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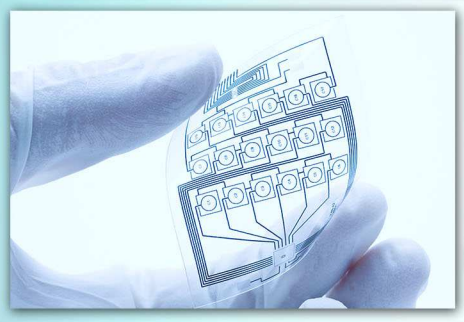


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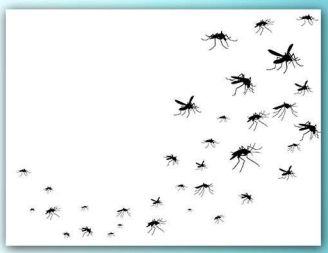


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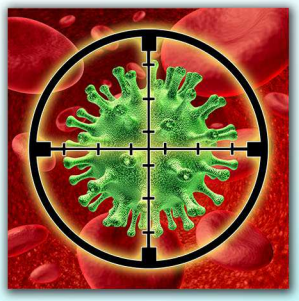

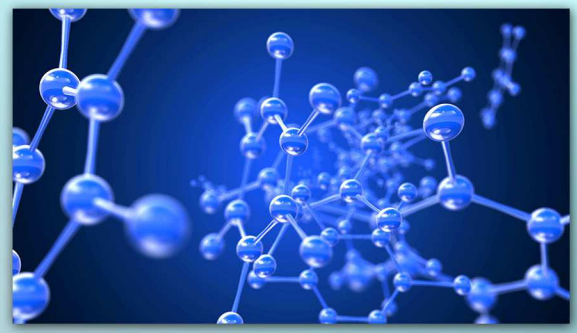

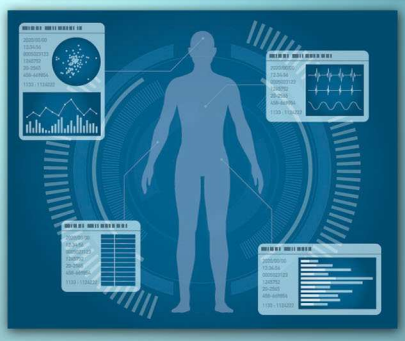

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We are excited to bring nine articles on recent scientific advancements which hold great potential - new drug to fight HIV, foldable electronic devices, alternative approach to novel medicines, new treatment for malaria and many more

Hope you find these intellectually stimulating!

Umesh Prasad

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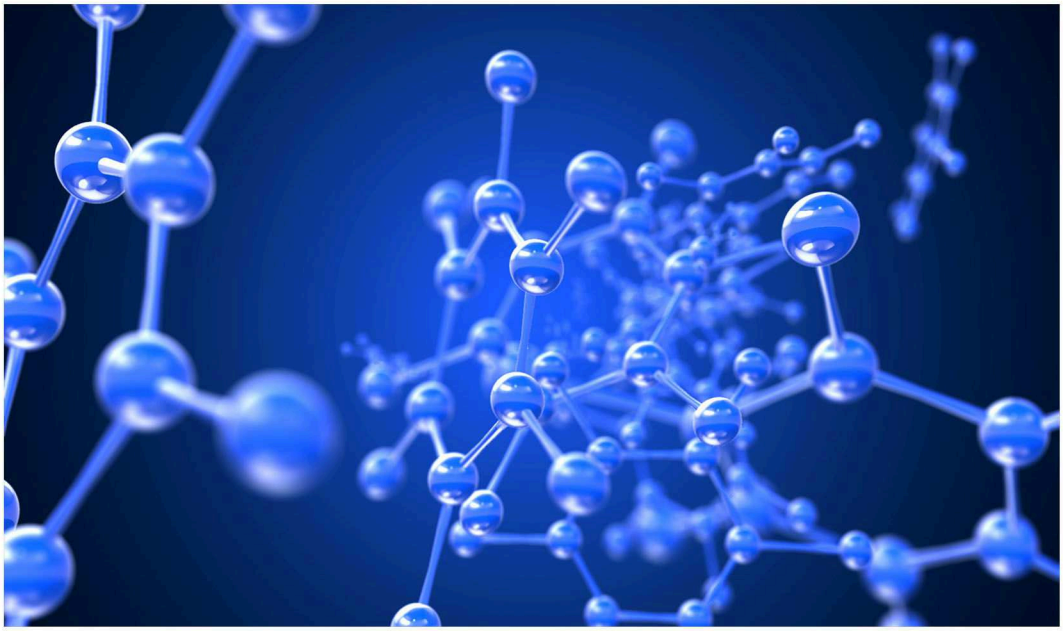
Enhancing Drug Efficiency by Correcting 3D Orientation of Molecules: A Step Forward Towards Novel Medicine

Researchers have discovered a way to be able to design efficient medicines by giving the compound a correct 3D orientation which is important for its biological activity

Advancement in healthcare is dependent upon understanding the biology of a disease, developing techniques and medicines for correct diagnosis and finally, treatment of the disease. After many decades of research scientists have gained an understanding of complex mechanisms which are involved in a particular disease which has led to many novel discoveries. But there are still several challenges that we face when it comes to finding and developing a new drug which would offer a novel way of treatment. We still have no medicines or methods to combat many diseases. The journey from first discovering a potential drug and developing it is not only complex, time-consuming and expensive but sometimes even after years of study there are poor outcomes and all hard work goes in vain. Structure-based drug design is now a potential area in which success has been achieved for new drugs. This has been possible because of massive and growing genomic, proteomic and structural information available for humans. This information has made it possible to identify new targets and investigate interactions between the drugs and their targets for drug discovery. X-ray crystallography and bioinformatics have enabled wealth of structural information on drug targets. Despite this progress, a significant challenge in drug discovery is the ability to control the three-dimensional (3D) structure of molecules – the potential drugs - with minute precision. Such constraints are a severe limitation to discovering new drugs.

In a breakthrough study published in *Science,* a team led by researchers at Graduate Centre of The City University of New York have devised a way which makes it possible to alter 3D structure of chemical molecules faster and more reliably during the drug discovery process. The team has built upon the work of Noble laureate Akira Suzuki, a chemist who developed cross-coupling reactions which showed that two carbon atoms can be bonded using palladium catalysts and won the Noble Prize for particular work. His original discovery enabled researchers to construct and synthesize new drug candidates faster but it was limited to only making flat 2D molecules. These novel molecules have been successfully used for applications in medicine or industry but Suzuki's method could not be used to manipulate a molecule's 3D structure during the design and development process of a new drug. Most biological compounds used in medical field are chiral molecules. Which means two molecules are mirror images of each other

though they may have the same 2D structure - like a right and left hand. Such mirror molecules will have different biological effect and response in the body. One mirror image could be medically beneficial while the other could have an adverse effect. A prime example of this is the thalidomide tragedy in the 1950s and 1960s when drug thalidomide was prescribed to pregnant women as a sedative in the form of both its mirror images, one mirror image was useful but the other caused devastating birth defects in the babies born to those women who consumed the wrong drug. This scenario imparts significance to controlling the aligment of indi vidual atoms which constitute a molecule's 3D structure. Though Suzuki's cross-coupling reactions are used routinely in drug discovery, the gap is yet to be filled in manipulating 3D structure of molecules.



This study was aimed at achieving control which would help in selectively forming the mirror images of a molecule. Researchers designed a method to carefully orient the molecules within their 3D structures. They first developed statistical methods which predict outcome of a chemical process. Then these models were applied to develop suitable conditions in which 3D molecular structure could be controlled. During palladium-catalysed cross-coupling reaction different phosphine additives are added which influence the final 3D geometry of the cross-coupling product and understanding this process was crucial. The ultimate aim was to either preserve the 3D orientation of the starting molecule or invert it to produce its mirror image. The methodology should 'selectively' either retain or invert the geometry of the molecule.

This technique can help researchers create libraries of structurally diverse novel compounds while being in a position to control the 3D structure or architecture of these compounds. This will enable faster and efficient discovery and design of new drugs and medicines. Structure-based drug discovery and design has untapped potential which can be utilized to discover new drugs. Once a drug is discovered there is still a long way to go from the laboratory to animal trials and finally human clinical trials only after which the drug is available in the market. Current study provides a strong foundation and an apt starting point to the drug discovery process.

Source

Shibin Zhao et al. 2018, 'Enantiodivergent Pd-catalyzed C–C bond formation enabled through ligand parameterization', *Science,*
DOI: https://doi.org/10.1126/science.aat2299 ■

Imperative for Nutritional Labelling

Study shows on the basis of Nutri-Score developed by UK, a low nutritional diet increases risk of illnesses and a nutrition labelling system must be incorporated to increase consumer awareness

There have been several studies in the past which link nutrition to higher risk of cancer and other chronic diseases. And even though several other factors are also applicable, nutrition is always given utmost importance. Nutrition as a risk factor can be tackled at an individual level without much medical intervention. There is a need to help consumers be able to make healthier food choices. Designing a strategy to achieve this remains a key challenge in prevention of chronic diseases like heart or metabolic illnesses and cancer.

A cohort study published in *PLOS Medicine* has shown in a large number of diverse participants across Europe that consumption of more unhealthy foods will lead to higher risk of diseases. Such unhealthy foods include baked goods like cakes and biscuits, puddings, ketchup, sauces, red and processed meat etc. Researchers examined the food intake of 471,495 adult participants from 10 countries in Europe and around 74,000 in the UK. All participants self-reported their food and beverage consumption. Researchers used the British Food Standards Agency nutrient profiling system (FASAm-NPS) the premise of which is to inform consumers whether a certain food is healthy or not. Unhealthy foods are flagged by the agency when having unhealthy level of fat, saturated fat, sugar or salt and are assigned a red, amber or green rating (sometimes even a grade from A to E) suggesting 'most nutritional to 'least nutritional'. Every food item is assigned a final score called Nutri-Score which is based upon its composition of vitality (energy), sugar, saturated fat, sodium, fibre and proteins. The score is already being used for food profiling for marketing meals to youth in the UK. The score is calculated for every meal or beverage.

The analysis on participants was adjusted to consider their individual characteristics like physical activity, Body Mass Index (BMI), smoking and drinking habits, education status and self or family medical history of cancer. Researchers first assigned a FSAm-NPS Dietary Index (DI) to every participant's diet and then computed a model to explain the connection between dietary index and cancer risks. The final Nutri-Score was then calculated which reflected that a diet having lower nutritional content and quality was associated with more cancer risk. The rates of cancer in people who consumed highest amount of junk food was 81.4 cases per 10,000-person year compared to 69.5 cases in

people with lowest 'junk or low nutrients' food scores where 'person year' is an estimated time frame for each participant of the study during which they reported irrespective of the total time they remained in the study. Unhealthy foods led to higher cancer rates at 11 percent compared to healthy eaters. People consuming maximum of junk or low nutrients food showed more risk of colon, digestive tract, oesophagus and stomach cancers. Males specifically had higher risk of lung cancer and females had higher risk of liver and breast cancer post menopause. Interestingly, participants from the UK, France and Germany were more junk food eaters, people from Italy, Greece, Spain and Norway made more healthier food choices while Denmark and Netherlands were average.

Obviously, people consuming junk food also do not exercise and have weight problems like being overweight. Such lifestyle factors also contribute to cancer risk as diet and lifestyle are related qualities. A major constraint of this study as has been with many other cohort studies is the limitation associated with self-reporting by participants as people tend to under report. Also, many foods which are designated as nutritionally adequate may still contribute to risk if eaten in excess or if toxic. More insights are needed to comprehend how high BMI, sedentary lifestyle, alcohol addiction and lack of exercise can counteract even a highly nutritional diet.

This study supports relevance and use of the British Food Standards Agency nutrient profiling

system (FASAm-NPS) as a nutrient profiling system for calculating a simple nutrition score called Nutri-score. And if such a unique nutrition label-system is made compulsory to display in packaging it can be more beneficial in helping people make healthy food choices in the UK and Europe. The primary objective of implementing this is to inform a consumer, especially the at-risk population about nutrition dimension of a food item at the time of purchase. It also encourages producers to improve the quality of their products and increase awareness about nutrition in general. A five-colour Nutri-Score is implemented in France and has been recently approved by Belgium. Public health policies should increase awareness about such a score in improving health outcomes.

Source

Mélanie Deschasaux et al. 2018, 'Nutritional quality of food as represented by the FSAm-NPS nutrient profiling system underlying the Nutri-Score label and cancer risk in Europe: Results from the EPIC prospective cohort study', *PLOS Medicine*, vol. 15, no.9, DOI: https://doi.org/10.1371/journal.pmed.1002651 ■

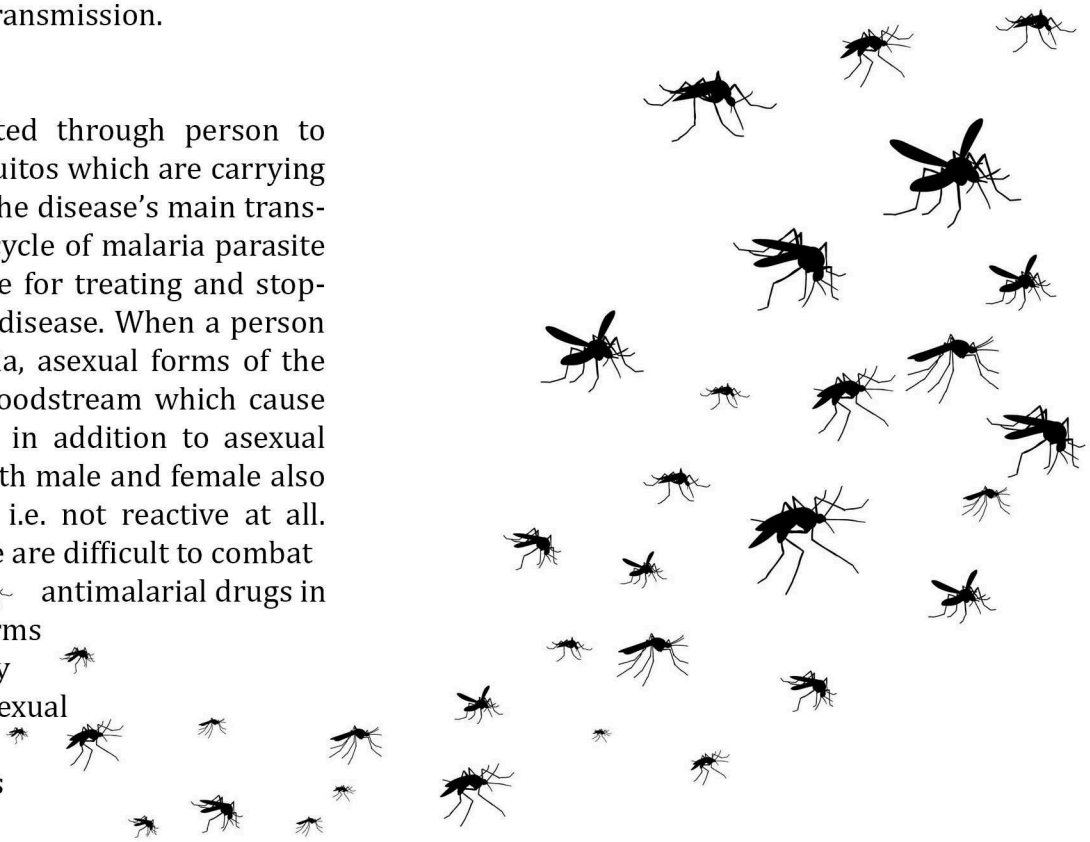
A New Drug that Prevent Malaria Parasites from Infecting Mosquitos

Compounds have been identified which could prevent malaria parasites from infecting mosquitos, thereby stopping the spread of malaria.

Malaria is a global burden and it claims 450,000 lives each year globally. The main symptoms of malaria include high fevers, chills and flu-like symptoms. An important aspect in eliminating a communicable infectious disease like malaria is to prevent its transmission.

The spread of malaria

Malaria is not transmitted through person to person contact but mosquitos which are carrying the malaria parasite are the disease's main transmitter. The complex life cycle of malaria parasite acts as a major hindrance for treating and stopping transmission of the disease. When a person gets infected with malaria, asexual forms of the parasite exist in one's bloodstream which cause the symptoms. However, in addition to asexual forms, sexual forms of both male and female also exist which lie dormant i.e. not reactive at all. Such forms of the parasite are difficult to combat using conventional antimalarial drugs in comparison to asexual forms which are well targeted by drugs. After undergoing sexual intercourse these male and female parasite forms create new 'infectious' asexual parasites which collect at the mosquito's salivary gland, to be passed onto the next human victim of malaria through the fly bite. Since antimalarial drugs have no effect on dormant sexual forms of the parasite



they rapidly mature and multiply inside the mosquito and can readily cause a fresh infection. In a way, the survivors who have been cured of malaria are still the carriers and contributors in spread of malaria. Therefore, the cycle can continue and in this vicious cycle more people can get infected when bitten by these mosquitos. Finding a solution to stop the spread of malaria is very challenging.

New possible drug for malaria

A study published in *Nature Communications* is based upon the idea that when the parasite is inside the mosquito, its sexual forms are very active, in fact they are cell types which are known to replicate very fast and thus are excellent potential drug targets. Though it's very difficult to target them with standard traditional drugs. A team of researchers led by Imperial College London set the goal of finding compounds which could disrupt sexual forms of the parasite, this can then inhibit creation of infectious asexual forms. They first set out to find conditions to mimic the embroilment inside the mosquito which would stimulate the sexual forms of the parasite. Once the apt conditions were found, they miniaturized this process so that they could examine it under a microscope. The whole process of finding the right conditions and miniaturizing the environment took several years. Researchers have identified several chemical compounds which can robustly prevent the malaria parasite to develop and mature inside a mosquito thus preventing the mosquito from being infected. This can stop the transmission of the disease. They screened around 70,000 compounds to see the effect on active sexual forms of the parasites and then successfully pinpointed six potent compounds which were active and safe and could inhibit this activity in human cells. One compound out of these has already been tested in a mouse model where it blocks transmission of parasite from mice. More work is needed to determine exactly how each of these six compounds work which can also shed more light into the parasite transmission process and how such compounds could be modulated as future drugs.

Researchers call these compounds as antimalarial drugs which can 'protect mosquitos' instead and thereby prevent further infectious journey of the parasites. Currently available antimalarial drugs that are not very efficient because parasites become resistant to drugs over time. A patient has to struggle with the treatment. The main transmission of malaria happens in mosquito and this process is a crucial target for designing beneficial and resistance-proof drugs. This could help to eliminate malaria. There are several challenges to the approach as giving these drugs directly to mosquitos is nearly impossible. The drug has to be strong and stable enough that when it is administered to a human, it must persist till it gets transferred from human to the mosquito.

If mosquitos – the important carriers of malaria parasite – don't get malaria then they cannot transmit the disease to humans. A drug which can combine the capability of existing antimalarials and the aspects from this new study would be a much powerful choice for eliminating the disease and would be useful for entire communities struggling with malaria.

Source

Michael J. Delves 2018, 'A high throughput screen for next-generation leads targeting malaria parasite transmission', *Nature Communications*, vol. 9, no.1,
DOI: https://doi.org/10.1038/s41467-018-05777-2

■

New Exomoon

A pair of astronomers have made the big discovery of an 'exomoon' in another solar system

Moon is a celestial object which are either rocky or icy and there is a total of 200 moons in our solar system. This includes Earth's moon which is our planet's own permanent natural satellite. Moon orbits the Earth as the planet Earth orbits the star Sun. In our solar system only two planets - Mercury and Venus- do not have moons. There are plenty of planets beyond our solar system called 'exoplanets' which have been confirmed by researchers, though no confirmation is available on moons. For the first time a pair of astronomers Alex Teachey and David Kipping at Columbia University have found strong evidence of a moon in another solar system. Although 3,500 exoplanets are known, this is the first time an exomoon has been discovered. This moon is orbiting a giant planet in another star system which is 8000 light years away from us. Its being called an 'exomoon' as it orbits a planet in another solar system. This celestial object is unique owing owing to its huge size - diameter being similar to that of planet Neptune or Uranus - and it 'also looms over a giant Jupiter-sized planet and their pairing has been remarked as a 'super-size pairing'. The exomoon is nine times bigger than Jupiter's Ganymede which is the largest moon is our solar system. The Hubble Space telescope and Kepler telescope from The National Aeronautics and Space Administration (NASA) have been used to make this significant discovery through investigations into distant star, planet and a possible moon.

In this study published in *Science Advances* what is

Key Points

- A strong evidence of a moon has been found for the first time outside our solar system.
- This extraordinary study can provide us with more understanding about moon formation and how planetary systems develop in comparison to our solar system.

being hailed as a milestone in astronomy, Teachey and Kipping examined data from 284 exoplanets which have been discovered till date by Kepler telescope which were seen in wide orbits for more than one month around their stars. The observations were able to measure brief dimming of a star's light when the planet passed in front of the star i.e. during the transit. Exoplanets are discovered by astronomers by observing this reduction in brightness of the star which the planet orbits. This method is called the 'transit method'. Theoretical models of planet formation are unable to make such predictions and that is why the transit method is used. This planet (or exoplanet), called

Kepler 1625b was the only planet around the particular star. When analysing observations, researchers found one particular instance with interesting features and anomalies. This star is about the 70 percent larger than our Sun but is older and the planet is at the same distance from its star as Earth is to the Sun. Although the object was not visible but many evidences hinted towards its existence. Particularly, small deviations and wobbles were seen in the light curve. This was an interesting result based upon which researchers intensively studied the planet for around 40 hours using the Hubble telescope. Before and during the 19-hour transit of the planet across the star observations were recorded. The planet is thought to be revolving around its star in such way that it looks like a possible moon is pulling onto it gravitationally. When the planet moved in front of the star, the star's light was dimmed very much hinting that there was something else present too. This dimness in stellar brightness was similar to the movement of the moon around the planet as only a moon could cause this kind of uncertain and wobbly path and this made for a strong evidence.

Similar observations and anomalies in the timing would be seen if someone from outside of our solar system (extra-terrestrial) were watching the moon transit our planet Earth. This exomoon would be around 2 million miles (3 million km) from its star and would actually appear twice the bigger size than our moon appears on Earth. Researchers plan to re-observe the star again sometime in the future to make further verifications, probably in 2019. What they have observed in their first attempt definitely points towards this judgement and so other possibilities have been ruled out. Also, the massive size of the exomoon and its planet helped the researchers as bigger things are easier to detect. Also, because a moon is orbiting the planet its position keeps shifting with transit. This is a remarkable achievement since moons are otherwise difficult to locate owing to their size compared to host planet and therefore they exhibit weak transit signal. The host planet and moon are both gaseous entities so researchers definitely won't be looking for signs of life. Though both these entities lie in the host star's habitable region where liquid water or other solids could perhaps exist because of moderate temperatures.

This is the first time an exomoon has been discovered. This study makes an extraordinary claim and many astronomers believe all this information needs to be grasped with some apprehension and certainly needs more evidence and further investigation. This study if successfully conducted further can provide us with more understanding about how moons are formed and what are they made of and how do planetary systems develop and what does out solar system have in common with the others.

Source

Alex Teachey, David M. Kipping 2018, 'Evidence for a large exomoon orbiting Kepler-1625b.
Science Advances, vol. 4, no.10,
DOI: https://doi.org/10.1126/sciadv.aav1784 ■

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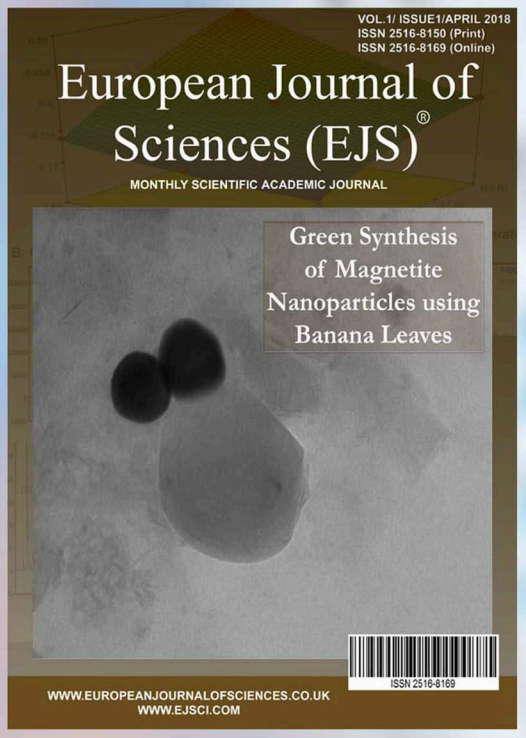

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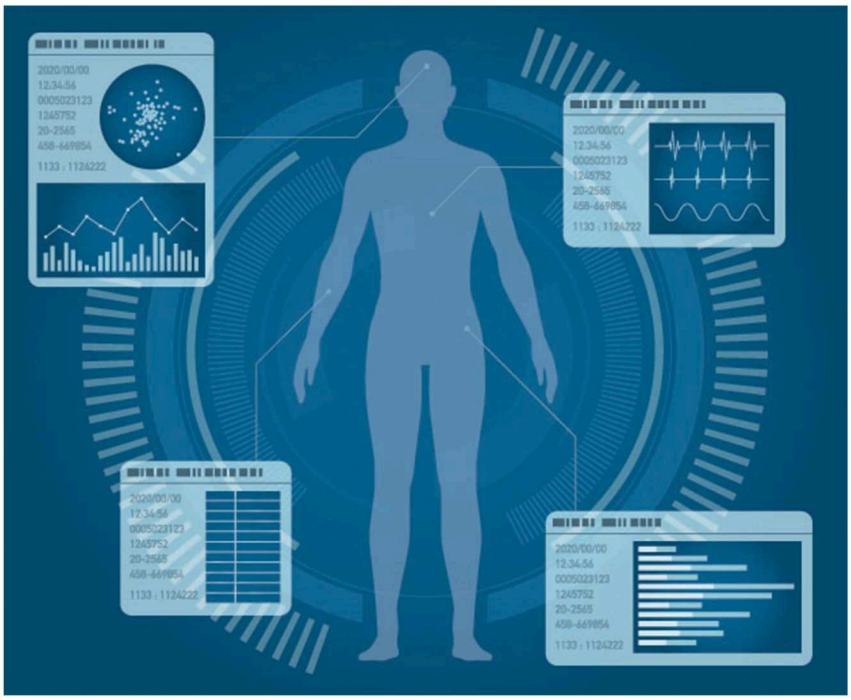
Skin-attachable Loudspeakers and Microphones

A wearable electronic device has been discovered which can attach to one's body and act as a speaker and microphone

Discovery and design of wearable electronic devices which can be worn by customers on their body is on the rise in the past several years. Such a wearable technology or gadget can be attached to human skin and can, for instance, track heath or fitness status of an individual. Such 'health or activity trackers' and smartwatches are now manufactured by several technology players in the market and their popularity is on the rise. They have small motion sensors which allow syncing with mobile devices. These have become a part of the daily lives of people.



A speaker and microphone which can be worn!

Scientists from UNIST 's School of Energy and Chemical Engineering have designed an innovative wearable technology for human skin which becomes a 'stick-on' speaker and microphone. This material is an ultrathin, transparent hybrid nanomembranes (less than 100 nanometres) which are conductive in nature. This nanomembrane can turn into a loudspeaker which can be attached to any device to produce sound. The nanomembranes are basically thin separation layers with nanoscale thickness. They are highly flexible, ultralight in weight and have superior adhesibility because of which they can directly attach to any type of surface. Routinely available nanomembranes are prone to tear and exhibit no electrical conductivity and this is reason that such emerging technologies have been limiting. To bypass these limitations, researchers embedded a silver nanowire matrix within a transparent polymer nanomembrane. Such a hybrid then has the additional property of being conductive part from being ultrathin, transparent and overall is unobtrusive in appearance.The thinness is remarkable and means it is 1000 times thinner than a single sheet of paper! The additional properties facilitate efficient interaction with curved and dynamic

surfaces without rupturing or cracking. Using such hybrid nanomembranes which have remarkable optical, electrical, and mechanical properties enabled researchers to fabricate loudspeakers and microphones which could be attached to the skin.

The speaker used an AC electrical voltage to heat the silver nanowire matrix which then produced sound waves (thermoacoustic sound) due to temperature-induced oscillations in the surrounding air. For practical demonstration, they used a commercial microphone to detect and record the sound. The speaker device attached to the skin played well and sounds were easily recognizable. To work as a microphone, hybrid nanomembranes were inserted between elastic films (micropatterned polydimethylsiloxane) with small patterns in a sandwich like structure. It could detect sound and vibration of vocal cords with precision. This happens because of the triboelectric voltage which is generated during contact with the elastic films. This was also practically tested and worked smoothly.

Such a paper-thin, stretchable, transparent skin-attachable technology which converts human skin into a loudspeaker or microphone is indeed interesting for customers for recreational purposes. This technology can also be useful in commercial applications. Example, the design of microphone could be modified to be used to unlock voice-activated security systems for smartphones or computers. It can be used for hearing and speech impaired, for use in sensors and conformal healthcare devices. For commercial . usage device's mechanical durability and performance will need to be improved. This study has set the path for new generation of wearable sensors and devices. The concern for safety for such wearable devices remains. Though very little scientific literature is available to comprehensively prove the harmful effects of such devices, it is well known that these devices emit radiation, especially cell phones and wi-fi connections. It is concerning that these electronic devices are worn so they are in direct contact with our body. A possibility exists that extended exposure from these devices could cause long term health risks to a person. More awareness is needed both on the part of manufacturers and consumers about whether such devices have been designed by following all correct safety procedures.

Source

Saewon Kang et al. 2018, 'Transparent and conductive nanomembranes with orthogonal silver nanowire arrays for skin-attachable loudspeakers and microphones', *Science Advances*, vol. 4, no.8, DOI: https://doi.org/10.1126/sciadv.aas8772 ■

Bendable and Foldable *Electronic Devices*

Engineers have invented a semiconductor made by a thin flexible hybrid material which can be used for displays on electronic devices in the near future.

Key points

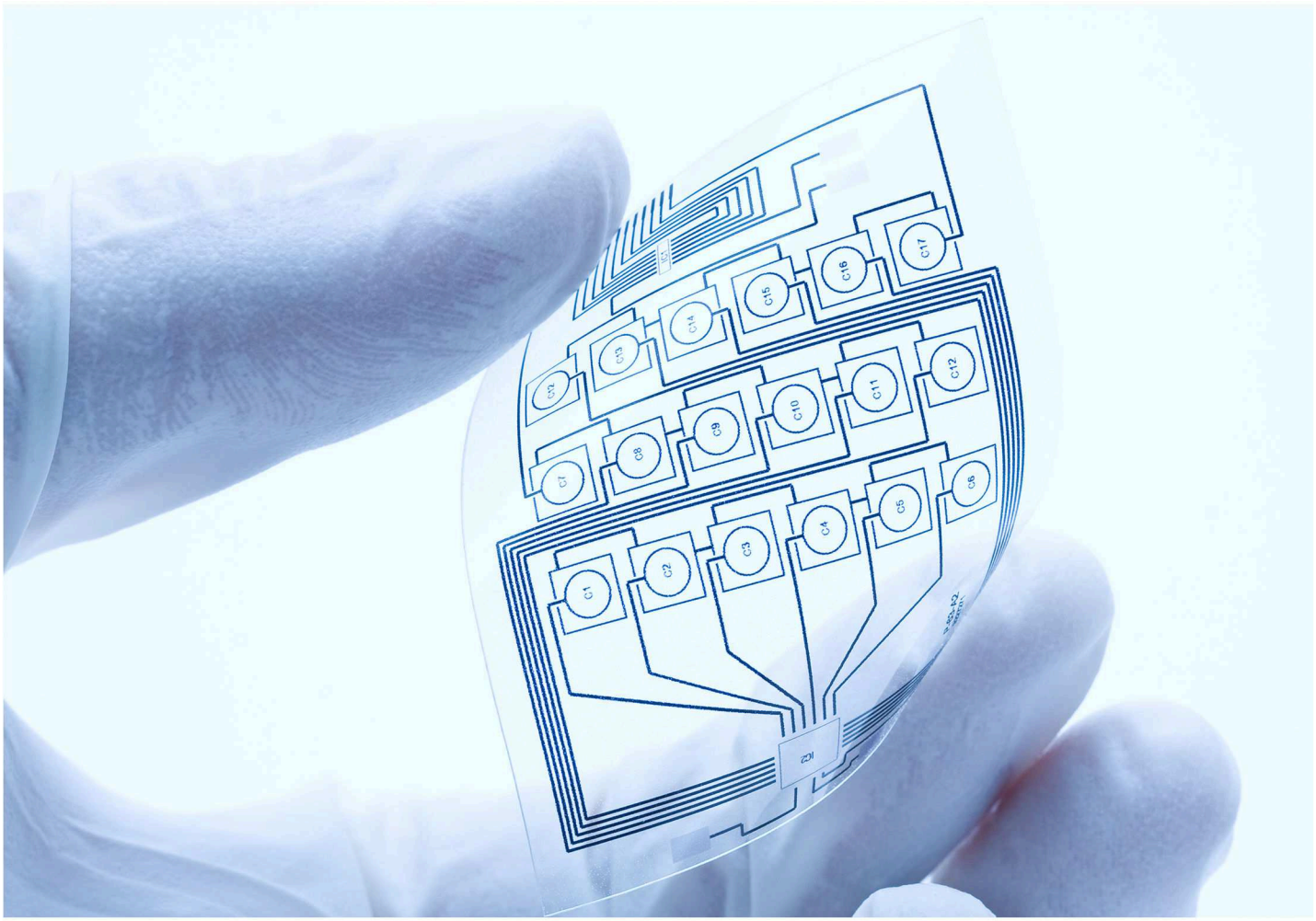
- For the first time an ultra-thin and flexible semiconductor made from organic and inorganic materials has been developed for display on electronic devices.
- This technology is suitable for designing bendable and foldable phones or other devices in the future.

Engineers at large corporations have been eyeing to design a foldable and flexible display screen for electronic devices like computers and mobile phones. A display screen which would feel like a paper i.e. be bendable but also function electronically is the goal. Samsung, one of the largest mobile phone manufacturers in the world will in all probability be launching a flexible mobile phone very soon. They have developed a flexible organic light emitting diode (OLED) panel which has an unbreakable surface. It is lightweight but also tough and robust and can withstand high temperatures. Its most remarkable feature would be that this display will not break or be damaged if the device falls. This is the biggest challenge faced today by mobile phone display designers. A regular LCD screen does display even when bent but the liquid inside them becomes misaligned and hence a distorted image is displayed. The new flexible OLED screen could be bent or curved without distorting the display, however, it still won't be completely foldable. The flexibility can be further increased by using more flexible nanowires in the future. A more advanced type of screen is the quantum dot light emitting diode display which is more flexible because of use of nano-crystals to produce high-quality sharp light. The displays still have to be encapsulated into glass or other material for protection.

A new material to build flexible screens

In a recent study published in *Advanced Materials* engineers from The Australian National University (ANU) have for the first time developed a semiconductor which is made from organic and inorganic materials which efficiently converts electricity into light. This semiconductor is ultra-thin and also very flexible making it unique. The organic part of the device which is an

important part of the semiconductor has a thickness of only one atom – carbon and hydrogen only. The inorganic part is also small, about two atoms thick. The material was constructed by a process called 'chemical vapor deposition', something similar to building a 3-dimentional structure from a 2D description. The semiconductor cannot be seen with naked eye, it rests between gold electrodes on a chip of size 1cm x 1 cm having a functional transistor. One such chip can hold thousands of transistor circuits. The electrode serves as electricity



input and output point. Once constructed opto-electronic and electrical properties of the material were characterized. This hybrid structure of organic and inorganic components converts electricity into light which then provides display on mobile phones, televisions and other devices. The light emission is seen to be sharper and better for higher-resolution displays.

Such a material can definitely be used in the near future to make devices bendable - example mobiles phones. Screen or display damage is very common in mobile phones and this material can come to the rescue. With popularity and demand of smart phones with bigger screens growing, the need of the hour is to have durability so that the display is not prone to scratches or breaks or fall etc. The hybrid structure is advantageous in terms of efficiency over traditional semiconductors which are made entirely of silicon. This material could be used to build screens for mobile phones, television, digital consoles etc and maybe build computers one day and or make a mobile phone as strong as a supercomputer. Researchers are already working on producing this semiconductor on a larger scale so that it can be commercialised.

Tackling electronic waste

It is estimated that 2018 will be produce a total of almost 50 million tons of electronic waste (e-waste) and very limited quantity would be

recycled. E-waste constitutes electronic devices and equipment which has reached the end of its life and is discarded including old computers, office or entertainment electronic equipment, mobile phones, television etc. This massive amount of e-waste is a huge threat to the environment and is causing irreversible damages to our natural resources and surroundings. This discovery is a starting point for designing electronic devices exhibiting high performance but which are made from organic 'bio' materials. Such an ultra-thin flexible device will be biodegradable in nature and can be recycled. Example, if mobile phones were made of a flexible material they would be easier to recycle. This will cut down on e-waste generated annually across the globe.

The future of foldable and flexible electronic devices is going to be very exhilarating. Engineers are already thinking of rollable displays where devices can be rolled up like a scroll. The most advanced type of display screen would be which can fold, curve or even crush like paper but can continue to display neat images. Another area is the use of 'auxtetic' materials which become thicker when they are stretched and which can absorb high energy impacts and self-realign to correct any distortion. Such devices would be lightweight but very flexible.

Source

Ankur Sharma et al. 2018, 'Efficient and Layer-Dependent Exciton Pumping across Atomically Thin Organic–Inorganic Type-I Heterostructures', *Advanced Materials*, vol. 30, no.40,
DOI: https://doi.org/10.1002/adma.201803986 ■

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Personality Types

Scientists have used an algorithm to plot huge data collected from 1.5 million people to define four distinct personality types.

Greek physician Hippocrates had said that there are four bodily humours shaped which then has resulted in four basic personality types in humans. There haven't been considerable scientific data to support his theory and thus it has been rejected from time to time. The concept of personality in psychology has largely remained controversial. Many studies have been performed on smaller groups and thus the results generated haven't been universally accepted as they are difficult to replicate. There has been no scientific data till date to support the concept of personality types.

This notion can finally change as a new study published in *Nature Human behaviour* has shown that there are four unique clusters of personality types in humans thereby declaring that Hippocrates' theory was indeed scientifically true. Researchers from Northwestern University have used a massive number of 1.5 million participants in their study to develop a data set. They collected information from four questionnaires for its 1.5 million respondents and combined data retrieved from John Johnson's IPIP-NEO, the myPersonality project and the BBC Big Personality Test datasets. These questionnaires had between 44 to 300 questions and have been comprehensively designed by researchers over years. People voluntarily take these internet quizzes in order to receive feedback on their personality and all this useful data is now available to researchers worldwide for their own investigation and analyses. Only because of the power of internet that it is possible to collect such data easily and all information can be logged. Earlier questionaries' had to be physically distributed and collected, which required huge manpower and was geographically limited. The most powerful aspect of the current study is the utilization of already available data.

When researchers tried to sort out the data by using traditional clustering algorithms, they experienced inaccurate results which vaguely suggested 16 personality types. So, they decided to change their strategy. They first used standard clustering algorithms to search available data but imposed additional constraints. They they plotted on a quadrant graph on how the data set manifested five most widely accepted traits of personality: neuroticism, extraversion, openness, agreeableness and conscientiousness. These traits called the 'Big Five' are accepted as the most reliable and replicable domains of human personality. Looking at the plots, researchers observed four major types of personality based upon their higher grouping. They went ahead and validated the accuracy of new clusters through teenage boys – considered to be vain and selfish – and are definitely the biggest cluster of 'self-centred' similar people across different demographics.

The four different groups are defined as reserved, role models, average and self-centred.
a) Reserved people are not open but are emotionally stable. They are introvert and mostly

agreeable and conscientious. This trait is the most neutral irrespective of age, gender or demography.

b) Role models are though low in neurotic charactertics but are high in others and have leadership qualities. They are nice, open and flexible to new ideas and most of the time dependable. Women were seen more in this group. And for obvious reasons people more than 40 years of age because the likelihood of being a role model increases with age. Authors state that being around more role models can make life easy and comfortable.

c) Average people are highly extrovert and neurotic and this is the most common type. These people tend to have an average score in all traits and in this group, there are women slightly more than men. According to the authors this would be a 'typical' person.

d) Self-centred people as the term suggests are highly extrovert but non-openminded. They are also not agreeable or conscientious or hardworking. Expectedly there are more teenagers in this group especially boys. And no women over 60 years of age are in this group.

The 'average' type of personality might be considered as the 'best' or 'safest'.

It is also discovered that as people mature, that is from adolescent to late adulthood, the personality types often shift or change from one type to another. Example people under 20 years of age are generally more neurotic and less agreeable compared to older adults. Such studies done on a large scale displays better results but how these character tics change with age needs to be investigated further. The methodology adopted is being labelled quite robust by experts. Such a study is not only interesting but can be of use to hiring personnel to look for potential people who can be a good fit for a particular job or organisation. It can be a useful tool for mental healthcare service providers to be able to assess personality types which have extreme traits. It could also be used for a dating service to meet suitable matching partner or the complete opposite even as it is believed that 'opposites attract'.

Source

Martin Gerlach, Beatrice Farb, William Revelle, Luís A. Nunes Amaral 2018, 'A robust data-driven approach identifies four personality types across four large data set', *Nature Human Behaviour*,
DOI: https://doi.org/10.1038/s41562-018-0419-z ■

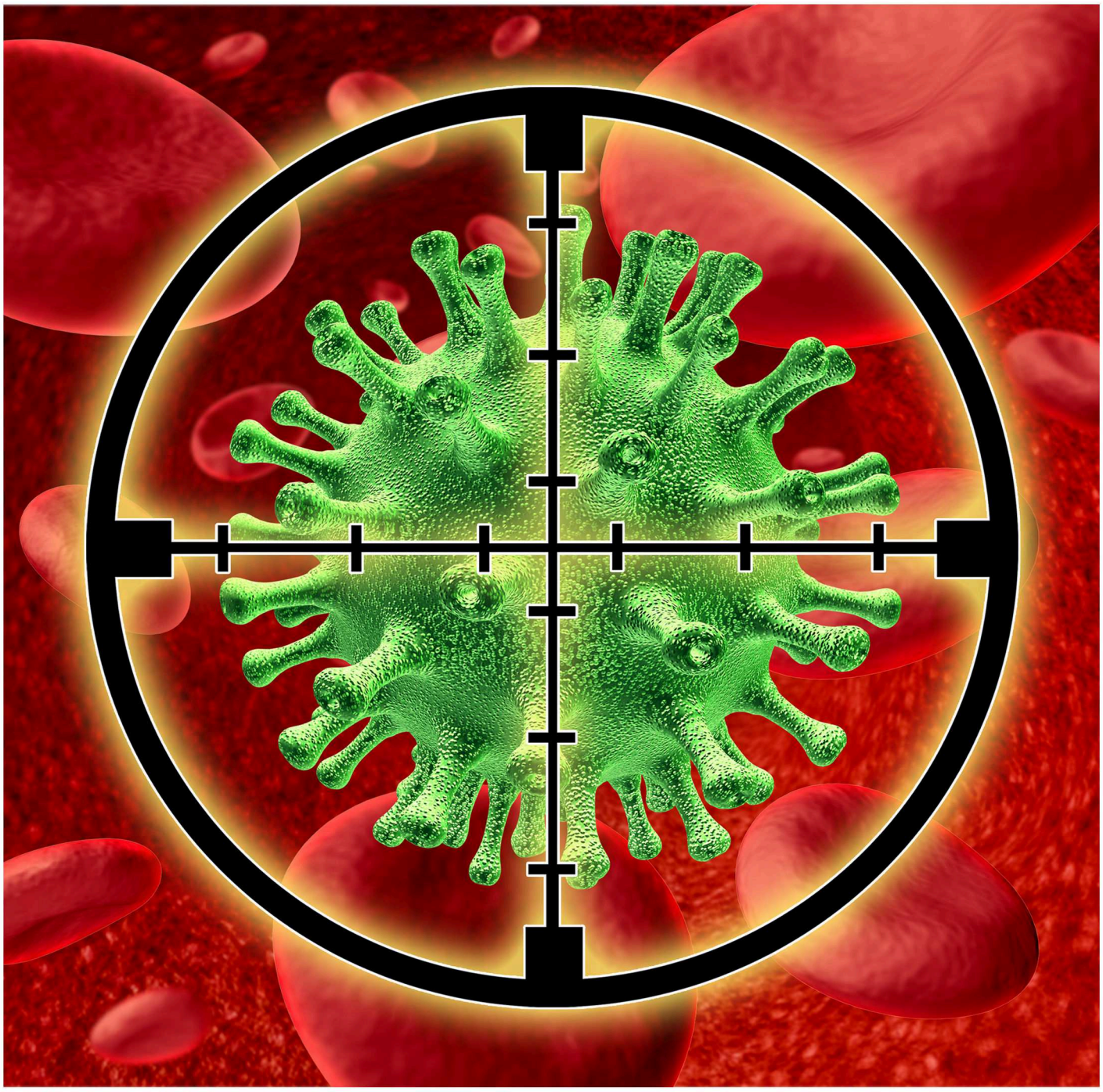
A New Drug to Fight Advanced Drug-resistant HIV Infection

Researchers have designed a novel HIV drug which can help fight advanced, drug-resistant HIV infection in patients who have no other treatment options.

At least 40 million people are living with HIV till mid-2018. HIV (Human immunodeficiency virus) is a retrovirus which attacks the crucial immune cells of our body (CD4 cells) which are integral to our immune system. This virus which is then found in all tissues in the body is transmitted from one human to another through body fluids of the infected person. AIDS (acquired immunodeficiency syndrome) is caused by HIV and this disease alters one's immune system completely making the person prone to infections and diseases. Despite our understanding of HIV and significant research in this area, prevention, care and efficient treatment of HIV infection remains a challenge. If HIV is left untreated, the virus attacks the immune system and can cause various life-threatening infections and cancers. Effective treatment of HIV with HIV drugs which are able to control the spread of the virus is available and patients with HIV can still lead healthy lives and lower the risk of transmission to others. Unfortunately, no cure exists for HIV as yet.

Challenges of current anti-HIV drugs

Most drug therapies available for HIV treatment – called antiretroviral therapy (ART) - involve taking medicines that slow the progression of the virus in the body. These existing drug therapies also have multitude of challenges attached to them particularly in middle- and low-income countries. There is always a delay in starting the treatment because first serious symptoms show up only when the virus has spread in the body. The known drugs also have considerable side effects. Also, drug resistance is a grave problem -when HIV medicines that previously controlled a person's infection are not effective against new, drug-resistant HIV. So, HIV medicines cannot prevent drug-resistant HIV from multiplying and such an acquired drug resistance can cause HIV treatment to completely fail. The existing drug therapies also do not work for some individuals as they have no effect on the virus and in turn lead to drug resistance and worse condition of the disease. Many HIV drugs are known to target the virus effectively, however despite extensive research no new class of HIV drugs has been discovered in the past decade.



Key Points

- Prevention, care and efficient treatment of HIV infection remains a big challenge.
- A new drug is seen to effectively reduce the virus and boost immunity in patients who are left with no treatment options.

A new anti-HIV drug which targets a novel mechanism

In March 2018, US Food and Drug Administration has approved a new drug called 'ibalizumab' which targets the primary receptor protein which is responsible for entry of HIV virus into the immune cells called CD4 T cells. The drug which is a monoclonal antibody targets this particular mechanism for the very first time in which the entry itself of the virus into the target cells can be prevented. The study describing phase III clinical trials is published in *New England Journal of Medicine*. Participants suffering from multi-drug resistant HIV were enrolled in the study at

multiple sites. These patients were suffering from advanced form of HIV infection and had resistant virus with virtually no treatment possibilities left for them.

The patients were given a dosage of ibalizumab (by directly injecting into the bloodstream) in addition to the HIV drugs they were already taking, for a period of one week. After this period, they were given ibalizumab combined with known effective drugs for a period of six months. It was observed that after a week's time itself, 83% patients exhibited suppression in amount of HIV virus (called the viral load) detected in their blood. After 25 weeks, 43 percent of the patients had viral load which was below the detectable limit. Alongside CD4 T cells - a known marker for immune strength – increased in the body. This is a remarkable result which generated immense hope. The viral suppression remained steady from week 24 till week 48 post start of the treatment. The trial conducted differed from previous trials for anti-HIV drugs. Firstly, the sample size was proportionate with population having multi-drug resistant HIV infection. The main assessment on how exactly the virus was getting depleted was done between 7 to 14 days of the start of the treatment. Patients also received their own personalised medication regime. Finally, durability and safety testing were done after 24 weeks (unlike 48 weeks in previous trials). Some adverse events were noted in the participants, like diarrhoea was most common. Authors pointed out that most adverse events were not directly linked to the drug ibalizumab. A small set of patients were enrolled because of the uncommonness of multi-drug resistant HIV and this is being labelled 'adequate' by some experts.

A combination of existing HIV medicines and this new drug ibalizumab looks like a good strategy for patients who have already undergone different drug therapies and are essentially left with no further options of treatment while having developed multi-drug resistance. The new drug effectively reduces the virus and boosts immunity in patients in such patients. Interestingly, the mechanism targeted by this drug is unique and therefore this drug cannot interact negatively with other drugs or medicines. It has to be intravenously injected once every two weeks and it persists more than currently available HIV drugs which are required to be taken orally every day. This is certainly a new class of medicine having a unique mode of delivery.

Source

Brinda Emu et al. 2018, 'Phase 3 Study of Ibalizumab for Multidrug-Resistant HIV-1', *New England Journal of Medicine*,
DOI: https://doi.org/10.1056/NEJMoa1711460 ■

Have We Found the Key for Longevity in Humans?

A crucial protein which is responsible for longevity has been identified for the first time in monkeys

Plethora of research is happening in the field of ageing as it is absolutely essential to understand the genetic basis of ageing to be able to comprehend how to delay ageing and treat age-related diseases. Scientists had discovered a protein called SIRT6 which is seen to control ageing in rodents. It's possible that this could also affect development in nonhuman primates. In 1999, Sirtuin family of genes and their homologous proteins including SIRT6 was linked with longevity in yeast and later in 2012 SIRT6 protein was seen to be involved in regulation of ageing and longevity in mice as deficiency of this protein led to characteristics associated with accelerated ageing like spinal curvature, colitis etc.

Using a model which is evolutionarily similar to human, like another primate, can fill the gap and guide us about the relevance of research findings to humans. A recent study published in *Nature* is the first ever work on understanding the role of SIRT6 in regulating development and lifespan in advanced mammals like primates[1]. Scientists from China bioengineered world's first primates' macaques (monkeys) lacking their SIRT6 protein producing gene by using CRISPR-Cas9-based gene editing technology and experiments so that they could directly observe the effect of SIRT6 deficiency in primates. A total of 48 'developed' embryos were implanted in 12 surrogate mother monkeys out of which four became pregnant and three gave birth to baby monkeys as one got aborted. Baby macaques which lack this protein died within hours of birth in contrast to mice which start showing 'premature' ageing in about two-three weeks of birth. And unlike mice, SIRT6 protein is seen to play a crucial role in embryonic development in monkeys because absence of SIRT6 caused serious full body developmental delays and defects. The three new-born babies showed lower bone density, smaller brain, immature intestines and muscle.

Baby monkeys exhibited serious prenatal development retardation leading to serious birth defects caused by delayed cell growth e.g. in brain, muscle and other organ tissues. If a similar effect would be seen in humans then a human foetus would not grow more than five months though it will complete the stipulated none months inside mother's womb. This would be due to loss of function in SIRT6-producing gene in the human foetus causing it to grow inadequately or die. Same team of scientists have shown earlier that SIRT6 deficiency in human neural stem cells can affect proper transformation into neurons. The new study bolsters that SIRT6 protein is a likely candidate for being a 'human longevity protein' and could be responsible for regulating human development and life span.

This study has opened up new frontiers for understanding human longevity proteins in the future. Discovery of crucial proteins can throw light on human development and ageing and direct treatment design for developmental delays, age-related disorders and metabolic disease in humans. This study is already done in monkey, so there is hope that similar studies on humans can shed light on important longevity proteins.

Ageing remains an enigma and mystery for mankind. Research on ageing has been often discussed much more than any other area because of the importance given to youth in society and culture. Another study[2] published in Science showed that there may not even be a natural limit for longevity in humans. Scientists from University of Roma Tre in Italy have performed a statistical analysis on the possibilities for survival in around 4000 elderly people who were between 105 years and older and stated that at the age of 105 a 'mortality plateau' is reached which means no limit to longevity now exists and after this age the possibility of life and death is at 50:50 i.e. someone could just live much longer hypothetically speaking. It is believed by medical experts that risk of death increases from adulthood till the age of 80 or so. Very less knowledge is available about what happens after 90s and 100s. This study says that human lifespan may not have any upper threshold! Interestingly, Italy is one of the countries having highest number of centenarians per capita in the world so it's a perfect location, however, to generalize the study further work is needed. This is the best evidence for age mortality plateaus in humans as very interesting patterns emerged. Scientists want to understand the concept of levelling in detail and it seems after one crosses 90s and 100, our body's cells may reach a point where repair mechanisms in our body can offset the further damage in our cells. Maybe such a mortality plateau could even stall death at any age? There is no immediate answer and many experts state that this study is serious overreaching and biologically implausible as the human body is designed in such a way that it will have its own limitations and boundaries. Many cells in our body do not replicate or multiple after forming the first time around - example in brain and heart - so these cells will die in the ageing process.

Source

1 Weiqi Zhang et al. 2018, 'SIRT6 deficiency results in developmental retardation in cynomolgus monkeys', *Nature,* vol. 560,
DOI: https://doi.org/10.1038/d41586-018-05970-9

2 Elisabetta Barbi et al. 2018, 'The plateau of human mortality: Demography of longevity pioneers', *Science*, vol. 360, no.6396,
DOI: https://doi.org/10.1126/science.aat3119 ■

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