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Automated Virtual Reality (VR) Treatments for Mental Health Disorders

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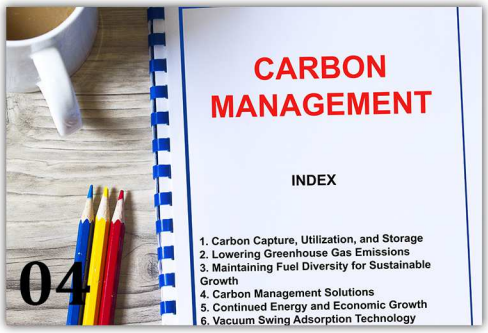

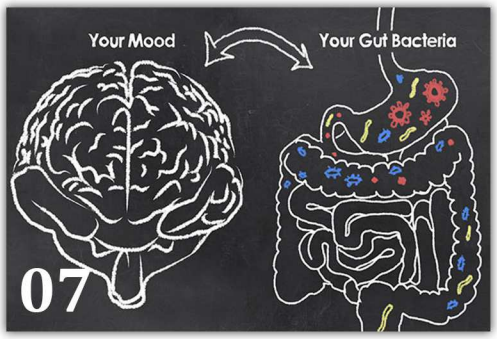

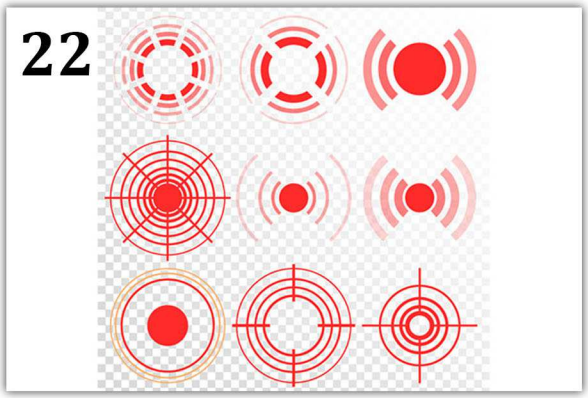

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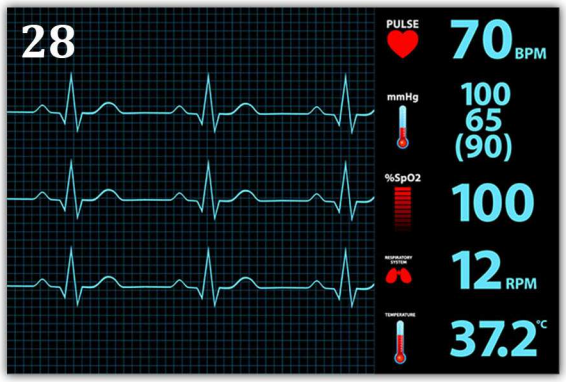

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NOTE FROM EDITOR-IN-CHIEF

We are delighted to bring to you nine articles on recent interesting and innovative scientific findings which have the potential to affect mankind including relief from neuropathy, new approach for carbon capture, virtual reality treatment for acrophobia, temperature-sensitive unique textile fabric and many more.

Hope you enjoy reading them!

Umesh Prasad

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Does Regular *Breakfast Eating Really* Help Reduce Body Weight?

A review of previous trials shows that eating or skipping breakfast may not have any impact on a person's health

Breakfast is well believed to be the "most important meal of the day" and time and again health advice recommends that breakfast should not be skipped for maintaining good health. Breakfast is believed to boost our metabolism and if we skip the morning meal, it can make us hungrier later in the day which can persuade us to overeat, and most of the time unhealthy calories. This can lead to unwanted weight gain. Some health experts argue that this theory could be one of the many myths related to diet which has been conditioned into our brains by previous generations. The exact health benefits of breakfast is a continuous debate for which no accurate answers have been found as yet.

A review of previous studies on benefits of breakfast

In a new systematic review published in *British Medical Journal*, researchers from Monash University, Melbourne have analysed breakfast data collected from previous 13 randomized controlled trials carried out in last several decades to make their assessment and come to a well-weighed conclusion. These trials had either looked at weight changes (gain or loss) and/or total daily

calorie or energy intake by a participant. The participants in all these previous studies were mostly obese people from UK and USA. It was seen that individuals who consumed breakfast ate more calories throughout the day (average of 260 calories more) and thus their average weight gain was 0.44 kg more than the people who skipped their first meal. This is a surprise find as earlier studies have shown the complete opposite, i.e. skipping breakfast makes people feel hungrier later in the day due to the hunger hormones and this can make people consume more food as they would try to compensate for the loss of energy intake in the morning.

These 13 studies collectively suggest that, firstly, eating breakfast is not an assured way to lose weight and secondly, skipping this first meal of the day may not be linked to weight gain either. Surprisingly, the studies conclude that eating or skipping breakfast makes no difference to ether weight gain or loss. Only one particular study found that skipping breakfast can lead to more calorie burn and this can cause higher levels of inflammation in the body which can affect one's health.

These previous studies provide suitable quality of evidences though they have limitations and several bias as they were conducted over an extremely short period of time. One of them was only a 24-hour study and the longest was also only 16 weeks. These durations may not be enough to arrive to generalized conclusions. Around one third of people in developing countries skip breakfast almost on a regular basis. People who tend to skip breakfast are likely to be poor, less healthy and they would have an overall poor diet which

could be responsible for their weight gain or loss.

Breakfast is recommended for many health benefits especially in children for better concentration, attentiveness and wellbeing in their growing years. The breakfast debate continues and higher quality studies which last for at least six months to one year could provide a better understanding of the long-term effects of role of breakfast in weight management. Healthy diet and exercise are important for overall health and nutritional requirements can vary for individuals.

Source

Sievert K et al. 2019, 'Effect of breakfast on weight and energy intake: systematic review and meta-analysis of randomised controlled trials', *British Medical Journal*, Vol. 364, DOI: https://doi.org/10.1136/bmj.l42

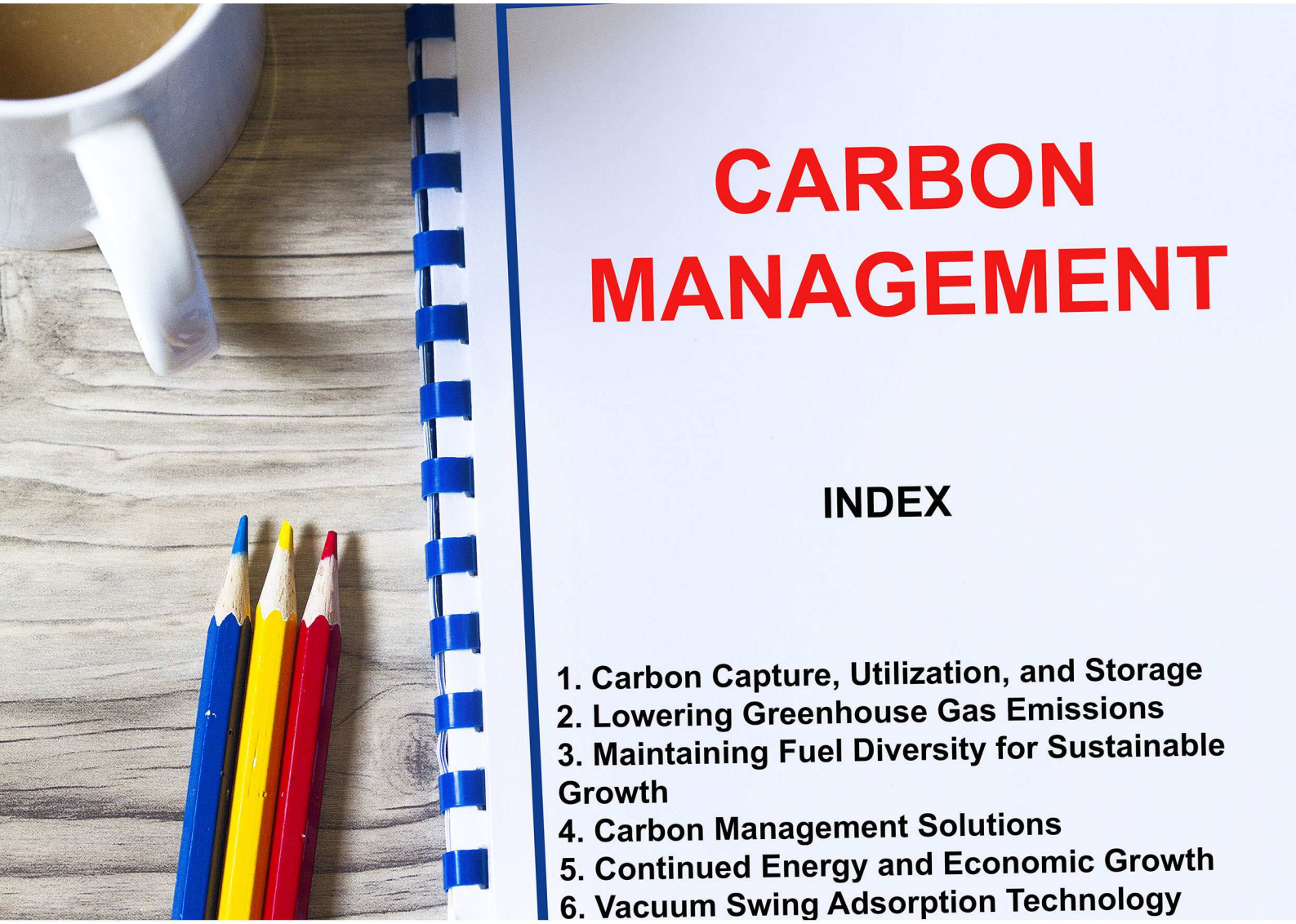
Carbon Capture Based *on Crystallization of* Bicarbonate-water Clusters: *A Promising Approach to* Control Global Warming

A new carbon capture method has been devised to capture carbon dioxide from fossil-fuel emissions

Greenhouse emissions are the biggest contributor towards climate change. Emissions of critical greenhouse gases is a result of large-scale industrialization and human activity. Most of these greenhouse emissions are of carbon dioxide (CO2) from burning of fossil fuels. The total concentration of CO2 in the atmosphere has increased by more than 40 percent ever since the era of industrialization started. This steady increase in greenhouse emissions is warming the planet in what is termed as 'global warming' as computer simulations have shown that emissions are responsible for increase in the average surface temperature of earth over time indicating 'climate change' due to changes in rainfall patterns, storm severity, sea levels etc. Thus, developing suitable ways of 'trapping or capturing' carbon dioxide from emissions is a critical aspect of tackling climate change. Carbon capture technology has been around for decades but has recently acquired more focus due to environmental concerns.

A new carbon capture methodology

The standard procedure of carbon capture involves trapping and separating CO2 from a gaseous mixture, then transporting it to storage



and storing it remotely away from the atmosphere usually underground. This process is highly energy intensive, involves several technical issues, risks and limitations, for example, high probability of leakage at the storage site. A new study published in *Chem* describes a promising alternative for capturing carbon. Scientists at Department of Energy USA have developed a unique method to remove CO2 from coal-burning power plants and this process requires 24 percent less energy when compared to benchmarks which are currently deployed in the industry.

Researchers worked on naturally occurring organic compounds called bis-iminoguanidines (BIGs) which have the ability to bind to negatively charged anions as seen in previous studies. They thought that this particular property of BIGs should also be applicable to bicarbonate anions. So BIGs can act like a sorbent (a substance which collects other molecules) and convert CO2 into solid limestone (calcium carbonate). Soda lime is a mixture of calcium and sodium hydroxides used by scuba divers, submarines and other closed breathing environments to filter exhaled air and prevent any dangerous accumulation of CO2. The air can be then recycled multiple times. For example, rebreathers for scuba divers enables them to stay underwater for long time which is otherwise impossible.

A unique method that demands less energy

Based upon this understanding they developed a CO2 separation cycle which used an aqueous BIG solution. In this particular carbon-capture method they passed flue gas through the solution which caused CO2 molecules to bind to BIG sorbent and this binding would crystallize them into a solid type of organic limestone. When these solids were heated to 120 degrees Celsius, bound CO2 would be released which could then be stored. Since this process occurs at relatively lower temperatures compared to existing carbon-capture methods, the energy required for the process is reduced. And, solid sorbent could be be dissolved again in water and recycled for reuse.

Current carbon-capture technologies have many persistent issues like problem with storage, high energy cost etc. The primary issue is use of liquid sorbents which either evaporate or decompose over time and also require at least 60 percent of total energy for heating them which is very high. The solid sorbent in the current study overcame the energy limitation because CO2 is captured from a crystallized solid bicarbonate salt which required around 24 percent lesser energy. There was also no sorbent loss even after 10 consecutive cycles. This lower need for energy can bring down costs of carbon capture and when we consider billions of tons of CO2, this method can be very impactful by making greenhouse emissions null through adequate capture.

One limitation of this study is the relatively low CO2 capacity and absorption rate which is due to the limited solubility of BIG sorbent in water. Researchers are looking at combining traditional solvents like amino acids to these BIG sorbents to address this limitation. The current experiment has been done on a small scale in which 99 percent CO2 was removed from exhaust gases. The process needs to be further optimized so that it can be scaled up to capture at least a ton of CO2 every day and from any different types of emissions. The method must be robust in handling contaminations in emissions. The ultimate goal of a carbon capture technology would be to directly capture CO2 from the atmosphere by using an affordable and energy efficient method.

Source

Neil Williams et al. 2019, 'CO2 Capture via Crystalline Hydrogen-Bonded Bicarbonate Dimers', *Chem*, DOI: https://doi.org/10.1016/j.chempr.2018.12.025 ■

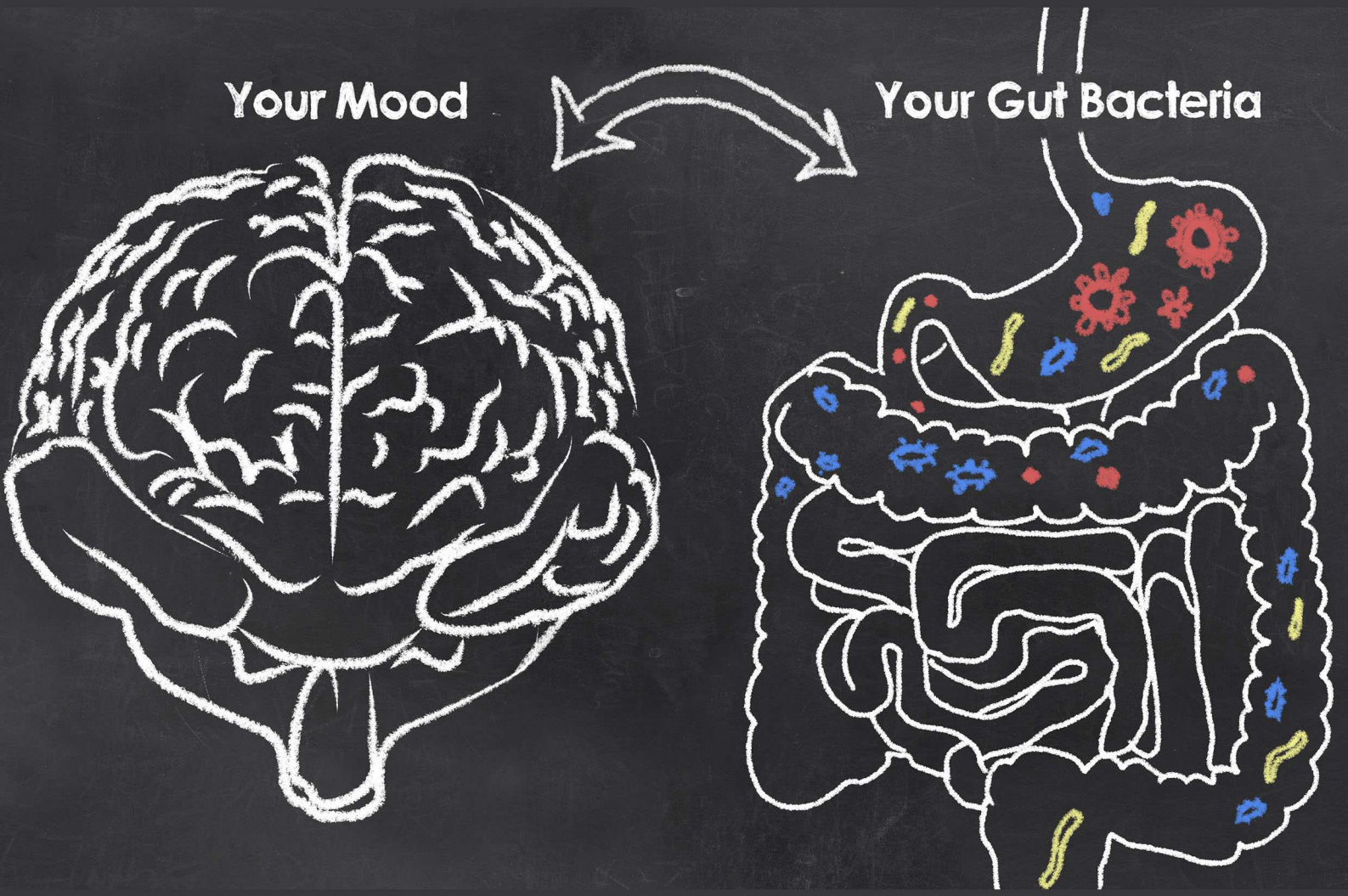
Influence of Gut *Bacteria on Depression* and Mental Health

Scientists have identified several groups of bacteria which varied along with depression and quality of life in humans

Our gastrointestinal (GI) track has a trillion of microorganisms. The microbes which reside in our gut perform important functions and are thought to influence our health by having an impact on diseases like obesity, diabetes and cancer. As researchers are now beginning to better understand this influence at the cellular and molecular level, it is being revealed that abnormal balance of gut bacteria can cause our immune system to overreact and contribute towards inflammation in the GI tract. This can lead to various illnesses throughout the body. In two recent studies[1,2], researchers have sequenced the DNA of more than 100 new species of gut microbes making it the most comprehensive list of human gut bacteria up till now. Such a list can be utilized for extensive research on effects of different gut bacteria on human health.

Finding the link between gut microbes and mental health

Research community is intrigued by the possible association of gut microbial metabolism and a person's mental health and wellbeing. It's interesting that microbial metabolites could interact with our brain and affect our feelings or behaviour by playing a role in neurological systems. This association has been studied in animal models but not sufficiently in humans. In a first every population study[3] published in *Nature Microbiology*, scientists aimed to unravel the exact nature of the relationship between gut bacteria found in human gastrointestinal tract and mental health by gathering evidences that gut bacteria can produce neuroactive compounds. They combined faecal microbiome data with general practitioner diagnose records of depression of around 1100 individuals who were part of the Flemish Gut Flora Project.


Your Mood
Your Gut Bacteria

Mental wellbeing was assessed using different ways including medical tests, doctor diagnoses and self-reporting by participants. By analysing this data, they identified the microorganisms which could have a potential positive or negative impact on mental health.

They showed that two bacterial groups Coprococcus and Dialister were seen to be in consistently low amounts in individuals suffering from depression, whether they were taking antidepressants as a treatment or not. And Faecalibacterium and Coprococcusbacteria were seen to be commonly present in individuals who had a higher quality of life and better mental health. The results were validated in two independent cohort studies, a first consisting of 1,063 individuals who were part of Dutch LifeLinesDEEP and second was a study of patients at University Hospitals Leuven, Belgium who were clinically diagnosed with depression. In one observation, microorganisms could produce DOPAC, a metabolite of human neurotransmitters like dopamine and serotonin which are known to communicate with brain and are linked to better mental health quality.

Computational analysis

A bioinformatics technique was designed which identified exact gut bacteria that interact with the human nervous system. Researchers utilized genomes of more than 500 bacteria in the microorganism's ability to produce neuroactive compounds in the human gut. This is a first comprehensive catalogue of neuroactivity in the gut which furthers our understanding about how gut microbes participate in producing, degrading or modifying molecules. Computational results will need testing to bolster the claims but they do expand our understanding of interactions between human microbiome and the brain.

At the time of initiating their study, researchers presumed that one's mental health might be having an impact on the microorganisms which can thrive in the gut and not the other way around. However, this study provided evidences that gut microbes do 'interact' in some way with our nervous system by producing neurotransmitters which are critical for good mental health. It is important to note that microorganisms which exist outside our body, example in the environment, are not capable of making similar neurotransmitters so microorganisms might have evolved. This is a first major study conducted on a large scale in individuals living in varied geographical locations. It can be suggested that clinical approach to mental health can also incorporate probiotics as a new way of treatment to boost 'good' bacteria in our intestines. The study needs to be first tested in animal models where specific bacteria would be cultured and subsequently animal's behaviour will be analysed. If strong links are established, human trials could be conducted.

Key points

- Goal was to understand the possible association of gut microbial metabolism and a person's mental health and wellbeing.
- Combination of faecal microbiome data with general practitioner diagnose records of depression of patients revealed bacteria which were present in universally low amounts in patients with depression.
- Gut microbes do 'interact' in some way with our nervous system by producing neurotransmitters which are critical for good mental health.

Source
1. Yuanqiang Zou et al. 2019, '1520 reference genomes from cultivated human gut bacteria enable functional microbiome analyses', *Nature Biotechnology*, Vol. 37, DOI: https://-doi.org/10.1038/s41587-018-0008-8
2. Samuel C. Forster et al. 2019, 'A human gut bacterial genome and culture collection for improved metagenomic analyses' *Nature Biotechnology*, Vol.37, DOI: https:/-doi.org/10.1038/s41587-018-0009-7
3. Mireia Valles-Colomer et al. 2019, 'The neuroactive potential of the human gut microbiota in quality of life and depression', *Nature Microbiology*, DOI: https://-doi.org/10.1038/s41564-018-0337-xac ■

A Unique *Textile Fabric with Self-Adjusting* Heat Emissivity

The first temperature-sensitive textile has been created which can regulate our body's heat exchange with the environment

Our body absorbs or loses heat in the form of infrared radiation. At room temperature around 40 percent of heart transfer occurs in this manner. Human body is a radiator and we use clothing as a means to enable this regulation as different fabrics trap infrared radiation and keep us warm or cool by regulating the temperature. Scientists have desired for very long to develop a fabric which could also release this energy rather than only trap it, so as to keep our body passively cool. However, textiles do not respond to the changes occurring in the external environment and so they do not possess the ability to regulate both cooling and heating. The only way for us humans to cope with change in temperature in the environment has been to choose and wear appropriate clothing.

A new unique textile

Scientists from University of Maryland, USA have created an innovative fabric which could 'automatically' regulate the amount of heat passing through a person's body according to the external weather conditions. The fabric is made of a specially

engineered heat sensitive yarn (polymer fibre) whose strands act as a 'gate' for the heat (or infrared radiation) to transmit or block. This 'gate' works quite intelligently in a very unique way. When the outside weather is hot and humid, the strands of the fibre compact and the fibre collapses which allows for opening of fabric weave. Once 'open', the fabric activates cooling by allowing the heat radiating from our body to escape. This makes us feel cooler as the fabric also reflects sunlight. In contrast, when the outside weather is rather dry and cold, the fibre expands and closes or reduces the gaps to prevent heat from escaping making the person feel warm. So, the fabric dynamically gates infrared radiation in real time based upon outside environmental conditions.

Technology behind it

The novelty of the fabric is due to its base yarn which is made up of two opposite kinds of commercially available synthetic materials, hydrophilic cellulose and hydrophobic triacetate fibres, which either absorb or repel water. The strands of the fibre are coated with a conductive metal – a carbon-based lightweight carbon nanotubes – by a process similar to solution dyeing commonly used for industrial dyeing of synthetic fibres. Because of the dual properties the fibre warps when it is

exposed to moist conditions like humidity. The electromagnetic coupling between carbon nanotubes inside the coating gets modified which acts like a 'regulating-switch'. Based upon this change in electromagnetic coupling every time, fabric either blocks heat or allows it to pass through. The person wearing the fabric doesn't realize this underlying activity as the fabric does this very instantly in under a minute. It senses levels of thermal discomfort of a person on its own and can vary the amount of heat radiated by 35 percent as the level of humidity under one's skin changes.

In a practical experiment, the team knit a 0.5 m2 swatch to show scalability for future manufacture. The shift in fibre spacing in humid and dry conditions was captured in real time using confocal fluorescence microscopy and a fluorescently dyed swatch of the fabric. To quantify fibre performance, they used a Fourier-transform IR spectrometer attached to a humidity-varying environmental chamber containing a small swatch of the fabric. They observed that the fabric could achieve 35-percent relative change in Infrared transmittance. The fabric could efficiently switch from cooling to heating mode in under a minute in all experiments.

Is it practical as real clothing?

A novel fabric has been created for the first time that helps to make a person stay warm when the outside weather is cool and dry and cool when the weather is hot and humid. This is fascinating indeed! The fabric could be knitted or dyed and also be washed in a manner similar to other sportswear. More research is likely needed to make this fabric more practical and useful for everyday use. Researchers hope to collaborate with a manufacturing unit in the near future to produce clothing made from this novel fabric. This discovery published in *Science* is innovative and promising as such a fabric could be beneficial for athletes, sportsmen, infants and older people by providing them comfort and feel of normal clothing.

Source

Xu A. Zhang et al 2019, 'Dynamic gating of infrared radiation in a textile', *Science*, Vol. 363, no.6427, DOI: http://doi.org/10.1126/science.aau1217 ■

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Delivering Oral Dose *of Insulin to Patients* of Type 1 Diabetes: *Trial successful in Pigs*

A new pill has been designed which delivers insulin into the bloodstream easily and pain-free, in pigs for now

Insulin is an important hormone required to break down the blood sugar – glucose - to prevent further illnesses. Since sugar is found in majority of diet which we consume including carbohydrates, dairy, fruits etc, insulin is needed every day to control blood sugar. Patients of diabetes need daily insulin injections as their pancreas is unable to produce this hormone adequately. If left untreated, diabetes can cause multiple health complications like heart stroke and kidney damage.

A new insulin pill

Taking injections administered in the stomach has been the traditional method for taking insulin for over a century. The main reason being that most drugs like insulin when taken orally do not survive the journey through our stomach and intestine to reach the bloodstream and so directly injecting them into blood is the only option. A team of researchers led by Massachusetts Institute of Technology, USA aimed to find an alternative way to take medications which otherwise require injection

in their study published in *Science.* They have developed a pea-sized drug capsule which can deliver an oral dose of insulin to patients of Type 1 diabetes. Such a pill could eliminate use of daily i nsulin injections.

Innovative design

The drug capsule consists of a small single needle made from compressed insulin which gets automatically injected after the capsule is consumed and reaches the stomach. The tip of this needle is comprised of 100 percent compressed, freeze-dried insulin while the shaft is made of biodegradable polymer material and a little bit stainless steel as it doesn't enter the stomach. The capsule was designed in an articulate way so that tip of the needle would always point to the tissue lining of the stomach allowing for targeted injection. Also, any movement like growling of the stomach would not affect the capsule's orientation. They achieved this through computational modelling by creating a shape design variant which allows reorientation in the dynamic environment of the stomach. The needle is attached to a compressed spring held by a sugar disk.

Once the pill is swallowed, the sugar disk dissolves as soon as it comes in contact with gastric juice in the stomach, releasing the spring and acting as a trigger to inject the needle into the stomach wall. And since stomach lining does not have any pain receptors, patients wouldn't feel anything making

the delivery totally painless. Once the tip of the needle gets injected into the stomach wall, the microneedle tip made of freeze-dried insulin get dissolved at a controlled rate. In a duration of one hour, all the insulin gets released into the bloodstream. Researchers aimed to avoid any delivery inside of the stomach as stomach acids break down most drugs quickly.

Testing in pigs

Initial testing in pigs confirmed delivery of 200 micrograms of insulin and later 5 milligrams which is sufficient to lower blood sugar levels and is comparable to insulin injections given to Type 2 diabetes patients. After this task is finished, the capsule passes through the digestive system without causing any adverse effects.

Researchers are collaborating with Danish pharmaceutical Nova Nordisk, who are the biggest supplier of insulin and also co-authors of this study, to manufacture these capsules for human trials to be conducted in next three years. They would also like to add a sensor which can track and confirm delivery of the dose. If this pill is successfully designed for human, the daily insulin injections would be a thing of the past and this would be very helpful for patients, especially children who are afraid of needles. The pill approach is more convenient, portable and also low on cost.

Source

Alex Abramson, et al., 2019, 'An ingestible self-orienting system for oral delivery of macromolecules', *Science*, Vol. 363, DOI: https://doi.org/10.1126/-science.aau2277 ■

Automated Virtual *Reality (VR) Treatments* for Mental Health *Disorders*

Study shows effectiveness of an automated virtual reality treatment to psychologically intervene in reducing a person's fear of heights

Virtual Reality (VR) is a method in which a person can reexperience the recreations of their difficult circumstances in a virtual environment. This can bring out their symptoms and they can be treated by training them for different responses in order to overcome their difficulties. VR is a fast, powerful and underused tool which could be of potential for patients who are undergoing conventional mental health care treatments. VR would involve a psychological treatment which can be carried out by sitting down on a couch and using a headset, handheld controllers and headphones.

Fear of heights

Fear of heights or Acrophobia is a psychological disorder which can cause a person to fear different things related to being far from the ground. This phobia of heights can be mild to severe which could prevent someone of being on a high floor of a building or climbing a ladder or even riding an escalator. Acrophobia is treated by clinical therapists using techniques like psychotherapy, medication, gradual exposure to heights and related methods. In a new study published in *Lancet Psychiatry,* a large randomized controlled trial of participants clinically diagnosed with fear of heights was conducted to compare a new automated virtual reality treatment with standard care. The aim was to evaluate

the effectiveness of automated cognitive intervention using VR for acrophobia.

A new automated virtual reality method

A Heights Interpretation Questionnaire was completed by all participants which rated their fear of heights on a scale of 16 to 80. Out of total 100 volunteer adult participants, 49 who scored more than a '29' on this questionnaire were called the intervention group and they were randomly allocated to automated VR which was delivered in six 30-minute sessions over a period of two weeks. The other 51 participants called control group were given standard care and no VR treatment. The intervention was performed by an animated 'counsellor' avatar by using voice and motion capture in VR unlike in real-life where a therapist guides a patient through the treatment. The intervention was focused mainly on guiding patients through ascending a 10-story high-rise building. At every floor of this virtual building, patients were given tasks which would test their fear response and they were helped to learn that they are safe. These tasks included standing close to safety barriers or riding a mobile platform just above the building atrium. These activities built up on participant's memories that being at height can mean safe, counteracting their earlier belief that height means fear and being unsafe. Three fear-of-heights assessment was done on all participants at the start of the treatment, immediately at the end of the treatment after 2 weeks and then at a 4-week follow up. No adverse events were reported. Researchers assessed change in participants' Heights Interpretation Questionnaire score, where a more or increased score indicated greater severity of person's fear of heights.

Conquering one's fear

Results showed that patients who received VR treatment displayed a reduced fear of heights towards the end of the experiment and at follow up compared to the control group. So, it could be suggested that automatic psychological intervention delivered via virtual reality can be more effective in reducing a person's fear of heights in comparison to clinical benefits received via face-to-face personal therapy. Many participants who had more than three decades of acrophobia also responded well to the VR treatment. Overall, fear of heights reduced by two-thirds on an average in the VR group and three-fourth participants now experienced 50 percent reduction in their phobia.

Key points

- Virtual reality (VR) involves a psychological treatment which can be carried out by sitting down on a couch and using a headset, handheld controllers and headphones.
- A large trial of participants clinically diagnosed with fear of heights was conducted to compare a new automated virtual reality treatment with standard clinical care.
- The patients who received VR treatment displayed a reduced fear of heights towards the end of the experiment and at follow up compared to the control group.

Such a fully-automated counselling system can be useful to control acrophobia and can help people to do activities without any fears which they have been unable to, example riding a simple escalator or going hiking, walking on rope bridges etc. The therapy offers an alternative and more personalized psychological expertise to patients dealing with mental health problems. Such a technology could bridge the gap for patients who are either not comfortable or do not have the means to speak directly to a therapist. Longer studies in the future will be helpful to directly compare VR treatments with real-life therapy sessions.

VR therapy can be expensive at first but once suitably created it can be a more cost-effective and powerful option in the long-term. VR could help design psychological treatment for other phobias like anxiety or paranoia and other mental disorders. Experts from the field suggest that training with real therapists will still be required for patients with severe symptoms. This study is a first step in using VR for treating a psychological disorder.

Source

Daniel Freeman et al. 2018, 'Automated psychological therapy using immersive virtual reality for treatment of fear of heights: a single-blind, parallel-group, randomised controlled trial', *Lancet Psychiatry,* Vol. 5, no. 8, DOI: https://-doi.org/10.1016/S2215-0366(18)30226-8

■

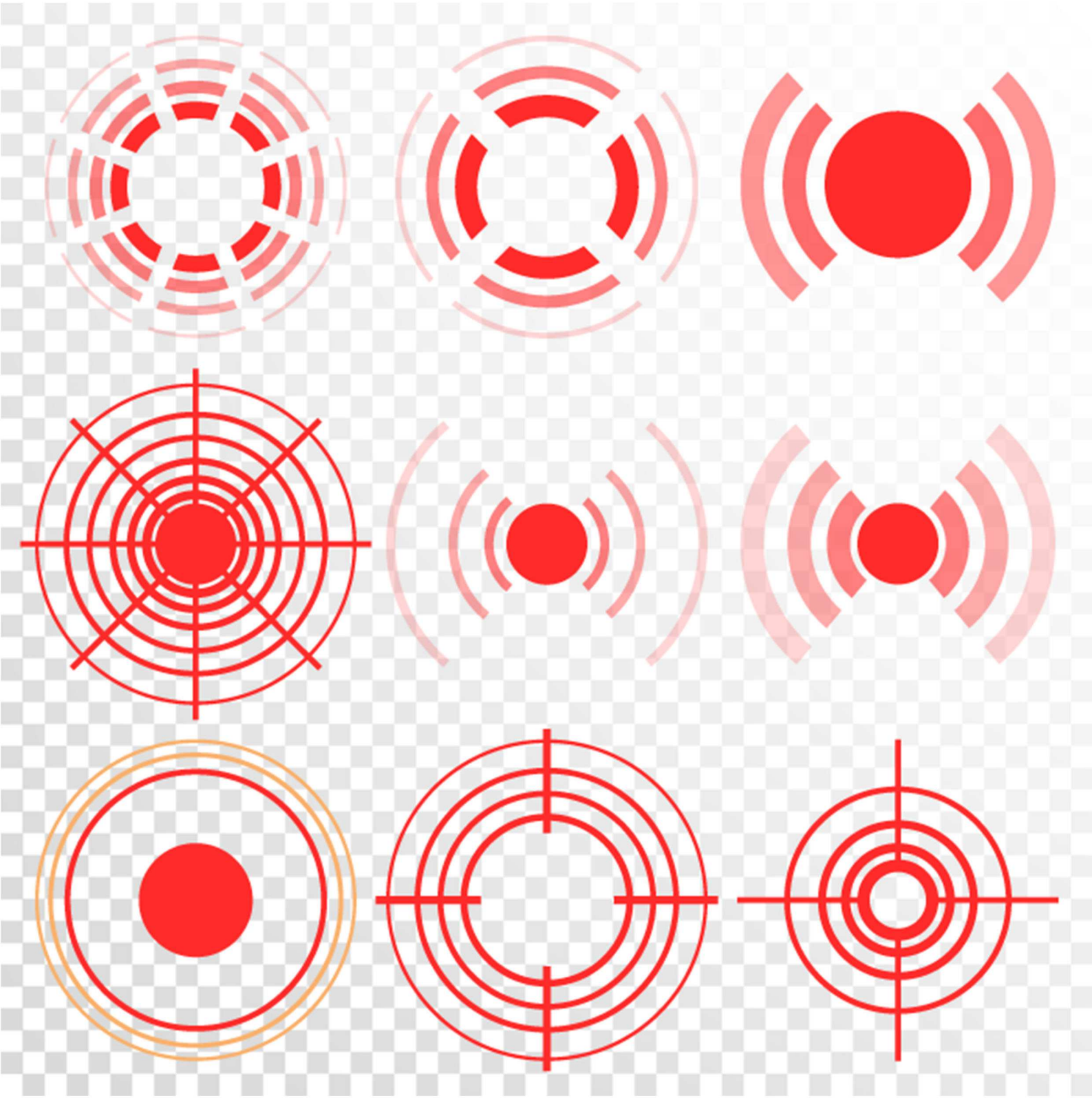
Resolving Painful *Neuropathy Through the Clearance of* Partially Damaged Nerves

Scientists have found a new way in mice to get relief from the chronic neuropathic pain

Neuropathic pain in humans is a chronic pain associated with nerve damage like neuropathy. This is very difficult to treat chronic type of pain which is commonly seen in nerve trauma, chemotherapy and diabetes. The pain is shooting and intense and/or causes a feeling of numbness or loss of sensation. The pain can generally accompany an injury, surgery, illness or infection and can occur constantly or randomly, keep changing intensity and it could gradually become better or worse in some patients.

Cause of difficult-to-treat neuropathic pain

The human nervous system is composed of a complex collection of nerves and dedicated cells called neurons which transmit signals from the brain to different parts of the body. Nerves are made of bundles of nerve fibers called axons. Neuropathic pain in humans is caused due to partially damaged axons of a nerve. In animals when a peripheral nerve gets crushed, it gets damaged completely and damaged axons then allow for growth of healthy axons inside the nerve. This doesn't happen in humans and that is why the chronic neuropathic pain lingers on. Managing chronic pain is very challenging and requires multitude of efforts to make it seem tolerable while maintaining normal body functions. Only very few patients get relief from this pain with use of a single drug as diagnosis of neuropathic pain is never down to only one cause. Pain relievers, topical treatments and physical therapy are advised but in most of the cases they are



unable to break the cycle of chronic pain.

Finding the treatment for neuropathic pain

Since it is established that the key reason for neuropathic pain in humans is partially damaged axons inside nerves, it would be imperative to explore this particular aspect. In a new study published in *Cell*, researchers aimed to understand the role of our immune cells in breaking down our damaged (partially or otherwise) nerves. They looked at an immune cell called natural killer or NK which can cut axons from neurons in a petri dish in the laboratory. These NK cells are a part of our body's innate immunity via which our immune system protects us from viruses and cancer. It was seen that disassociated neurons expressed a protein called RAE1 which then invites NK cells to target the neurons. So, once neurons were grown along with activated NK cells, these cells started breaking down the injured/partially damaged nerves by eating away the axons but, without destroying their cell bodies. So here was a potential possibility to grow new healthy axons in place of damaged ones.

Current experiment was conducted in living mice by first increasing the function of NK cells and thereafter crushing mice's sciatic nerve of the leg. Within just a short period of time, immune stimulated mice exhibited reduced sensitivity in their affected paw. After an interval, scientists recorded that affected neurons started to make a protein which then makes neurons vulnerable to attack by NK cells. The NK cells responded immediately by coming to the nerve and deleting damaged axons. Once these damaged axons were cleared, healthy ones started to grow in their place. And after about two weeks, mice regained sensation in their affected paws. The control group of mice who didn't receive any immune stimulation to increase their NK cells also recovered in a similar time interval. But the crucial point is that since control group mice's damaged axons were not removed, they continued to sustain touch-induced chronic pain for almost one month after the injury.

Key points

- Managing chronic pain is very challenging since a single drug never treats neuropathic pain which is caused due to partially damaged axons.
- Experiments in mice show that immune stimulation by increasing NK cells can clear all partially or completely damaged axons can make allow for healthy axons to grow subsequently.
- A similar method may be possible in humans and it could effectively treat chronic pain.

The experiment has been successful in an animal model and researchers are confident that a similar scenario can be envisioned in humans as well during occurrence of neuropathic pain. The partially damaged nerves in humans continue to send signals to the brain and cause chronic pain and hypersensitivity long after the first shot of pain is endured. A method could be designed in humans which can similarly modulate NK cell function and clear all partially or completely damaged axons and subsequently allow for healthy axons to grow. This could treat neuropathic pain effectively as seen from the current study on mice. Understanding the critical role of NK cells in axonal degeneration is going to be important for designing treatments for chronic neuropathic pain in humans.

Source

Alexander J. Davies et al. 2019, 'Natural Killer Cells Degenerate Intact Sensory Afferents following Nerve Injury', *Cell*, DOI: https://doi.org/10.1016/j.cell.2018.12.022 ■

E-Cigarettes Twice *More Effective in* Helping Smokers to *Quit Smoking*

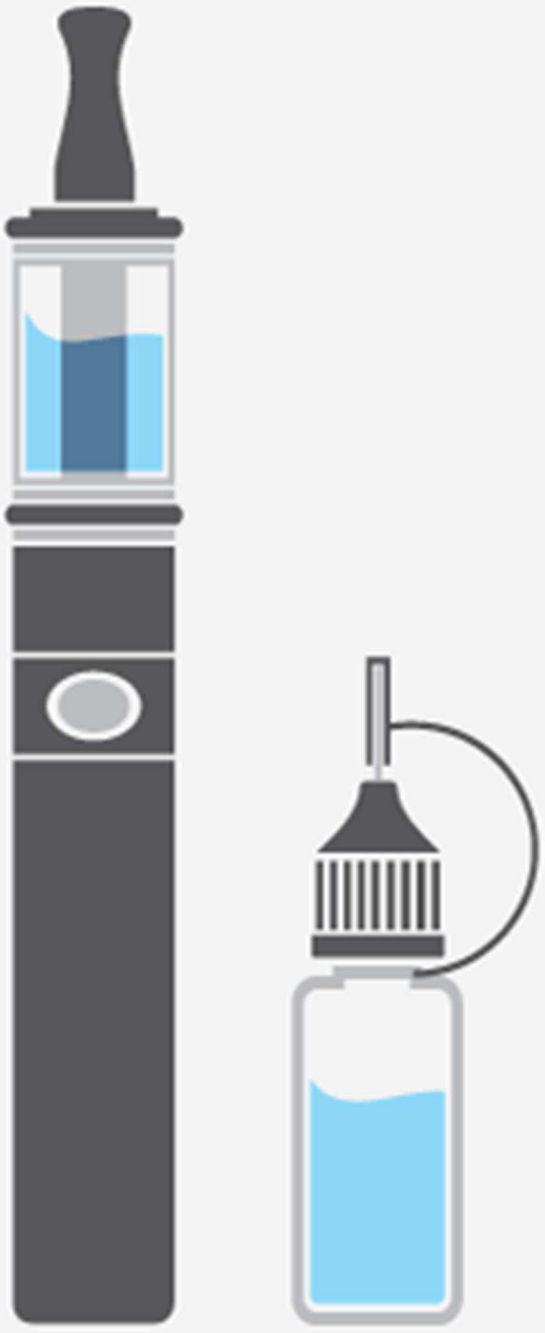
Study shows the e-cigarettes are twice more effective than nicotine-replacement therapy in helping smokers to quit smoking.

Smoking is one of the leading causes of death worldwide. Smoking can cause a variety of respiratory diseases by damaging airways and small air sacs found in our lungs and it is also responsible for most cases of lung cancer. Cigarettes contain toxic chemicals like carbon monoxide and tar which are very harmful for human health. Smoking is very addictive because of nicotine, the chief substance found in tobacco. Quitting smoking is a physically, mentally and emotional challenging task. Less than 5 percent smokers are able to quit smoking by going cold turkey. But for the majority, even trying to quit can cause unpleasant withdrawal symptoms like anxiety, irritability, moodiness and smokers tend to fall back on smoking again.

An e-cigarette

An electronic cigarette (e-cigarette) is a device which emits nicotine as vapor or mist for the user to inhale providing a similar sensation to inhaling tobacco smoke from a real cigarette. E-cigarettes are smokeless cigarettes, which look like real cigarettes but do not light.

They are being discussed as an alternative method to consume nicotine minus harmful chemicals found in real cigarettes. E-cigarettes are now a part of deaddiction mechanisms



which helps smokers in quitting. However, not much research has been done to validate this claim while some other studies have shown the ill effects of using e-cigarettes. Two previous randomized controlled trials on e-cigarettes had shown that firstly, e-cigarettes may be slightly effective in helping to quit smoking by working similar to nicotine patches. Secondly, smokers using e-cigarettes with or without nicotine can help them to stay away from conventional cigarettes. These evidences haven't been very conclusive and the e-cigarettes debate is still open.

Can using e-cigarettes help smokers to quit?

In a new study published in *New England Journal of Medicine,* researchers evaluated the effectiveness of e-cigarettes in helping smokers to quit. This is a first randomized controlled trial which aimed to check the effectiveness of modern e-cigarettes versus nicotine replacement products. A total of 886 participants were enrolled for the trail who were part of UK's free National Health Services 'stop smoking' program and they were randomly assigned two treatment groups. The first group was given a free e-cigarette starter pack, along with a manual to use it, a bottle of tobacco-flavored nicotine vaping

liquids and three more e-liquids of their choice to buy in the future. The second group were asked to use their choice of nicotine-replacement product like patches, lozenges or chewing gum, for a period of three months. Additionally, both these groups also received a weekly face to face counseling on quitting smoking and all participants were tracked for one year. Researchers found that 18 percent of smokers using e-cigarettes were smoke-free after a year compared to 9.9 percent users taking the nicotine-replacement therapy. So, e-cigarette therapy was twice more effective as in helping smokers to quit compared to nicotine-replacement therapy.

Both the groups claimed that e-cigarettes and nicotine-replacement products were both unsatisfying compared to real cigarettes. However, e-cigarettes group rated their device as more satisfying and useful compared to the nicotine-replacement group. E-cigarette group showed more occurrence of mouth irritation but had reduced coughing and phlegm while nicotine-replacement group experienced more nausea as side effects. The most important observation was that 80 percent participants in the e-cigarettes group who had successfully quit smoking were still using e-cigarettes at the end of one year compared to only 9 percent from the nicotine-replacement group. This clearly indicated that e-cigarette group participants definitely developed a habit of using them.

The current study is limited to UK, so conclusions cannot be generalized at this point of time as societal and cultural context will vary for every country. Also, most countries do not have guidance or counselling as part of the quitting program. E-cigarettes have been marked controversial as many studies have shown their negative effects on one's health. Any possible harms of using e-cigarettes needs to be taken into account especially in younger impressionable population because young people's bodies and brain are still developing making them more vulnerable to the effects of nicotine.

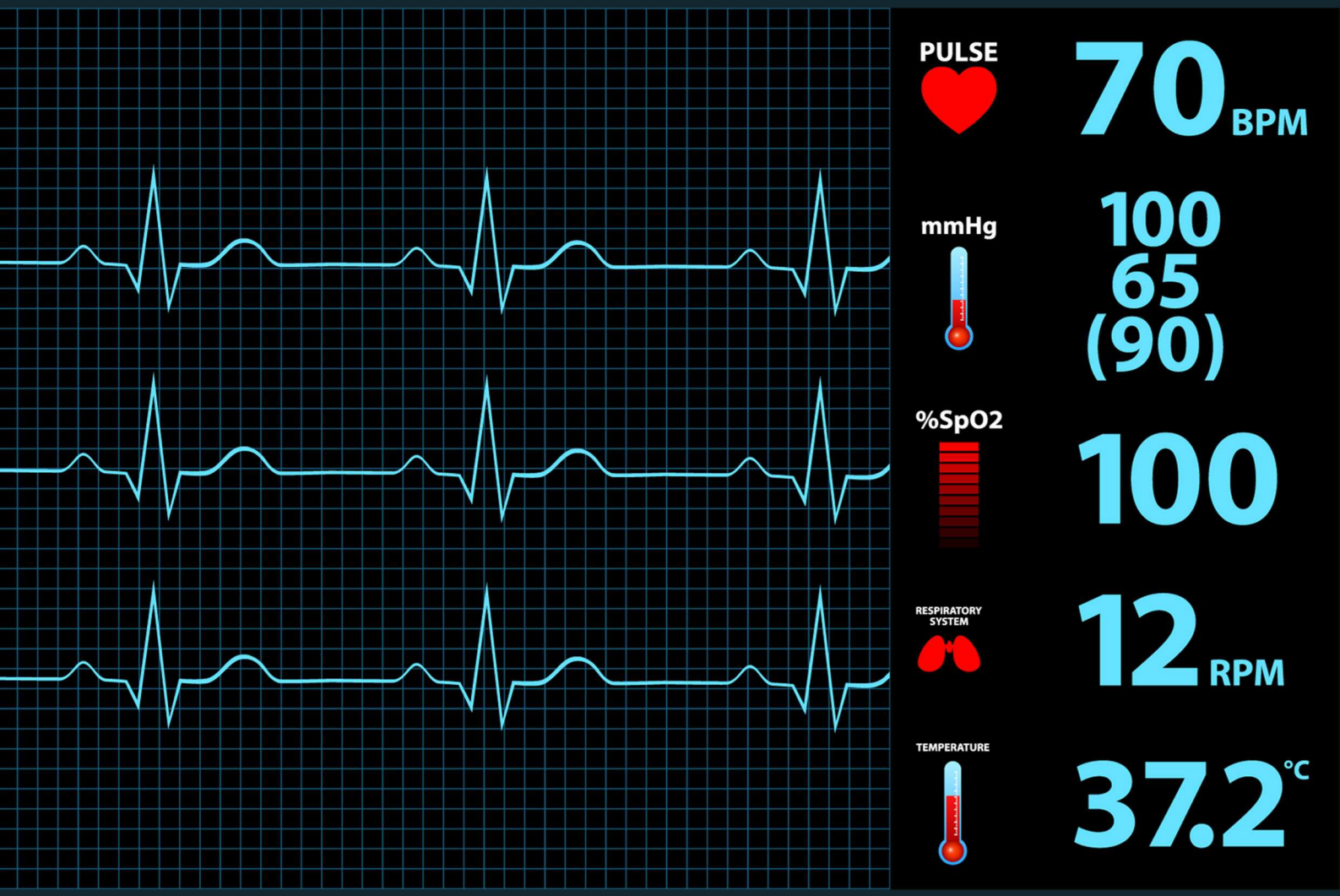
Source

Peter Hajek et al. 2019, 'A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy', *N Engl J Med*, Vol.380, DOI: https://-doi.org/10.1056/NEJMoa1808779 ■

Vital Sign Alert *(VSA) Device: A Novel Device for* Use in Pregnancy

A novel vital signs measurement device is ideal for low resource settings for timely intervention of illnesses during pregnancy

The main driving force behind developing a unique device called Cradle Vital Sign Alert (VSA) [1] was the observation made of different clinical outcomes in maternity care for pregnant women in diverse countries around the world - high, middle and and low-income. Almost 99 percent of maternal deaths occur in low-income and middle-income countries because of lack of timely intervention for illnesses due to deprived access and lack of training in public health care settings. Vital signs measurement - especially blood pressure and heart rate - is the most critical assessment which is necessary to do in pregnant and postpartum women to recognize early signs of any ailment. This assessment can allow for timely intervention and prevention of any serious clinical outcome and thus reduce mortality and morbidity due to pregnancy. Obstetric hemorrhage is a condition in which blood pressure increases and causes severe bleeding and infections. This illness alone accounts for 60 percent pregnancy deaths worldwide. Hypertension, sepsis and complications


PULSE
70 BPM
mmHg
100
65
(90)
%SpO2
100
RESPIRATORY SYSTEM
12 RPM
TEMPERATURE
37.2°C

Key points

- Cradle project VSA device can accurately detect abnormalities in pregnant women's vital signs like blood pressure and heart rate.
- An innovative yet simple-to-use device can make a strong impact on reducing annual pregnancy deaths in limited-resource settings of low-and-middle income countries by almost 25 percent.
- The device was seen to be a success in terms of costing, practicality and ease of use in evaluation studies conducted in India, Mozambique and Nigeria and

from abortion are some other serious outcomes and all these conditions are preventable and directly related to abnormal vital signs.

Microlife Cradle Vital Sign Alert device

Cradle project of Microlife[2] aimed to develop a device which can accurately detect abnormalities in pregnant women's vital signs like blood pressure and heart rate and could be used in low-and-middle income countries in small community nursing homes, clinics and hospitals. This device would be evaluated for its ability to provide a fast referral and intervention. The Cradle VSA device can accurately measure both blood pressure and heart rate and using these it can calculate a women's risk of developing shock by providing a maximized alert through its novel early warning system. This simple visual warning system is based on a traffic-light color system where green means no risk, amber means careful monitoring is required and red means emergency treatment is needed. The warning alerts assist in identifying conditions for which low-cost and simple standard treatments are available. The standard algorithm used for non-pregnant adults was improvised for pregnant women over a period of six years.

Ideal for low-and-middle income countries

The Cradle VSA device is the first ever to achieve WHO standards for use in low-resourced countries as it costs only around 15 GBP per device. It consumes very little power and can be charged by any USB phone charger allowing up to 250 readings with one cycle of charge. It's a robust, almost unbreakable and specially calibrated device which can withstand extreme temperatures, humidity and pressure. Clinical trials are ongoing in many low-and-middle-income countries[1].

A study published in BMJ Innovations evaluated the usability and accessibility of this device in typical low resource settings3,4. One study was conducted in primary care settings in low or middle incomes countries of India, Mozambique and Nigeria and some hospitals in South Africa. 155 interviews within six focus groups were conducted in local languages along with audio recordings of pregnant women and their family members. This was followed by a thematic analysis after recordings were transcribed into English. Results showed that majority of healthcare workers found the device accurate and easy to use. The integrated traffic-light signal approach to warning was easily understood and well received while imparting confidence in less trained healthcare workers. This helped them in taking accurate and fast decisions which were then taken forward as referrals or a form of treatment. Only very few workers reported that they

were not comfortable with using the device when measuring vital signs in obese women and patients having hypertension.

The Cradle VSA is an innovative yet simple-to-use device which can make a strong impact on reducing annual pregnancy deaths in low-and-middle income countries by almost 25 percent. By early and timely detection, pregnant women can receive medical care quickly providing a better outcome to soon-to-be-mothers and also to their unborn babies.

Source

1. Cradle Innovation, http://cradletrial.com
2. Microlife, https://www.microlife.com
3. Vousden N et al. 2018, 'Evaluation of a novel vital sign device to reduce maternal mortality and morbidity in low-resource settings: a mixed method feasibility study for the CRADLE-3 trial', *BMC Pregnancy Childbirth*, Vol.18, no.1, DOI: http://10.1186/s12884-018-1737-x
4. Hannah L. Nathan et al. 2018, 'The CRADLE vital signs alert: qualitative evaluation of a novel device designed for use in pregnancy by health-care workers in low-resource settings, *Reproductive Health*, DOI: https://-doi.org/10.1186/s12978-017-0450-y

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