionnaires to evaluate weekly intellectual and physical activity in middle age.

The study was supported by the National Institutes of Health.

http://bit.ly/1oHoDlm

Gentler attack on cancer may mean we can live with it for longer

Can we lull cancer into a false sense of security?

Instead of trying to wipe out cancer, an evolutionary principle might help us to live with it. A less aggressive line of attack might actually be more effective at stopping the disease from progressing than our current "kill all" approach.

Standard cancer treatment involves giving people high doses of chemotherapy in an attempt to eradicate their cancer cells. Often this leaves behind a population of cells that are resistant to treatment. These cells go on to multiply aggressively and spread to other organs.

The person can be put on a different type of chemotherapy only for the same thing to happen, sometimes repeatedly.

Robert Gatenby at Moffitt Cancer Center in Tampa, Florida, believes he has a better strategy: keep some treatment-responsive cells alive so they compete with the resistant cells and stop them from taking over. The premise is based on the idea that acquiring resistance genes must come at a cost to the cell and make them weaker in other ways.

"The goal is to enhance the value of therapy by using evolution in our favour rather than letting it beat us," he says.

As a result, any non-resistant cells that aren't killed off should be able to outcompete the resistant but weakened cells in check, by dominating the available resources.

Adaptive treatment

His team has developed an algorithm that adjusts the chemotherapy dose in line with the size of the tumour. The idea is to blast the tumour with a high dose when it's growing rapidly, then reduce the dose as the tumour shrinks.

In mice with the equivalent of breast cancer, standard therapy was successful at suppressing tumour growth for 10 to 20 days, but after that the tumour grew rapidly. The evolutionary approach, known as "adaptive treatment", kept tumours small for much longer, and after the initial 20 days only low doses were needed to prevent the tumours growing larger.

The mice on the adaptive therapy were observed for 155 days and during that period, therapy was stopped completely for 60 per cent of the animals, without the cancer progressing.

We have to move past the intuitively appealing idea of killing as many cancer cells as possible, says Gatenby. "When you do these high-dose therapies, which make patients very sick, there's an implied promise that we're taking our best shot at curing the cancer".

His team has already begun a clinical trial testing the strategy in men with metastatic prostate cancer who have stopped responding to the first line treatment. Rather than scaling the dose of the new drug with the size of the tumour, they are using levels of prostate specific antigen (PSA) in the blood, a disease marker, to determine when they need to give treatment and how much.

Long game

"Our goal is to keep playing this game with the tumour to keep it sensitive, and as long as we do that the patient is alive and fine. Then they can have prolonged periods of time when they're not getting any therapy at all."

While the approach could be used on cancer at any stage of progression, it may be a more humane way of treating advanced cancers when aggressive treatment wouldcause a lot of discomfort, without much hope of remission. "We want to keep the patients alive and comfortable for as long as possible. Our goal of eradicating all the cancer has to change," says Gatenby.

Mel Greaves at the Institute of Cancer Research in London says scientists are increasingly thinking of treatment of cancer as a Darwinian process. "It's like antibiotic resistance," he says. "If you apply very aggressive therapy, there's a very strong selective pressure for the emergence of these mutants. You just clear the space and hey presto, they have the opportunity to take off. So unfortunately aggressive treatment does the opposite of what you want."

But translating the approach to the clinic could be a challenge. "Are you going to persuade oncologists to adopt this treatment rather than more aggressive treatment? I don't know," he says.

Whether or not this particular approach is successful, Gatenby thinks applying evolutionary principles in medicine will prove useful in a range of diseases besides cancer. "You're going to see it more and more in antibiotic therapy; I know it's a topic of great interest in worldwide management of common diseases like malaria, tuberculosis and HPV," he says.

Journal reference: Science Translational Medicine, *DOI:* *10.1126/scitranslmed.aad7842*

http://bit.ly/1KUKTCQ

Pancreatic cancer: Major breakthrough in our understanding of the mechanisms of the disease

Door opens to a better understanding of the molecular mechanisms that cause this cancer to develop

Montreal - Pancreatic cancer carries a very bleak prognosis for patients. However, a recent breakthrough by two research teams, including one at the Hôpital Maisonneuve-Rosemont (CIUSSS-EST, Montreal) and University of Montreal, has opened the door to a better understanding of the molecular mechanisms that cause this cancer to develop.

This biomedical research conducted jointly by the groups of Dr. Frédérick Antoine Mallette (Université de Montréal / Centre de Recherche HMR) and Dr. Stéphane Richard (McGill University / Lady Davis Institute for Medical Research) and that was published in *Cell Reports* has shown that pancreatic tumours often lose the ability to express a small ribonucleic acid molecule called miR-137.

This molecule induces a defence mechanism called cellular senescence, which keeps cancer cells in check. The loss of miR-137 works in conjunction with various mutations frequently observed in pancreatic tumours to trigger uncontrolled cell growth and then cancer.

"It is essential that we better understand the mechanisms that lead to the loss of miR-137 expression. Once we do, we can create therapeutic strategies to treat and prevent pancreatic cancer," said Dr. Frédérick Antoine Mallette.

This joint research study by doctoral student Mathieu Neault has also demonstrated that restoring normal miR-137 levels in pancreatic cancer cells has a protective effect, as doing so induces senescence and stops the cells from spreading.

A relentless cancer

In 2015, approximately 4800 people received a diagnosis of pancreatic cancer, and nearly 4600 Canadians succumbed to this terrifying disease.

Although this cancer is the 12th highest in terms of incidence, it is 4th highest in cancer-related mortality.

Survival rates for pancreatic cancer haven't improved in the past 40 years. This is why we urgently need to clarify the mechanisms of this cancer to find new therapeutic avenues that will change these grim statistics.

This study was made possible through funding from the Canadian Institutes of Health Research and the Fonds de recherche du Québec - Santé.

http://www.eurekalert.org/pub_releases/2016-02/aaft-aee022216.php

Antibodies eliminate Ebola symptoms 5 days after infection

One of two antibodies from an Ebola survivor was so effective that nonhuman primates treated 5 days after infection experienced nearly complete protection

Researchers have harvested two antibodies from a survivor of a 1995 Ebola outbreak, one of which was so effective at subduing the virus that nonhuman primates given the treatment five days after infection experienced nearly complete protection. While several different cocktails of antibodies that target the Ebola virus are currently being tested, Davide Corti et al. sought to find a single or dual-combination agent that could result in a simpler, yet effective treatment. Monoclonal antibodies harvested from an Ebola survivor 11 years after the 1995 Kikwit outbreak showed potent neutralizing activity against the virus, indicating that the survivor's immune system had maintained its memory of the virus for more than a decade following infection. Three of these monoclonal antibodies demonstrated 25% higher binding capability to the Ebola virus than a component of the ZMapp cocktails of antibodies, which is currently being tested in humans. Corti and his team focused on the two most potent, mAb100 and mAb114. Upon treating macaques with the dual combination twice every 24 hours, beginning one day after infection with Ebola, the group did not experience any Ebola symptoms. Tests of mAb114 alone administered five days after infection showed similar results, suggesting that this antibody could serve as a potent therapeutic for those who contract Ebola, even in relatively late stages.

A second study by Misasi et al. depicts the structure of these two monoclonal antibodies and how they interact with the virus. The results could help facilitate development of therapies and vaccines. Both antibodies work by targeting the glycoprotein (GP), a protein on the surface of the Ebola virus that helps it bind to the membrane of host cells, but the two antibodies target different regions of this protein. The researchers' analysis of these crystallized structures reveals that mAb100 binds to the base of GP, similar to how a commonly tested baseline antibody, KZ52, binds; however, the component of mAb100 that binds to GP is more rotated, and thus can "latch" on to three different units of the protein, as opposed to the single unit to which KZ52 binds. Previous studies have shown that a certain protein loop on the GP must be cleaved in order for the virus to enter a host cell, and results by Misasi et al. show that mAb100 interferes with this cleaving. Analysis of mAb114 shows that this monoclonal antibody works by blocking a key receptor of the virus after the loop has been cleaved. The data suggest that mAb114 is more effective than an antibody used in the ZMapp cocktail - despite targeting the same region of the GP - because it remains bound to the GP after the loop has been cleaved. These results shed more light on why

mAB100 and mAb114 are such potent antibodies against Ebola, and may pave the way to therapies to fight the life-threatening virus.

http://www.eurekalert.org/pub_releases/2016-02/wtsi-gr5022316.php

Genetics reveal 50,000 years of independent history of aboriginal Australian people

Scientists worked with aboriginal Australian communities to explore heritage

The first complete sequences of the Y chromosomes of Aboriginal Australian men have revealed a deep indigenous genetic history tracing all the way back to the initial settlement of the continent 50 thousand years ago, according to a study published in the journal *Current Biology* today (25th February 2016).

The study by researchers from the Wellcome Trust Sanger Institute and collaborators at La Trobe University in Melbourne and several other Australian institutes, challenges a previous theory that suggested an influx of people from India into Australia around 4-5 thousand years ago. This new DNA sequencing study focused on the Y chromosome, which is transmitted only from father to son, and found no support for such a prehistoric migration. The results instead show a long and independent genetic history in Australia.

Modern humans arrived in Australia about 50 thousand years ago, forming the ancestors of present-day Aboriginal Australians. They were amongst the earliest settlers outside Africa. They arrived in an ancient continent made up of today's Australia, Tasmania and New Guinea, called Sahul, probably thousands of years before modern humans arrived in Europe.

Five thousand years ago, dingos, the native dogs, somehow arrived in Australia, and changes in stone tool use and language around the same time raised the question of whether there were also associated genetic changes in the Australian Aboriginal population. At least two previous genetic studies, one of which was based on the Y chromosome, had proposed that these changes could have coincided with mixing of Aboriginal and Indian populations about 5 thousand years ago.

Anders Bergstrom, first author on the paper at the Wellcome Trust Sanger Institute, said: "We worked closely with Aboriginal Australian communities to sequence the Y chromosome DNA from 13 male volunteers to investigate their ancestry. The data show that Aboriginal Australian Y chromosomes are very distinct from Indian ones. These results refute the previous Y chromosome study, thus excluding this part of the puzzle as providing evidence for a prehistoric migration from India. Instead, the results are in agreement with the archaeological record about when people arrived in this part of the world."

Dr John Mitchell, Associate Professor at La Trobe University in Melbourne, explained: "Clearly there is keen interest in the Aboriginal community to explore their genetic ancestry and without them this study would not be possible - our first step was to return their results to them, before the scientific article was published. This collaboration in genome sequencing, to explore their ancient history, was made possible by years of engagement beforehand with Aboriginal communities."

Further study is needed to answer questions such as how the dingo did get to Australia and why other people such as the seafaring Polynesians didn't settle on the continent. Expanding the genetic analyses beyond the Y chromosome and to the whole genome will also be necessary to completely rule out external genetic influences on the Aboriginal Australian population before the very recent times.

Lesley Williams, who was responsible for the liaison with the Aboriginal community, said: "As an Aboriginal Elder and cultural consultant for this project I am delighted, although not surprised, that science has confirmed what our ancestors have taught us over many generations, that we have lived here since the Dreaming."

Dr Chris Tyler Smith, group leader at the Wellcome Trust Sanger Institute added: "By fully sequencing and analysing Y-chromosomal DNA, we have been able to trace ancient human migrations and inform living people about their ancestry. We are using the latest technology to genetically unearth our ancient history - something that has only become possible in the last decade. We look forward to further collaborations to understand more of this unique heritage."

http://www.eurekalert.org/pub_releases/2016-02/ku-gme022516.php

Genetically modified E. coli pump out morphine precursor

Bacteria engineered in Japan yield 300 times more opiates than yeast

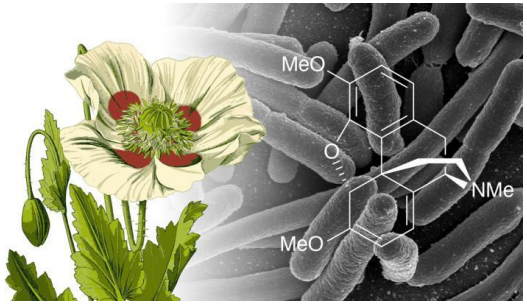
Kyoto, Japan - A common gut microbe could soon be offering us pain relief. Japanese bioengineers have tweaked *Escherichia coli* genes so that they pump out thebaine, a morphine precursor that can be modified to make painkillers. The genetically modified *E. coli* produces 300 times more thebaine with minimal risk of unregulated use compared to a recently developed method involving yeast.

"Morphine has a complex molecular structure; because of this, the production of morphine and similar painkillers is expensive and time-consuming," said study author Fumihiko Sato of Kyoto University. "But with our *E. coli*, we were able to yield 2.1 miligrams of thebaine in a matter of days from roughly 20 grams of sugar, as opposed to 0.0064 mg with yeast."

Morphine is extracted from poppy sap in a process that results in opiates such as thebaine and codeine. Other synthetic biologists have recently engineered the yeast genome so that it produces opiate alkaloids from sugar. There were ethical concerns, however, including a risk that the pain-killing molecules could be

produced easily and unregulated, provided that one has access to the necessary yeast strain.

With *E. coli*, Sato says that such production risk is insignificant.



"Four strains of genetically modified *E. coli* are necessary to turn sugar into thebaine," explains Sato. "*E. coli* are more difficult to manage and require expertise in handling. This should serve as a deterrent to unregulated production."

Japanese bioengineers have tweaked Escherichia coli genes so that they pump out thebaine, a morphine precursor that can be modified to make painkillers. The genetically modified E. coli produces 300 times more thebaine with minimal risk of unregulated use compared to a recently developed method involving yeast. **Eiri Ono/Kyoto University**

In 2011, Sato and colleagues engineered *E. coli* to synthesize reticuline, another morphine precursor that appears earlier in the transformation process than thebaine. In the new system, the team added genes from other bacteria and enzyme genes from opium poppies, *Coptis japonica*, and *Arabidopsis*. The team credits the strong activity of enzymes in the new system for their success in making thebaine, and hopes to achieve further improvements.

"By adding another two genes, our *E. coli* were able to produce hydrocodone, which would certainly boost the practicality of this technique," Sato said. "With a few more improvements to the technique and clearance of pharmaceutical regulations, manufacturing morphine-like painkillers from microbes could soon be a reality."

The paper "Total biosynthesis of opiates by stepwise fermentation using engineered Escherichia coli" appeared 5 February 2016 in Nature Communications, with doi: 10.1038/ncomms10390

http://www.medscape.com/viewarticle/859055

The Verdict on Statins and Dementia Prevention?

This is the Medscape Psychiatry Minute. I'm Dr Peter Yellowlees.

Peter M. Yellowlees, MBBS, MD

Vascular risk factors, including high cholesterol levels, increase the risk for dementia due to Alzheimer disease and vascular dementia. Some observational studies have suggested an association between statin use and lowered incidence of dementia.

Now, a team of investigators[1] from Queens University, Belfast, has used standard Cochrane methodology to evaluate the efficacy and safety of statins for the prevention of dementia in people at risk for dementia owing to their age. This third Cochrane review of the topic included two new trials with 26,340 participants aged 40 to 82 years of whom 11,610 were aged 70 or older. The researchers found that there is good evidence that statins do not prevent cognitive decline or dementia when given to people in late life who are at risk for vascular disease.

From a clinical perspective, many physicians themselves—because of the widespread belief that logically, they should be effective—used to take statins in part to possibly delay cognitive decline. We can now unequivocally advise our patients, and our colleagues, that statins are not effective in preventing dementia and that they should be taken only for known cardiovascular or metabolic indications.

Thank you for listening to this Medscape Psychiatry Minute. Do enjoy your practice.

References*McGuinness B, Craig D, Bullock R, Passmore P. Statins for the prevention of dementia. Cochrane Database Syst Rev. 2016;1:CD003160.*

http://bit.ly/1KUWzFD

First life may have been forged in icy seas on a freezing Earth

Did life begin in the freezer? Early Earth may not have been as hot and hellish as we thought. In fact, it may have become a snowball around the time life first emerged.

This is according to a fresh analysis of rocks from South Africa that formed about 3.5 billion years ago, during the Archaean period. Previous research suggested that the ocean in which these rocks formed was warm – perhaps around 85°C.

But Maarten de Wit at the Nelson Mandela Metropolitan University in Port Elizabeth, South Africa, now says the ocean temperature was similar to today's – and that there is even evidence that ice was present.

Because South Africa's Barberton Greenstone Belt, where these rocks are now found, formed at a latitude of 20° to 40°, this implies that Earth may have become engulfed in ice at least once during the Archaean, he says.

Rocky balance

The temperature of oceans in which ancient rocks formed is reconstructed by measuring the balance of oxygen isotopes inside the rocks.

Some of these reconstructions have found that temperatures were high when the belt formed. But de Wit says that's because the isotopes they looked at had been subject to extensive hydrothermal activity – as there are remains of ancient hydrothermal vents in the rocks. This means the isotope evidence doesn't tell us about the temperature of the ocean water, he says.

So de Wit and Harald Furnes at the University of Bergen, Norway, looked at rocks formed out of ocean sediments that hadn't been exposed to hydrothermal activity. They found evidence that a mineral called gypsum was able to grow. "Such minerals only grow today in deep-sea environments where there is cold water," says de Wit.

The pair also looked at slightly younger rocks in the belt that formed in shallow oceans or even above sea level. In these rocks, de Wit and Furnes found finely banded siltstones with occasional pebbles embedded within them.

These rocks are similar to "varve" sequences that form in the still waters below an ice-covered ocean, they say – with the larger pebbles resembling dropstones that fell from the bottom of icebergs.

Glacial doubters

But not everyone is convinced by the new evidence.

Paul Knauth at Arizona State University in Tempe, who has argued in favour of warm ancient oceans, says experiments show that gypsum can actually grow well in water that is at 80°C.

De Wit counters that gypsum will only grow at such warm temperatures in very shallow oceanic environments where water is evaporating. "The difference is that we can show these gypsum crystals grew in deep ocean water, 2 to 4 kilometres deep," he says.

Don Lowe at Stanford University in California, meanwhile, says his team's extensive studies in the area have found no evidence of glaciation but he doesn't entirely dismiss the idea that ice may have been present.

"We will definitely revisit and re-examine the outcrops yet again in order to evaluate the hypotheses presented in this paper," he says.

De Wit and Furnes's ideas aren't completely out of step with geological thinking. Ruth Blake at Yale University says her oxygen isotope research also suggests water temperatures in the area were relatively cool in the Archaean, and similar to those of modern tropical oceans.

Life's cold birth?

If there was glaciation at this time, it may have implications for the origin of life. This is because some research suggests life might actually have emerged in frozen water.

"Key organic compounds thought to be important in the origin of life are more stable at lower temperatures," says Jeffrey Bada at the University of California at San Diego. He adds that organic molecules considered key to the origin of life – that might have been present in tiny quantities in the early ocean water – could become more concentrated in ice.

James Attwater and Philipp Holliger at the MRC Laboratory of Molecular Biology in Cambridge, UK, have also explored the possibility that ice was important early in the history of life.

One idea for the origins of life suggests that the very first replicators from which life evolved were RNA molecules, in what is called an RNA world.

"Studies from our laboratory and others have shown how frozen conditions could benefit the emergence of an RNA world," says Holliger. Ice enhances the synthesis of some important molecules, and it slows the breakdown of fragile molecules once they do form.

Alternatively, life could have still formed in hot conditions, around hydrothermal vents within those cold waters. There's no obvious way to work out which of the competing ideas is correct.

But the new research does, at least, suggest that some of the world's most ancient rocks still have secrets to reveal. "The Barberton Mountains are a beautiful but tough terrain and it does not easily reveal its treasured memories of the deep past," says de Wit. "You have to really drag it out of them."

Journal reference: Science Advances, *DOI:* *10.1126/sciadv.1500368*

http://nyti.ms/1ReH5cf

Report Cites Dangers of Autonomous Weapons

Such weapons could be uncontrollable in real-world environments

By JOHN MARKOFF FEB. 28, 2016

A new report written by a former Pentagon official who helped establish United States policy on autonomous weapons argues that such weapons could be uncontrollable in real-world environments where they are subject to design failure as well as hacking, spoofing and manipulation by adversaries.

In recent years, low-cost sensors and new artificial intelligence technologies have made it increasingly practical to design weapons systems that make killing decisions without human intervention. The specter of so-called killer robots has touched off an international protest movement and a debate within the United Nations about limiting the development and deployment of such systems.

The new report was written by Paul Scharre, who directs a program on the future of warfare at the Center for a New American Security, a policy research group in Washington, D.C. From 2008 to 2013, Mr. Scharre worked in the office of the Secretary of Defense, where he helped establish United States policy on unmanned and autonomous weapons. He was one of the authors of a 2012 Defense Department directive that set military policy on the use of such systems.

In the report, titled "Autonomous Weapons and Operational Risk," set to be published on Monday, Mr. Scharre warns about a range of real-world risks associated with weapons systems that are completely autonomous.

The report contrasts these completely automated systems, which have the ability to target and kill without human intervention, to weapons that keep humans "in the loop" in the process of selecting and engaging targets.

Mr. Scharre, who served as an Army Ranger in Iraq and Afghanistan, focuses on the potential types of failures that might occur in completely automated systems, as opposed to the way such weapons are intended to work.

To underscore the military consequences of technological failures, the report enumerates a history of the types of failures that have occurred in military and commercial systems that are highly automated.

A new report says eight new F-22 fighter jets like these experienced total computer failure when crossing the international date line. **Kim Hong-Ji/Reuters**

"Anyone who has ever been frustrated with an automated telephone call support helpline, an alarm clock mistakenly set to 'p.m.' instead of 'a.m.,' or any of the countless frustrations that come with interacting with computers, has experienced the problem of 'brittleness' that plagues automated systems," Mr. Scharre writes.

His underlying point is that autonomous weapons systems will inevitably lack the flexibility that humans have to adapt to novel circumstances and that as a result killing machines will make mistakes that humans would presumably avoid.

Completely autonomous weapons are beginning to appear in military arsenals. For example, South Korea has deployed an automated sentry gun along the demilitarized zone with North Korea, and Israel operates a drone aircraft that will attack enemy radar systems when they are detected.

The United States military does not have advanced autonomous weapons in its arsenal. However, this year the Defense Department requested almost $1 billion to manufacture Lockheed Martin's Long Range Anti-Ship Missile, which is described as a "semiautonomous" weapon by the definitions established by the Pentagon's 2012 memorandum.

The missile is controversial because, although a human operator will initially select a target, it is designed to fly for several hundred miles while out of contact with the controller and then automatically identify and attack an enemy ship.

The Center for a New American Security report focuses on a range of unexpected behavior in highly computerized systems like system failures and bugs, as well as unanticipated interactions with the environment.

"On their first deployment to the Pacific, eight F-22 fighter jets experienced a Y2K-like total computer failure when crossing the international date line," the report states. "All onboard computer systems shut down, and the result was nearly a catastrophic loss of the aircraft. While the existence of the international date line could clearly be anticipated, the interaction of the date line with the software was not identified in testing."

The lack of transparency in artificial intelligence technologies that are associated with most recent advances in machine vision and speech recognition systems is also cited as a source of potential catastrophic failures.

As an alternative to completely autonomous weapons, the report advocates what it describes as "Centaur Warfighting." The term "centaur" has recently come to describe systems that tightly integrate humans and computers. In chess today, teams that combine human experts with artificial intelligence programs dominate in competitions against teams that use only artificial intelligence.

However, in a telephone interview Mr. Scharre acknowledged that simply having a human push the buttons in a weapons system is not enough.

"Having a person in the loop is not enough," he said. "They can't be just a cog in the loop. The human has to be actively engaged."

Correction: February 28, 2016

An earlier version of this article misstated the year that the Defense Department issued its directive on the use of unmanned and autonomous weapons. It was 2012, not 2013.