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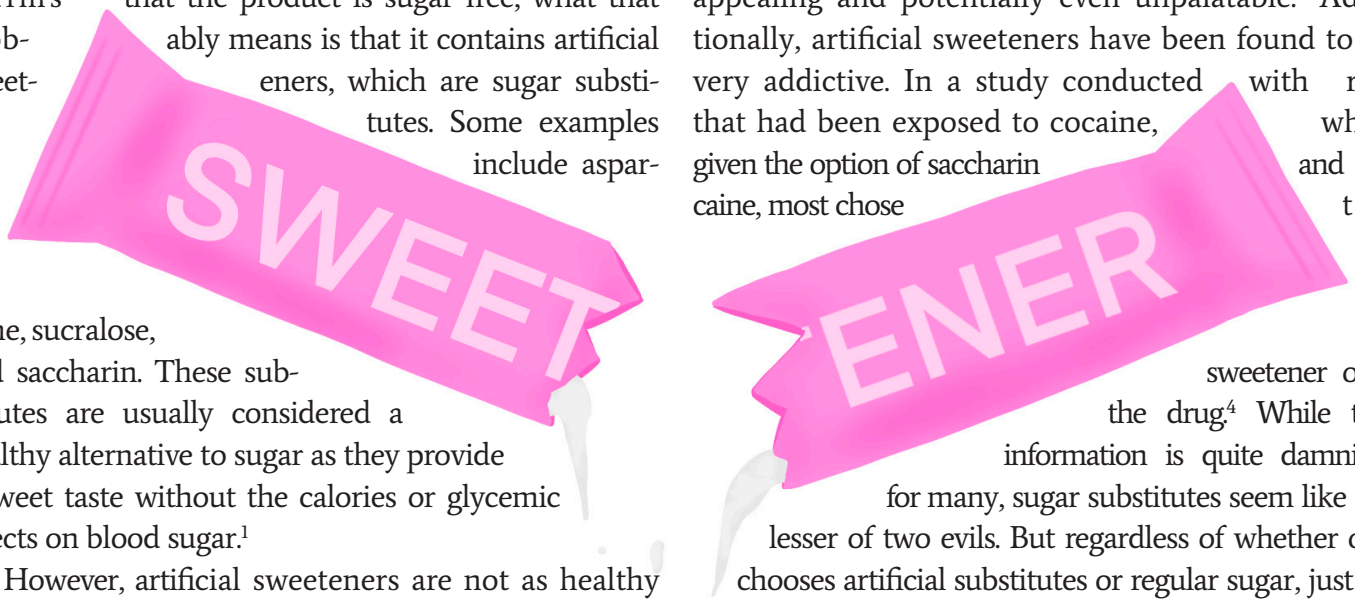
CONTENTS

THE HARMFUL SIDE OF ARTIFICIAL SWEETENERS

By Rosemary Wolff '23

When people go out grocery shopping, they may, out of habit, reach for the package that says "No Added Sugar" or "Sugar Free" or "Diet" without considering what those labels really mean. Though the package claims that the product is sugar free, what that probably means is that it contains artificial sweeteners, which are sugar substitutes. Some examples include aspartame, sucralose, and saccharin. These substitutes are usually considered a healthy alternative to sugar as they provide a sweet taste without the calories or glycemic effects on blood sugar.[1]



However, artificial sweeteners are not as healthy as people are led to believe. They can have many negative effects on people's health, especially for those who have a high intake of these sugar substitutes. One study showed that daily consumption of artificially sweetened soda drinks was linked to a 67% greater risk of type 2 diabetes. The intake of these sweeteners can increase the desire to consume sugary, energy-dense foods and beverages. As a result, the study suggested that drinking diet soda may have caused overconsumption and weight gain.[2] In addition, evidence suggests consistent use of these substitutes raises the risk of several other chronic diseases, including obesity and heart disease.[1]

In addition to affecting our physical health, consumption of artificial sweetener may also alter healthy behaviors. Research shows these sweeteners can make us dissociate sweetness from caloric intake, thus making us crave more sweets, make unhealthy food choices, and gain weight.[3] Routine use can also make sweet food less appealing and potentially even unpalatable.[3] Additionally, artificial sweeteners have been found to be very addictive. In a study conducted with rats that had been exposed to cocaine, when given the option of saccharin and cocaine, most chose the sweetener over the drug.[4] While this information is quite damning, for many, sugar substitutes seem like the lesser of two evils. But regardless of whether one chooses artificial substitutes or regular sugar, just remember: everything in moderation.

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Graphics by Sesame Gaetsaloe '21

THE FAT TRUTH

By Jayden Khuu '21

The U.S., in spite of numerous breakthroughs in health treatments, has had a third straight year of declining life expectancy[1] — and the reason why may lie in diet. The typical western diet derives only 20% of its calories from fat, 55% less than that of our ancestors.[2] Though fats have long been deemed unhealthy, they actually provide many health benefits that a low-fat diet fails to take advantage of.

From a molecular standpoint, fats are made up of glycerols and fatty acids. Saturated fats like butter contain fatty acid chains with only single bonds, which give the fats their solid-state at room temperature. Unsaturated fats, which are often plant oils, have unsaturated fatty acid chains that have double bonds. These double bonds lend the unsaturated fats their liquid state at room temperature.

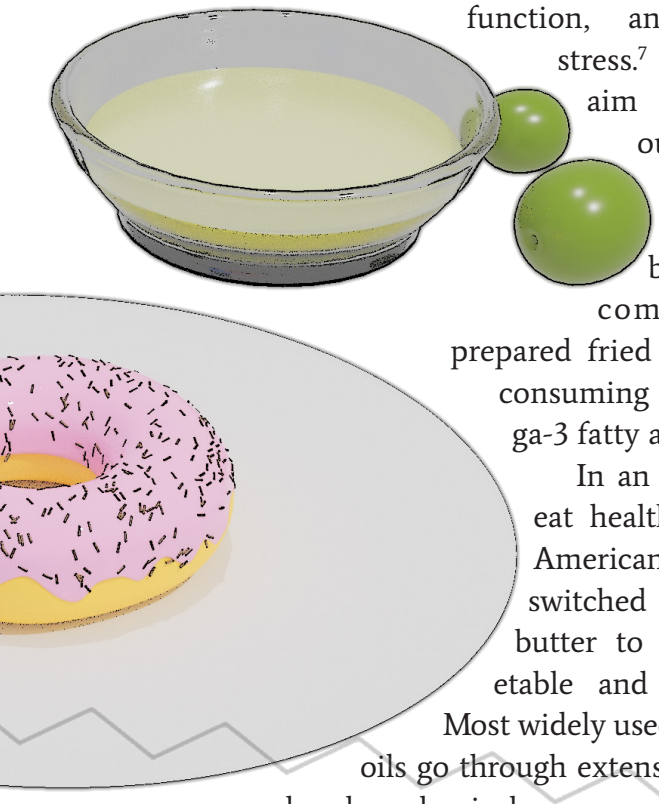
The health benefits of consuming unsaturated fats over saturated fats and trans-fats are overwhelming. Studies have shown that the consumption of unsaturated fats can reduce low-density lipoprotein (LDL) blood cholesterol levels and the risk of developing chronic heart disease.[3] There aren't exclusive benefits to consuming monounsaturated fats over polyunsaturated fats as a whole. Rather, the sources and types of monounsaturated and polyunsaturated fats play a larger role in dictating the health benefits we can derive from consuming them.

Monounsaturated fats are defined by their single double bond in the fatty acid chain. Olive oil, peanut oil, avocados, and nuts are major sources of monounsaturated fat. However, not all of these sources were created equal, as olive oil and nuts emerge superior in health benefits. Olive oil is rich in oleic acid, which has been shown to be beneficial to genes linked to cancer,[4] and nuts are rich in antioxidants and vitamins. Moreover, noticing the relatively low incidence of heart disease, diabetes, and dementia in the Mediterranean, a group of researchers performed a large scale study that followed over seven thousand people over a 4.8 year time period.

Graphic by Elton Zheng '22

They prescribed three different diets: a Mediterranean diet supplemented with olive oil and second, a Mediterranean diet supplemented with nuts, and a control diet. The Mediterranean diets supplemented with olive oil and nuts were statistically shown to reduce the occurrence of cardiovascular events.[5]

Polyunsaturated fats, as suggested by their name, have multiple double bonds in their fatty acid chains. They mainly contain omega-3 and omega-6 fatty acids, which are essential fatty acids our body requires to function. However, there is a serious imbalance between our omega-3 and omega-6 consumption. Nowadays, most commercially prepared foods are prepared with vegetable, canola, and corn oil that are high in omega-6 fatty acids. An optimal omega-6 to omega-3 ratio should be lower than four to one, but studies suggest that most western diets have a ratio between 10 to 1 and 50 to 1, leading to chronic inflammation and an increased risk of heart disease.[6] Omega-3, on the other hand, can protect against heart disease, optimize brain function, and reduce stress.[7] We should aim to reduce our intake of omega-6 oils by avoiding commercially prepared fried foods and consuming more omega-3 fatty acids.



In an attempt to eat healthier, many Americans have switched from using butter to using vegetable and seed oils. Most widely used vegetable oils go through extensive chemical and mechanical processes during the extraction. These highly refined oils can be easily oxidized and lead to free-radical formation, damaging cells in the process. Moreover, small amounts of trans fat can be formed in this process and, since food manufacturers do not have to report amounts under 0.5 grams (given, the FDA allows manufacturers to round to the nearest gram),[8] these "healthy" oils prove too good to be true.

Neuroscientist and nutritionist Dr. David Perlmutter said it best: most of us equate the idea of eating fat to *being* fat.[2] In reality, we will all benefit from consuming less carbohydrates — which cause spikes in our blood sugar and insulin levels — and depending more on fats. We can all begin by eating more fish, extra-virgin olive oil, and nuts to reap the many benefits fats provide.

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BREAST CANC

By Sofia M

In the United States, breast cancer is the most commonly diagnosed cancer among women, with an estimated 276,480 invasive cases expected to be diagnosed in 2020.[1] Breast cancer takes the form of abnormal growth in the cells of the breasts. Though it is most commonly diagnosed in women, men can be affected as well. For many years, the primary method of diagnosing breast cancer was through mammograms, which are x-ray images of the breast.[2] However, mammograms are costly, uncomfortable, and inconvenient for many. To alleviate this issue, an innovative blood test was created and recently unveiled at the 2019 NCRI (National Cancer Research Institute) Conference. This new test has the potential to identify signs of breast cancer up to five years before the appearance of any clinical symptoms,[3] as it can detect specific markers in the blood of a person before a lump shows up on a mammogram.

The body naturally produces autoantibodies in response to proteins called antibodies that are made by invasive cancer cells. At the University of Nottingham, in the United Kingdom, researchers have found that specific tumor-based antigens (TAAs) are reliable indicators of cancers. These researchers have developed panels of TAAs that come from patients or normal subjects who participate in medical investigations.[4] These TAA panels are directly associated with breast cancer, and can perceive whether or not there are autoantibodies present to act against the cancer's antibodies.[3]

The University of Nottingham researchers, who are a part of the Centre of Excellence for Autoimmunity in Cancer (CEAC) group, started a pilot study in 2019. In this study, they took 90 blood samples from breast cancer patients who had just received their initial diagnosis. The samples were then compared to 90 other samples of blood from people who did not have breast cancer. The researchers utilized screening technology called a protein microarray, which is when different molecules of protein are affixed in separate locations in an organized manner, forming what is known as a microscopic array.[5] By experimenting using protein microarrays, researchers were able to screen the blood tests quickly for the presence of antibodies, which would indicate the presence of cancer cells. Ms. Daniyah Alfattnai, a Ph.D. student who is a part of the CEAC group, stated, "The results of our study showed that breast cancer does induce autoantibodies against panels of specific tumor-associated antigens. We were able to detect cancer with reason-

Graphic by Ser

LANDSCAPE OF ER DIAGNOSIS

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able accuracy by identifying these autoantibodies in the blood."[3]

There were three specific panels of TAAs that researchers determined could be used against antibodies. The more TAAs, the more the results of the panels improved. The first panel, which had five TAAs, yielded breast cancer in 29% of samples from the breast cancer patients and precisely labeled 84% of the samples being cancer-free, which was accurate.[3]

While there is still work to be done to perfect these tests, they may be able to catch breast cancer five months earlier than usual due to the accuracy of the results and how quickly they can be communicated to patients and researchers. The researchers estimate that with the help of additional funds, the blood test could become available in special clinics in around four to five years.

Why could this simple blood test be revolutionary? The answer is that it is a simple, cost-effective alternative to the mammogram, the price of which can range from $100 to $250.[6] The Affordable Care Act, Medicaid, and Medicare can cover the costs of receiving one; however, people who aren't insured simply cannot afford it. Moreover, administering blood tests could become a more efficient way of testing for breast cancer. If breast cancer can be detected at an early stage, more patients could receive treatment earlier and get a better prognosis. Blood tests would also be easier on patients, as it is a more straightforward screening method.

Thanks to these researchers, breast cancer diagnosis can finally become accessible for people of all financial statuses, providing the opportunity for easier and earlier detection.

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THE ROAD TO RECOVERY

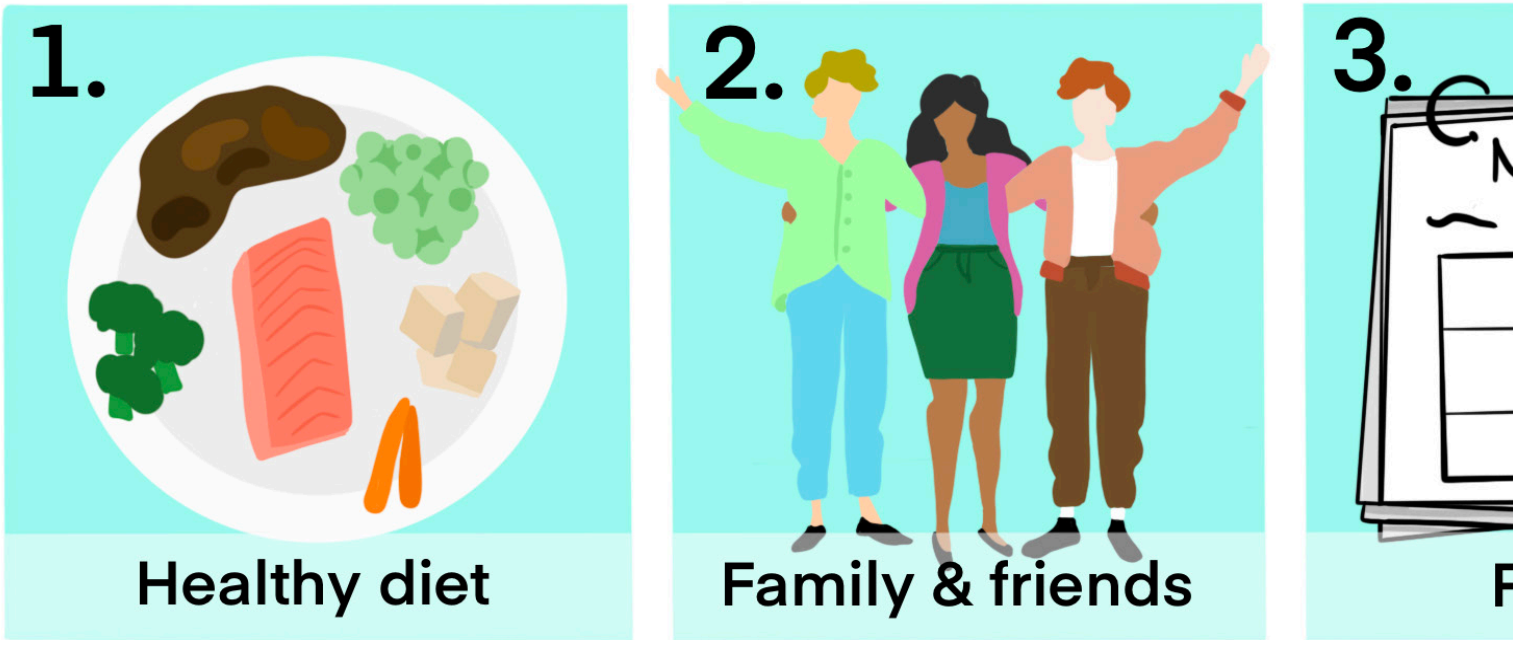
By Bella Capuano '21 and Renee Jiang '22

Universally enjoyed by children and adults alike, sports not only serve as a form of entertainment but also boost psychological and physical health. With these benefits, however, comes the risk of injury. Sport injuries, while common, should be taken seriously, and it is important for injured athletes to focus on healthy recovery rather than getting back on the field as quickly as possible. Coping with injuries includes both physical and psychological rehabilitation, as sports injuries can often take a toll on athletes mentally and emotionally. Given the uniqueness of each injury, the recovery process can vary significantly from person to person; therefore, it is important to always consult with an athletic trainer or medical professional.

The first few days of almost every sports injury center around rest, ice, compression, and elevation (RICE) to control inflammation, as well as range of motion (ROM) exercises to reduce swelling and stiffness.[1] Then, depending on the diagnosis and severity of the injury, the medical professional will determine the best course of treatment. Most commonly, the recovery process starts off with resistance training for "the restoration of balance, the development of reflex control, the redevelopment of neuromuscular control and function, and the development of strength and endurance in injured tissues."[2] After first healing the injury, the focus shifts to functional recovery through more aggressive efforts to retrain strength and endurance.[2] Following a full muscle and function recovery, the athlete must undergo exercises specific to their sport and be monitored carefully to prevent re-injury before returning to gameplay.

For a full recovery, injured athletes must also combine physical rehabilitation with mental and personal recovery, which requires patience and positivity. My own experiences with sports injuries have supported the idea that an effective psychological rehabilitation correlates to a faster recovery.

In the case of both of my injuries in the past two years, I tore the meniscus of my knee. The first time, my recovery process was foreign and extensive. Despite



Graphic by Sesame Gaestsoloe '21

undergoing physical therapy for one and a half months, I only returned to 50% of my original state and was not ready to get back on the soccer field until almost three months after my initial injury. However, my second injury's recovery process proved much less difficult, as I immediately started physical therapy alongside working on personal and emotional recovery. Here I will share some of my personal recovery strategies I completed to ensure the most efficient and safe recovery:

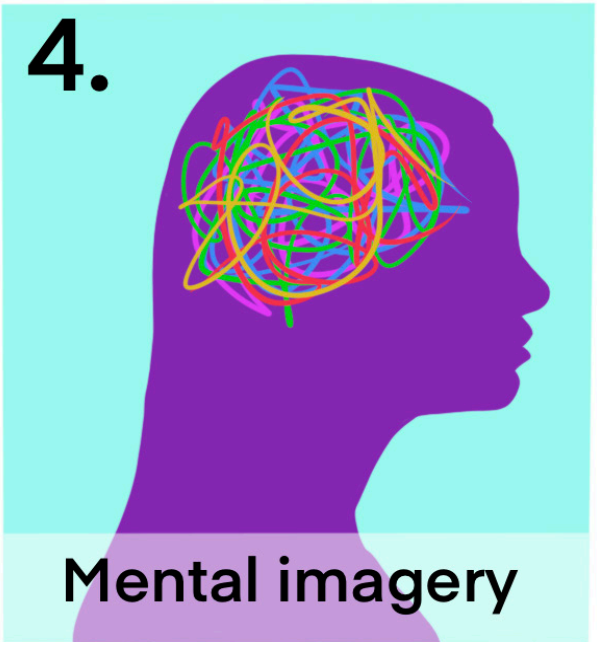
1. Implement a healthy diet. Since proteins are the building block of muscles, a protein-rich diet helps prevent inflammation and assists in rebuilding lost muscle. The best foods for this are fish, tofu, poultry, beans, peas, nuts, and seeds. In addition, the Vitamin C found in fruits and vegetables can help speed up recovery. It plays a major role in building the collagen of your bones, tendons, muscles, and skin and also has properties that prevent inflammation.[3] I personally recommend making smoothies and topping it with coconut, granola, and seeds.

2. Lean on family and friends for support. The recovery process may feel lonely at times, but surrounding yourself with friends is important for sustaining a happy and energetic mindset. Additionally, attend sports practices even if you can't participate — being surrounded by your teammates can provide motivation to continue the slow process of recovery.

3. Give it a little more, but don't be too hard on yourself. This may sound cliché, but you know your body the best. It is critical to heal slowly without pushing your body to its limits just to speed up the recovery and risk reinjury. Since setbacks are common with every injury, it is important to find the right balance between rest and exercise. Patience is key to having a full recovery and minimizing health risks in the long run.

4. Develop mental imagery. A visualization of yourself performing your sport will help connect the mind and body, activating your muscles physically by tricking your body into actually performing the sport.[4] Mental imagery offers the opportunity for you to maintain both physical and mental sports skills, while also boosting motivation and confidence.

Implementing careful physical and mental recovery strategies following an injury will help ensure full recuperation. The process can be long and frustrating, but it is important to be patient with yourself and with your body, seeking guidance and support from medical professionals and loved ones.



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CALORIE RESTRICT
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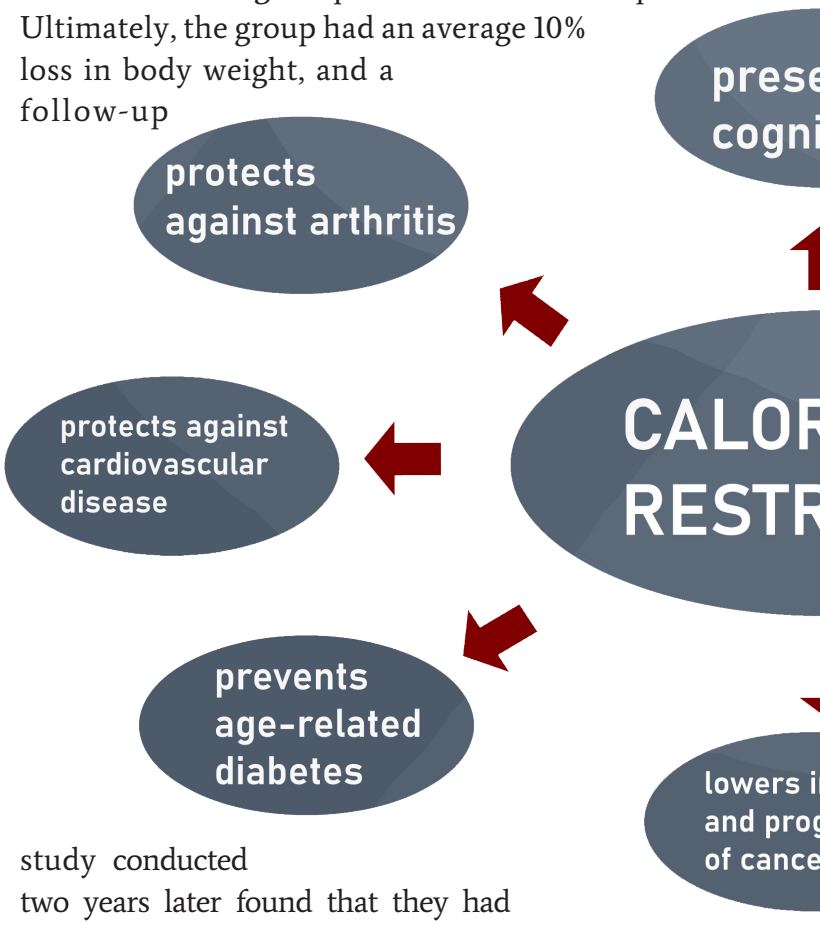
By Deven H

Calorie restriction is a popular diet method for those looking to lose weight as well as for some athletes. Unlike many other diets that may restrict food groups, calorie restriction simply involves consuming fewer calories while maintaining a balanced diet that provides the necessary macro and micronutrients. People who find some other fasting diets difficult or too limiting may choose calorie restriction for its flexibility in food choice.[1] Beyond calorie restriction as a weight loss strategy, however, recent studies suggest that it may bring many health benefits.

One of the first studies on calorie reduction was on a group of individuals who voluntarily practiced extreme degrees of calorie restriction over many years, believing that it would extend lifespan or preserve health. Over the course of the study, scientists found that the individuals had improved bodily functions, including markedly low levels of risk factors for cardiovascular disease and diabetes. Other physiological effects, such as reductions in sexual interest and the ability to maintain body temperature in cold environments, were also found. However, these people also consumed a variety of nutritional supplements on a daily basis, which limits knowing for sure which effects are due to calorie restrictions.

After this study, the National Institute on Aging (NIA) supported a clinical trial called Comprehensive Assessment of Long-term Effects of Reducing Intake of Energy (CALERIE), in which 218 adults of varying ages and weight were divided into two groups to test the effects of calorie restriction. People in the experimental group were told to follow a calorie restriction diet for two years, while the others continued their usual diets. During the two year period, the experimental group reduced their daily caloric intake by 12%, while maintaining adequate nutrient consumption. Ultimately, the group had an average 10% loss in body weight, and a follow-up study conducted two years later found that they had sustained much of this weight loss. The experimental group had reduced risk factors for age-related diseases such as diabetes, heart disease, and stroke. They also showed decreases in some inflammatory factors and thyroid hormones. Moreover, in the calorie-restricted individuals, no adverse effects on quality of life, mood, sexual function, and sleep were found.[1]



The evidence presented by the study shows that calorie restriction can potentially be a healthy

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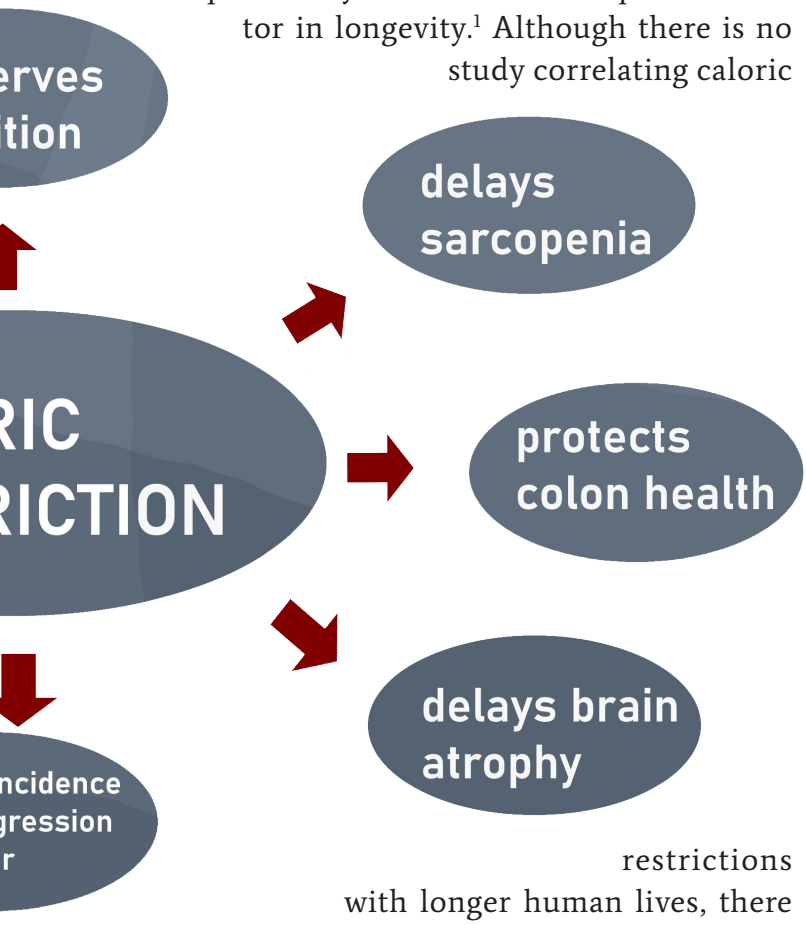
dietary routine with physiological benefits. But the primary reason the NIA is researching calorie restriction goes beyond the health effects: calorie consumption may in fact be an important factor in longevity.[1] Although there is no study correlating caloric



restrictions with longer human lives, there have been plenty of studies on animals. In 1935, Cornell scientist Clive McCay found that rats on a calorie-restricted diet lived nearly 30% longer than those on "normal" diets, leading to a series of subsequent experiments to test this theory on a variety of other animals.[2] These studies found that calorie restrictions increase life expectancy through two processes: reducing the production of “damaged” forms of oxygen and increasing cell resistance to stress. Combined, these effects lead to a lower risk of cardiovascular diseases and cancer, supporting a long life.[2] In two other studies by the NIA, rhesus monkeys were kept on a calorie-restricted diet of about 30% fewer calories for more than 20 years.[1] Both studies provided evidence that a restricted diet reduced the appearance of age-related conditions, such as cancer, heart disease, and diabetes. To this day, many of the monkeys involved in the studies are still alive, so the full impact of calorie restriction on their maximum lifespan has yet to be determined. Nonetheless, this study has led to the longest-living rhesus monkeys kept in captivity. There is a large possibility that calorie restriction also provides similar longevity benefits for humans, as rhesus monkeys share a 93% genetic resemblance with humans, along with similar sleeping and eating patterns.[3]

Caloric restrictions are obviously not to be done in isolation, or to be done to an extreme level. It is a practice that should be in tandem with daily exercise and a healthy amount of sleep, and if cultivated carefully, calorie restriction seems to be a promising contributor to a longer, healthier life.

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Graphic by Elton Zheng '22

BIG DATA ANALYSIS FOR A

By Claren

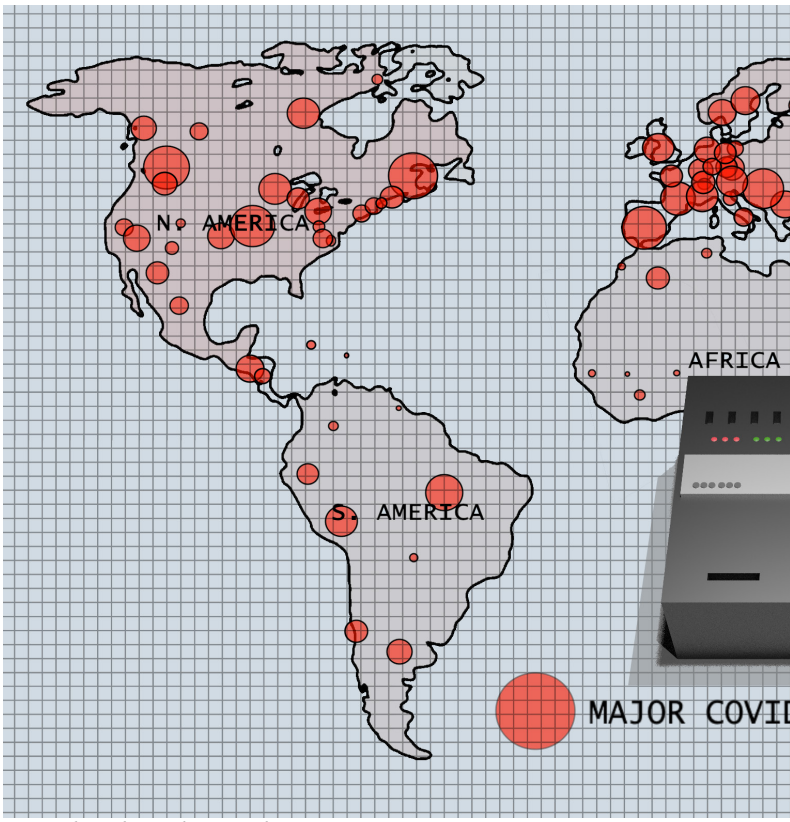
Imagine a future world in which the season's flu forecast can be readily accessed on the internet. In this imaginary world, scientists can predict the spread of infectious diseases with the certainty of a meteorologist mapping the weather. The only problem with attaining this future? According to Cécile Viboud, an epidemiologist at the U.S. National Institutes of Health Fogarty International Center, "There is just not a lot of observational data in the disease world."[1] Despite this hurdle, what if this future is actually more feasible than scientists have previously predicted?

Over the past 15 years, there has been a rapid emergence of data science research promoted by the increasing prevalence of electronic records and data generated by the use of the internet, mobile phones, satellites, and radio-frequency sensors.[2] Scientists are particularly interested in "big data," data sets so long and complex that modern computing technology cannot even come close to analyzing.

Currently, researchers are developing new technologies to collect and interpret this big data in hopes of revealing hidden patterns and connections through careful analysis. These new patterns could make a substantial difference in a diverse range of fields, including medicine.[3] Take cancer for example: big data could help fight cancer through prompt diagnosis, which can help contain the cancer early before it spreads and becomes inoperable.

Additionally, big data can identify trends that will determine particular risk groups or reveal unknown links that can be investigated as a cause or cure. One example particular to cancer is the identification of the mutations most responsible for producing a set of tumor cells. In fact, a recent revelation has already proven big data analysis as extremely effective. Desipramine, a commonly used antidepressant, was newly revealed to be a potentially effective treatment for small-cell lung cancer.[3]

Another exciting aspect of big data analysis is infectious disease surveillance. By analyzing big data, scientists can gauge the severity of deadly diseases such as influenza A virus subtype H1N1. In 2009, the accessibility of large patient-level administrative databases and detailed mortality statistics in certain countries proved instrumental



Graphic by Elton Zheng '22

in understanding the transmission mechanisms, age patterns, and health burden of the 2009 H1N1 pandemic.

In Mexico, hospital data helped detect the unusual excess of severe pneumonia among younger adults and a sharp drop among the elderly in the first few weeks of the pandemic. Later, hospital and mortality records also

BRIGHTER MEDICAL FUTURE

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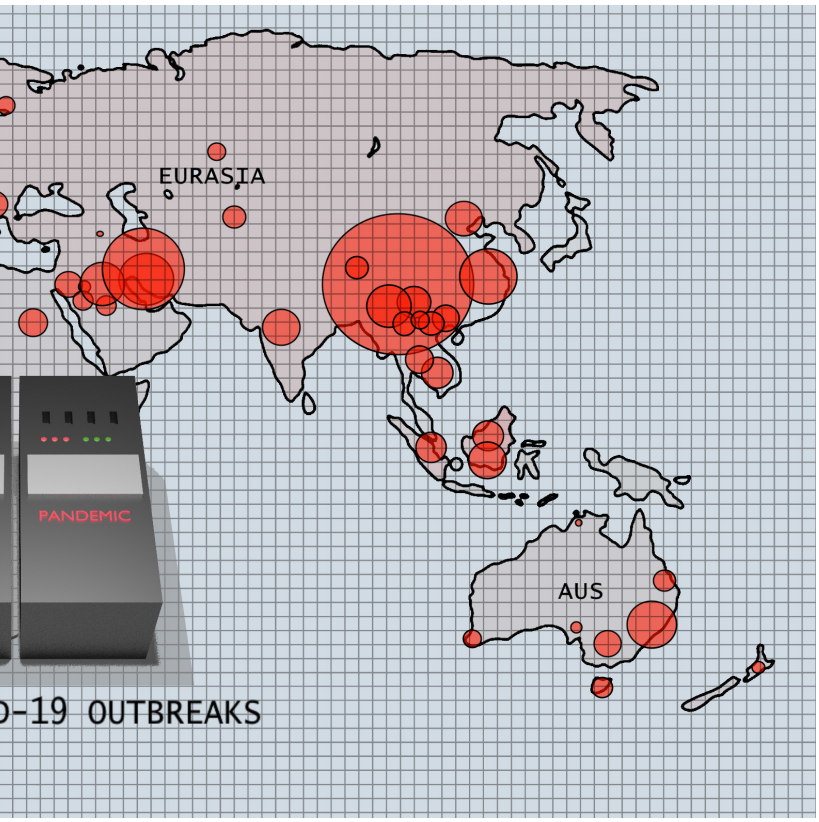
helped document the occurrence and severity of a fourth H1N1 pandemic wave. Results of big data analyses helped to promptly measure the severity of the novel influenza virus, allowing for quicker implementation of national and global intervention strategies.[4]

Although big data has potential as an early-warning and information-collecting system, it still implicates certain drawbacks and issues. For



one, there are many ethical concerns regarding the violation of patient privacy during the collection and analysis of big data.[4] There are also examples of failed data analysis systems such as Google Flu Trends (GFT), which appeared accurate when it was first introduced but failed to detect unusual patterns during the emergence of a pandemic, resulting in its eventual shutdown. Thus, if scientists do proceed with new big data analysis technology, it is imperative that the new system is carefully and continually verified against established systems.[2]

Another problem with big data analysis involves the common concern that big data may not accurately represent the general population. Since data streams mostly rely on the internet, they lack important demographic information such as age and sex. As a result, they represent only a limited segment of the population, with a lack of representation of infants, seniors, and citizens of developing countries.[2]

Finally, there is the concern surrounding data volatility, as they are not created specifically for surveillance or research purposes and may not reflect the true nature of a situation. Data streams are also not always continuous — instead, they are subject to user interest, popularity, and financial concerns.[2]

Despite certain reservations, big data analysis is nevertheless a huge step forward in disease documentation, prevention, and resolution. With this new technology, a world with effortless disease identification and prevention may actually be within reach after all.

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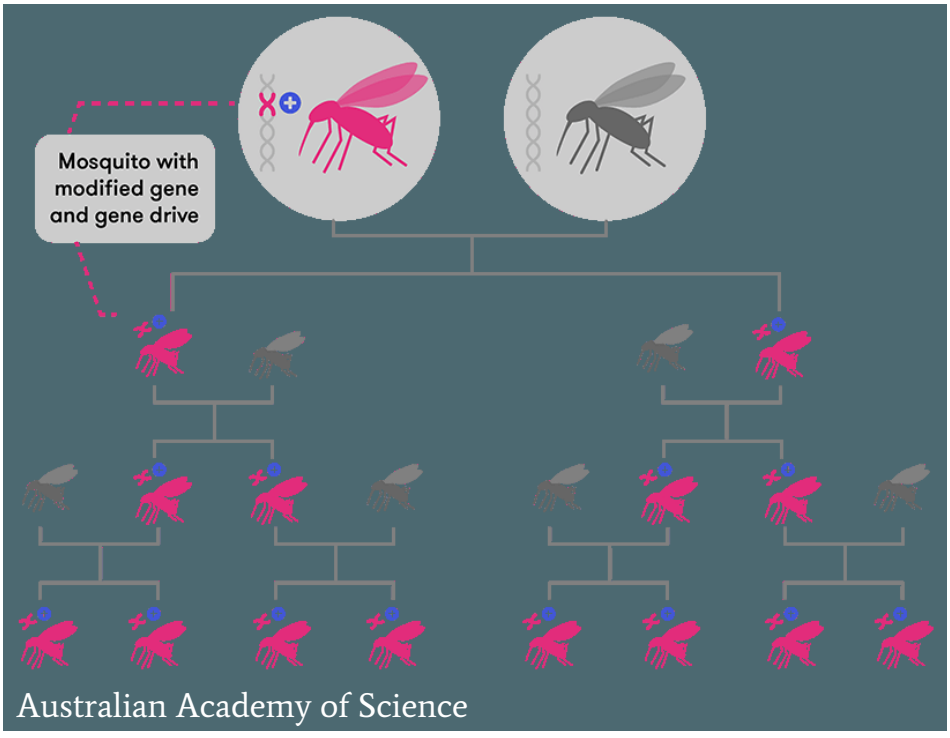
GATTACA IN REAL LIFE: THE RISE OF GENE DRIVES

By Kenadi Waymire '22

Is having a weighted die cheating in Yahtzee? If you could ensure that you'd always get a four-in-the-row, would you capitalize on the opportunity, even if it's immoral? Anthony James of UC Irvine and his team of biologists have been toying with this dilemma. In the summer of 2018, James and his team revealed to about two hundred writers, directors, and producers of scientific fiction media a new piece of biotechnology: gene drives.[1]

In short, a gene drive is a tool that can make some biological phenomena a certainty (gene editing, essentially). For example, two brown-eyed parents birthing a blue-eyed child is incredibly rare in the real world. With the use of gene drives, however, this could happen one hundred percent of the time. The changes caused by the use of gene drives aren't only apparent for one generation; they are passed down from parent to child. If gene drives were used on these brown-eyed parents to create a blue-eyed child, that child would also have a blue-eyed child. But beyond simply changing eye color, gene drives have the potential to drastically change an entire species.



Australian Academy of Science

James's team has been using these gene drives to engineer against health risks. While the work will need at least five years before it is ready to be released to the public, anti-malarial gene drives in Anopheles mosquitoes are currently deep in development. Another target is Lyme disease; the sandflies that transmit the leishmaniasis carrying Lyme to ticks can also have these carrier genes entirely deleted. This work, though, still has a ways to go. Even in the most developed use of gene drives, the output has only decreased the spread of malaria in these mosquitoes by around 1-2%.[1]

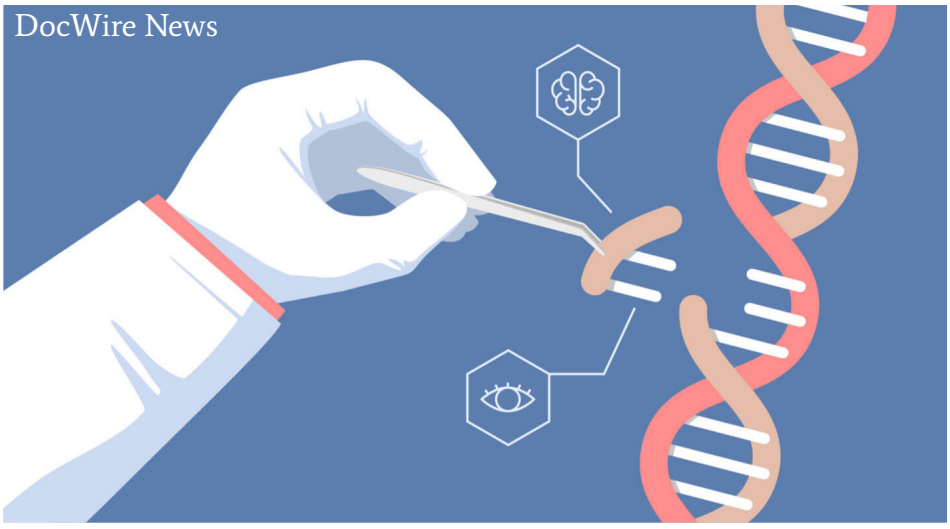
Though gene drives have immense positive potential, they also raise ethical concerns: perhaps people should not have the power to edit genes and alter populations.[2] Popular media has highlighted these issues around genetic engineering: see the 1997 science fiction movie Gattaca. Set in the future, eugenics has taken over society. At conception, wealthy parents can choose whether or not to

edit their child's genes. Physical strength, intelligence, longevity, and any other desirable trait can be purchased for their unborn child. Some parents forego this practice and birth a child normally; an unedited child is considered an "invalid," cast from any chance at an upper-class life. Despite the government technically outlawing genetic discrimination, invalids take up menial tasks and live quaint lives.[5]

In our world today, many of these same concerns arise. The National Human Genome Research Institute (NHGRI) brings up many ethical questions about genetic engineering. Informed consent is a mainline issue: as the decision to edit unborn children's genes would come from previous generations, would the person being edited have given full consent to the change?[6] Wealth inequality also plays heavily into the issues of human genome editing. Say genome editing becomes widespread — the process would, at least for a while, be incredibly expensive. This lends itself as a socioeconomic issue; if only the elite can afford such genetic changes, the gap between classes will only expand.

Despite the limitations and concerns that must be addressed, gene drives are an attractive technology that seems to suggest a future of possible biological longevity. With the use of Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), genetic engineering can become exponentially more accurate and efficient. CRISPR can be used to make targeted alleles act like building blocks, and scientists can easily rearrange DNA to obtain the desired effects.[3]

Valentino Gantz and Ethan Bier of UC San Diego teamed up to explore the use of CRISPR in fruit flies. They were able to turn nearly an entire generation of these flies (including the first generation) yellow, which was a previously recessive gene. These results proved the same, generation after generation.



Despite some moral concerns (What if some of the engineered flies spread the mutation?), Gantz and Bier published their research to raucous feedback.[4]

Technologies like the gene drive have opened new doors of scientific discovery. With further development of these techniques, entire diseases like malaria and Lyme disease could be wiped out. Though there are still ethical concerns to address, the future of genetic engineering seems bright.

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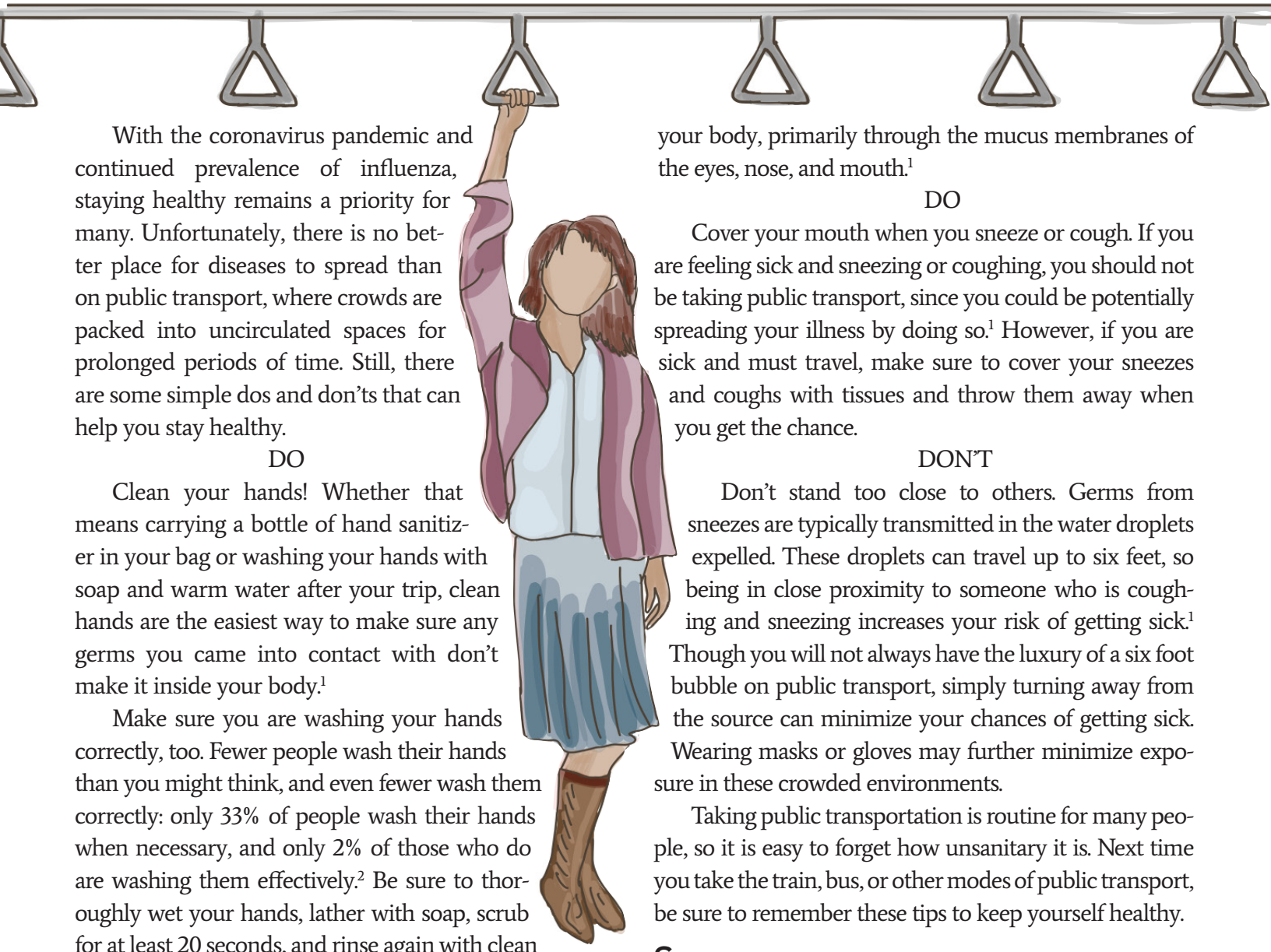
THE DOS AND DON'TS OF PUBLIC TRANSPORT

By Jack Sun '21

Graphic by Senching Hsia '21



With the coronavirus pandemic and continued prevalence of influenza, staying healthy remains a priority for many. Unfortunately, there is no better place for diseases to spread than on public transport, where crowds are packed into uncirculated spaces for prolonged periods of time. Still, there are some simple dos and don'ts that can help you stay healthy.

DO

Clean your hands! Whether that means carrying a bottle of hand sanitizer in your bag or washing your hands with soap and warm water after your trip, clean hands are the easiest way to make sure any germs you came into contact with don't make it inside your body.[1]

Make sure you are washing your hands correctly, too. Fewer people wash their hands than you might think, and even fewer wash them correctly: only 33% of people wash their hands when necessary, and only 2% of those who do are washing them effectively.[2] Be sure to thoroughly wet your hands, lather with soap, scrub for at least 20 seconds, and rinse again with clean water. Dry your hands with a clean towel or air dryer.

DON'T

Don't touch your face. Your hands will come into contact with plenty of contaminated things on your journey via public transport. Think about it: everyone is touching the rails, chairs, doors, sink handles, and more, making them the perfect breeding grounds for viruses. Touching your face only makes it easier for these viruses to get into your body, primarily through the mucus membranes of the eyes, nose, and mouth.[1]

DO

Cover your mouth when you sneeze or cough. If you are feeling sick and sneezing or coughing, you should not be taking public transport, since you could be potentially spreading your illness by doing so.[1] However, if you are sick and must travel, make sure to cover your sneezes and coughs with tissues and throw them away when you get the chance.

DON'T

Don't stand too close to others. Germs from sneezes are typically transmitted in the water droplets expelled. These droplets can travel up to six feet, so being in close proximity to someone who is coughing and sneezing increases your risk of getting sick.[1] Though you will not always have the luxury of a six foot bubble on public transport, simply turning away from the source can minimize your chances of getting sick. Wearing masks or gloves may further minimize exposure in these crowded environments.

Taking public transportation is routine for many people, so it is easy to forget how unsanitary it is. Next time you take the train, bus, or other modes of public transport, be sure to remember these tips to keep yourself healthy.

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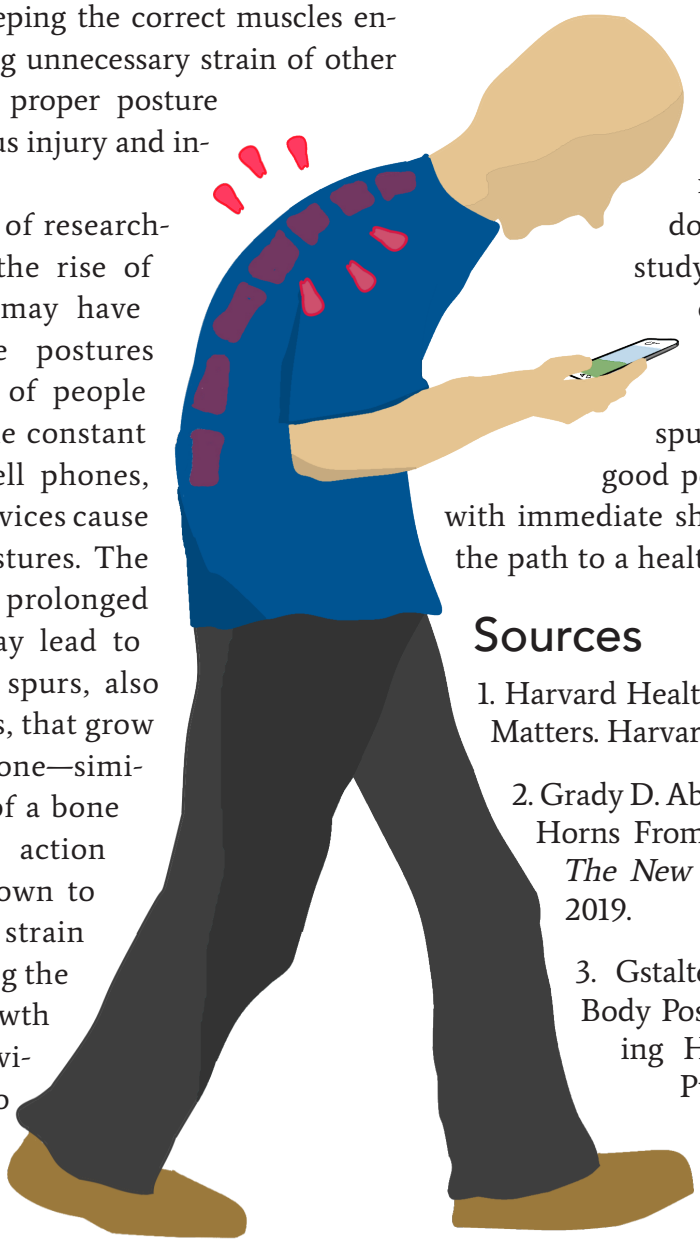
HORNS ON YOUR SKULL?: THE ADVERSE EFFECTS OF POOR POSTURE

By Izzy MacArthur '21

It is easy to forget the age-old advice of "standing up straight," but in fact, there is scientific evidence that suggests that good posture is related to improved health and wellbeing. Good posture contributes to balance by keeping the correct muscles engaged while preventing unnecessary strain of other muscles. Maintaining proper posture can also prevent serious injury and increase athleticism.[1]

Recently, a group of researchers discovered that the rise of modern technology may have greatly affected the postures and bone structures of people around the world. The constant use of computers, cell phones, and other personal devices cause consistently bent postures. The study found that this prolonged improper posture may lead to growths called bone spurs, also known as osteophytes, that grow off the edge of a bone—similar to the extension of a bone next to joints.[2] The action of tilting the head down to look at a device puts strain on the neck, increasing the potential for the growth of a bone spur to alleviate the strain.[3] Due to the drastic increase in the use of technology and subsequently, a trend in poor posture, the development of bone spurs has increased dramatically, according to the study. Over time, bone spurs can lead to swelling, pain, and loss of motion in joints.



Graphic by Elton Zheng '22

Due to insufficient evidence, however, researchers and doctors are hesitant to confirm this theory in the medical community. Furthermore, many doctors were quick to discredit the study, claiming that bone spurs occur not only around the neck but also in joints such as knees and shoulders.[4] Even if the bone spur phenomenon is debatable, good posture from a young age comes with immediate short-term benefits and can pave the path to a healthier and more lively adulthood.

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THE STRUGGLE FOR AN HIV CURE

By Brooke Edwards '22

For the past two years, Adam Castillejo has been completely HIV free. In fact, he is the second person in history to be completely cured from this virus. With the recent developments in modern medicine, society may finally be able to see the end of the global HIV epidemic.[1] But what does this mean for those currently living with HIV? Is this new treatment widely available? And most importantly, is it approved?

HIV stands for human immunodeficiency virus. It is an infection that revolves around the immune system, which is responsible for the body's ability to fight infections. HIV is spread through contaminated blood, semen, and vaginal fluid, among other bodily fluids. Overall, HIV is most known to be transmitted through sexual contact. While it has various parallels to AIDS, it is important to distinguish the difference between the two. HIV is a virus that leads to a systemic breakdown in the body and eventually, AIDS. However, AIDS refers specifically to a condition developed through serious damage to the immune system. While the symptoms vary from person to person, HIV has a survival rate of 67% to 88%, depending on the transition time to AIDS, and there is a drug-based treatment for HIV known as antiretroviral therapy, which was approved in 2012. These treatments can slow the progression of the virus but cannot guarantee immunity or a complete cure.[2]

Callum Abbott

During the 90s, there was a mass outbreak of HIV and AIDS that took the lives of approximately 16,432 people. This time period created immense stigma against the LGTBQ+ community with little hope for a cure.[3] While innovations in recent years are promising, with the development of antiretroviral drugs, there is still no definitive cure.[4]

The difficulties in discovering a cure for HIV lie within the complexity of the disease itself. Since HIV directly attacks the immune system, measuring the quantity of the virus in one's body is a challenge. The cells that HIV specifically targets are important immune cells that are responsible for fighting bacterial and fungal infection and once infected, can progressively weaken the immune system. Once bodily cells have been impacted, the virus can also transform into a state known as a latent infection, or dormancy, to avoid detection.[5] One main reason why it is so difficult to find a cure can be attributed to the challenges for medicine to reach and terminate the disease hidden deep within cells.[6]

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In recent years, however, scientists have discovered that a stem-cell transplant might serve as a cure for HIV. So far, this treatment has proved successful for two reported patients. The first study revolved around multiple transplants and intensive radiotherapy, but the most recent patient only needed one stem-cell transplant without radiology to be cured. While it may sound simple and viable, one of the leading scientists cautions against using stem-cell therapy as a widespread treatment, stating, "It is important to note that this curative treatment is high-risk, and only used as a last resort for patients with HIV who also have life-threatening haematological malignancies... Therefore, this is not a treatment that would be offered widely to patients with HIV who are on successful antiretroviral treatment." It may take a long time for the Food and Drug Administration (FDA) to formally approve of this procedure. But in the years to come, stem-cell transplants may help to prevent another HIV outbreak and save more patients.

Adam Castillejo, one of the two successes of stem-cell therapy, recently went public with his identity after referring to his experience as "humbling." He stated in a recent interview with the *New York Times,* "I want to be an ambassador of hope."[1] His efforts in naming his identity come from a place of inspiration, as he is working to destigmatize HIV and AIDS.[1]

In the coming years, scientists are looking to continue research on the complete treatment and eradication of HIV. Current work to do this involves genome editing, the process of using genetic tools to modify DNA to force a bodily remission. While bone marrow transplants have been successful, the treatment's intensive nature still proves to be a challenge. Overall, scientists are working towards a cure that would not only benefit the present generation but also eliminate the virus entirely for future generations.

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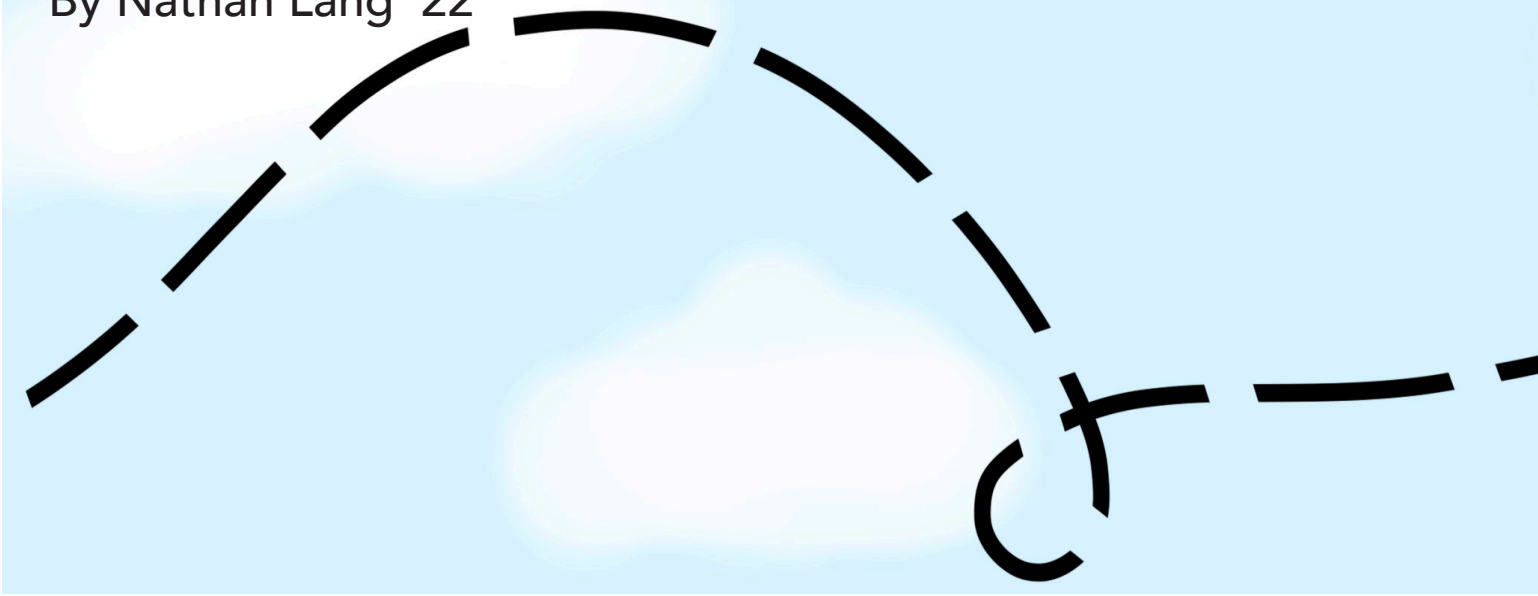
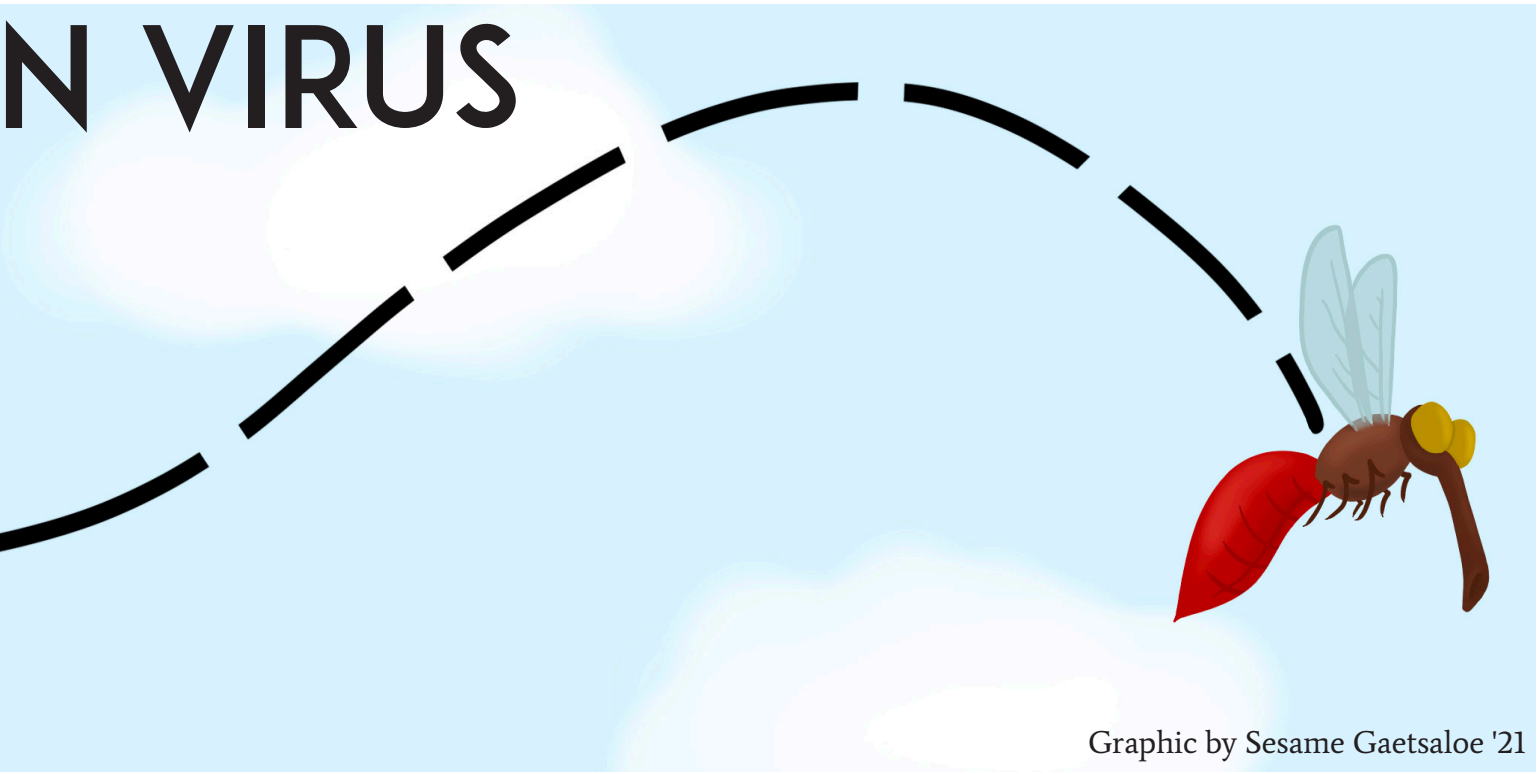
DENGUE: A FORGOTTE

By Nathan Lang '22



Amidst the current fears over COVID-19, many have forgotten about the existence of another deadly, infectious viral disease: the dengue virus. The dengue virus is spread to people through the bite of an infected Aedes species mosquito, a species also connected to the spread of the zika virus and chikungunya virus.[2] Although the dengue virus is not as deadly as other viruses, with only around 22,000 deaths per year, it does have a very high infection rate, with 400 million cases of infection each year, and 100 million people getting sick from the infection.[2] The virus has spread to around 100 countries in the world, and currently, 40% of the world population lives in areas with risk of contracting dengue.[2] This virus has brought about great suffering for many.

Dengue can be caused by four different viruses: dengue virus 1, 2, 3, and 4. Due to the various types of viruses, a person can be infected with dengue up to four times in his or her lifetime.[2] This makes the dengue virus extremely contagious and allows it to spread quickly throughout populations. Furthermore, the symptoms of dengue fever, the illness caused by dengue virus, make it difficult to track and detect. Mild dengue fever can be commonly confused with other illnesses due to the indistinct symptoms. The most common symptoms include fever, nausea, vomiting, rash, aches, eye and muscle pain.[1] These symptoms generally last around two to seven days after the first infection, and most people recover fully from these mild symptoms.[1] However, more severe dengue fever symptoms can be extremely problematic and even fatal. Only about 1 in 20 people who contract dengue virus will develop severe symptoms; however, patients have a higher risk of developing severe dengue if they have previously contracted the virus or are pregnant.[1] These symptoms include stomach pain and tenderness, vomiting (at least three times in 24 hours), bleeding from the nose or gums, vomiting blood, blood in the stool, and irritability, and can lead to shock, internal bleeding, and even death.[1] With these intense symptoms in mind, severe dengue fever requires immediate medical attention or hospitalization, but mild dengue has no specific treatment methods other than resting, drinking fluids, or taking acetaminophen.[1] It is important to note that taking other antipyretic medications such as aspirin or ibuprofen can worsen the illness, and only acetaminophen can help control the dengue fever.[1]



Graphic by Sesame Gaetsaloe '21

Since the dengue virus is spread solely through mosquitos, its impacts are mostly felt in tropical and humid countries where the Aedes mosquitoes thrive in the heat. Dengue outbreaks occur in many countries but are more concentrated in the Central and South Americas, Africa, the Middle East, South East Asia, the Caribbean, and Pacific Island nations.[3] These areas are the most susceptible due to high numbers of mosquitoes and dense populations. However, this does not guarantee that regions outside of the hot and humid belt of the world have immunity. Heavy tourism in the Caribbean, Southeast Asia, and Central America has caused the virus to become a worldwide issue since the 1960s and has caused cases to periodically emerge in the United States in regions that have adequate weather for Aedes mosquitoes to survive.[4] Florida and Hawaii have experienced local dengue outbreaks in 2013 and 2015 respectively, and all 48 contiguous US states have reported cases with infected travelers.[4]

As travel and tourism through the aforementioned regions have boomed in recent years, the virus has spread to countries all across the globe.

The dengue virus, like eastern equine encephalitis (EEE) and COVID-19, has taken the lives of countless people. Even amidst the rapid technological advances of the modern era, viruses and diseases still plague our society. It is necessary that steps be taken to prevent their spread as well as cure them to prevent global outbreaks.

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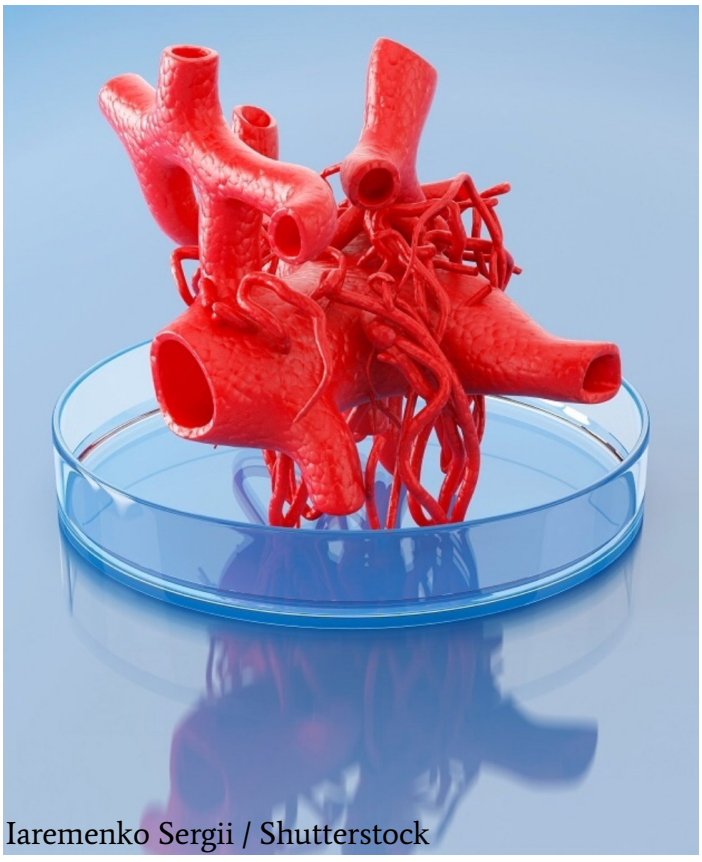
BIOPRINTING: 3D PRI

By Lisa

A few decades ago, the public witnessed the success of 3D printing technology to produce daily essentials, ranging from prosthetics to movie props. Bioprinting, a novel technology inspired by conventional 3D printing, has the ability to combine biomaterials into tissue-like structures that imitate original human body tissues and organs, contributing greatly to the field of medicine and bioengineering.[1]

Functioning similarly to a 3D printer, a bioprinter utilizes bio-ink, the "thermoplastic" of the printer that is composed of living cells, to produce artificial live tissues through a sophisticated, organized process.[2] To prepare for the printing, a digital model must be established beforehand using computed tomography (CT) and magnetic resonance imaging (MRI) scans. Afterwards, the printed imitation parts go through mechanical and chemical stimulation to ensure a stable product for the future medical use.[1]



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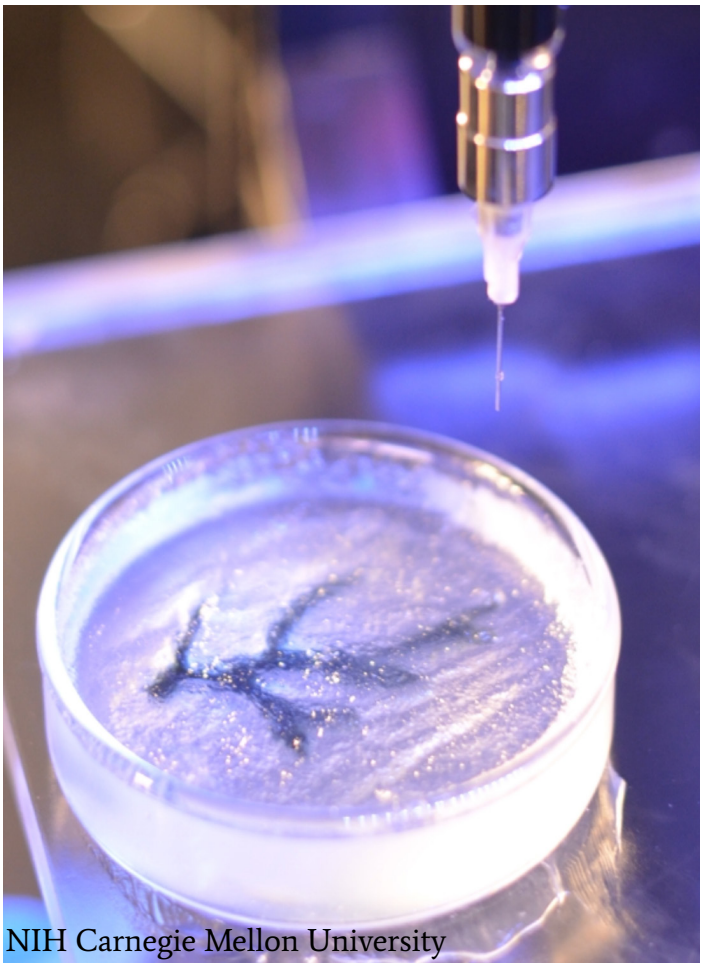
This seemingly simple technology holds great importance. 3D bioprinting not only has the potential to reduce ethical concerns but also alleviate the difficulty of finding available organs from donors. The tissue-like structures from bioprinting highly resemble human tissues and organs, providing a more humane, research-friendly opportunity for pharmaceutical testing and clinical trials.[1] Instead of testing with animals or searching for large groups of volunteers, researchers can simulate diseases in these artificial tissues and organs and find treatment methods accordingly. The availability of bioprinted organs can also help resolve the issue of organ transplants, which has been growing due to an increasing rate of vital organ failure and a number of patients waiting on the transplant list. Grown from the patients' cells, bioprinting guarantees a patient-specific treatment that minimizes complications or organ rejections.

Fortunately, the bioprinting of a less complicated organ, the bladder, was successful. In one case, researchers at Wake Forest University in the United States took cells from a patient's failing bladder, printed a biodegradable mold, or scaffold, shaped like a bladder and then soaked the cultivated cells through it.[3] The engineered bladder functioned well in the patient's body, marking a victory in artificial organ construction. Already, bioprinting human cartilage, urethras, and blood vessels have become possible.[4]

Recently, the National Institutes of Health National Institute of Dental and Craniofacial Research provided a five-year grant of $2.8 million to a team of researchers that investigated 3D bioprinting methods to grow complex tissues for craniomaxillofacial reconstruction. Since the reconstruction of the face and head requires ex-

NTING FOR MEDICINE

a Ji '22



NIH Carnegie Mellon University

tremely precise procedures, further research on stem cells, biomaterials, and differentiation factors granted by the fund could allow for a more advanced and refined reconstruction method produced by bioprinting surgery. The researchers are aiming to directly bioprint appropriate tissues onto damaged or defective areas by studying bone tissue bioprinting, the anatomy of multilayered skin tissue, the impact differentiation factors, and the location vascularization around tissues. The composition of bioprinting material guarantees the heterogeneity of skin graft and tissues, creating the possibility of achieving an anatomically accurate as well cosmetically appealing facial image using bioprinting for craniofacial reconstruction.[5]

The rapid advancements in bioprinting have already yielded plenty of promising results with wide-ranging applications. Ongoing research has great potential to evolve into fields such as bioprinting stem cells and in-vitro biological model production.[6] However, obstacles such as limited options for biomaterials, difficulty in replicating the vascular system, and challenges in establishing connections with blood vessels, tissues, and nerves still remain.[7] Thus, printing intricate organs for transplant surgeries still requires decades of research. Furthering bioprinting research will be one of the biggest challenges for researchers around the world to overcome, but it will have limitless possibilities.

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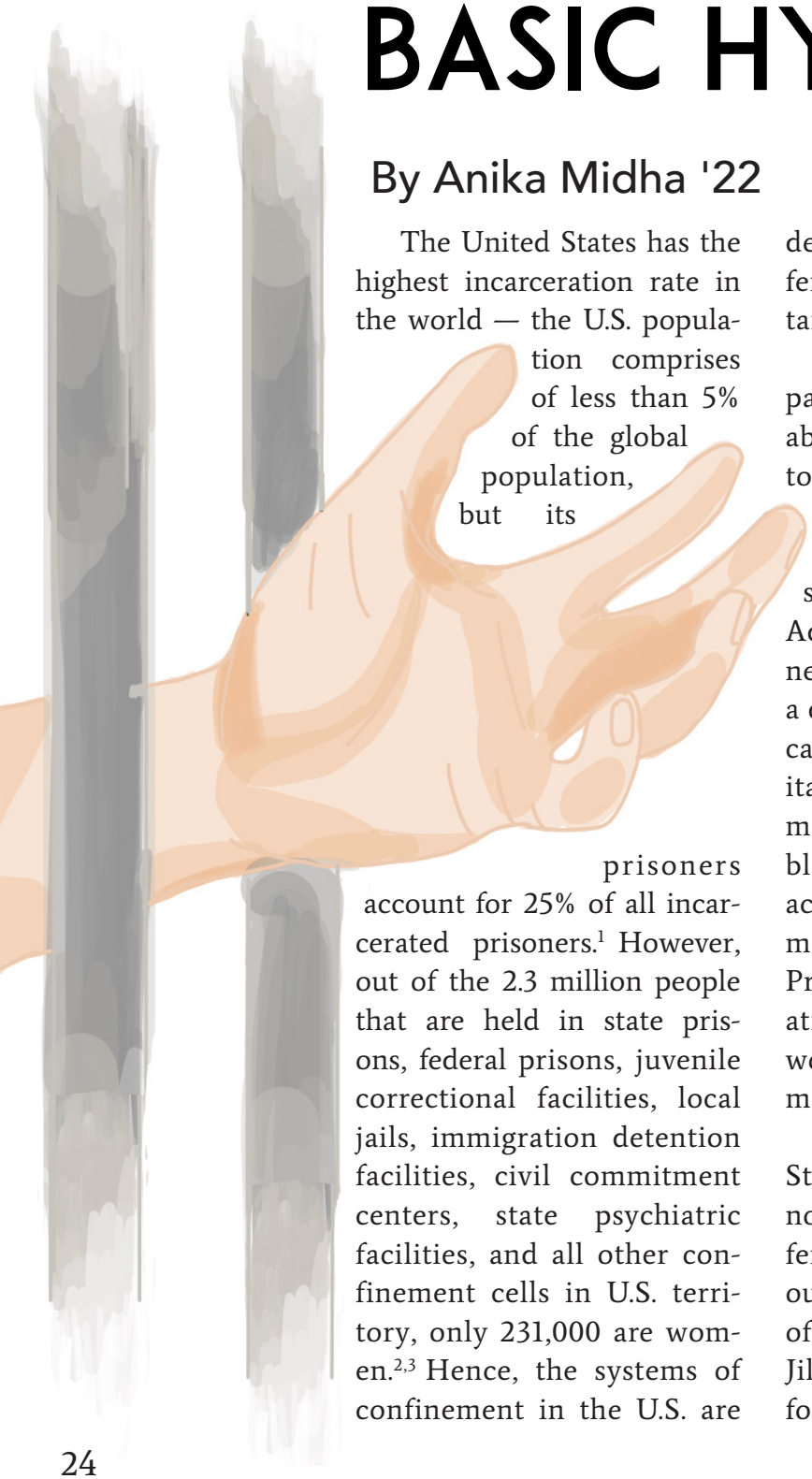
INCARCERATED WOMEN'S FIGHT FOR BASIC HYGIENE

By Anika Midha '22



The United States has the highest incarceration rate in the world — the U.S. population comprises of less than 5% of the global population, but its prisoners account for 25% of all incarcerated prisoners.[1] However, out of the 2.3 million people that are held in state prisons, federal prisons, juvenile correctional facilities, local jails, immigration detention facilities, civil commitment centers, state psychiatric facilities, and all other confinement cells in U.S. territory, only 231,000 are women.[2,3] Hence, the systems of confinement in the U.S. are designed to cater to men, overlooking specific feminine health and hygiene needs such as pads, tampons, and other sanitary products.

Even though most prisons do provide sanitary pads, quantities are limited and are often unavailable when needed. As a result of restricted access to sanitary products, women who turn to makeshift materials face an increased risk of disorders and infectious conditions such as toxic shock syndrome or an overgrowth of bacteria.[4] Additionally, being denied access to resources needed to manage their menstrual cycle can be a dehumanizing experience for many women. Incarcerated women who are denied access to sanitary products are forced to practice unhygienic methods to manage their cycles, including free bleeding. Others revert to bartering or criminal activity, such as trafficking prohibited items, to make enough money to afford pads or tampons.[5] Practicing proper menstrual hygiene is imperative to both the mental and physical health of women, so it is crucial that the country's prisons make these products readily available.

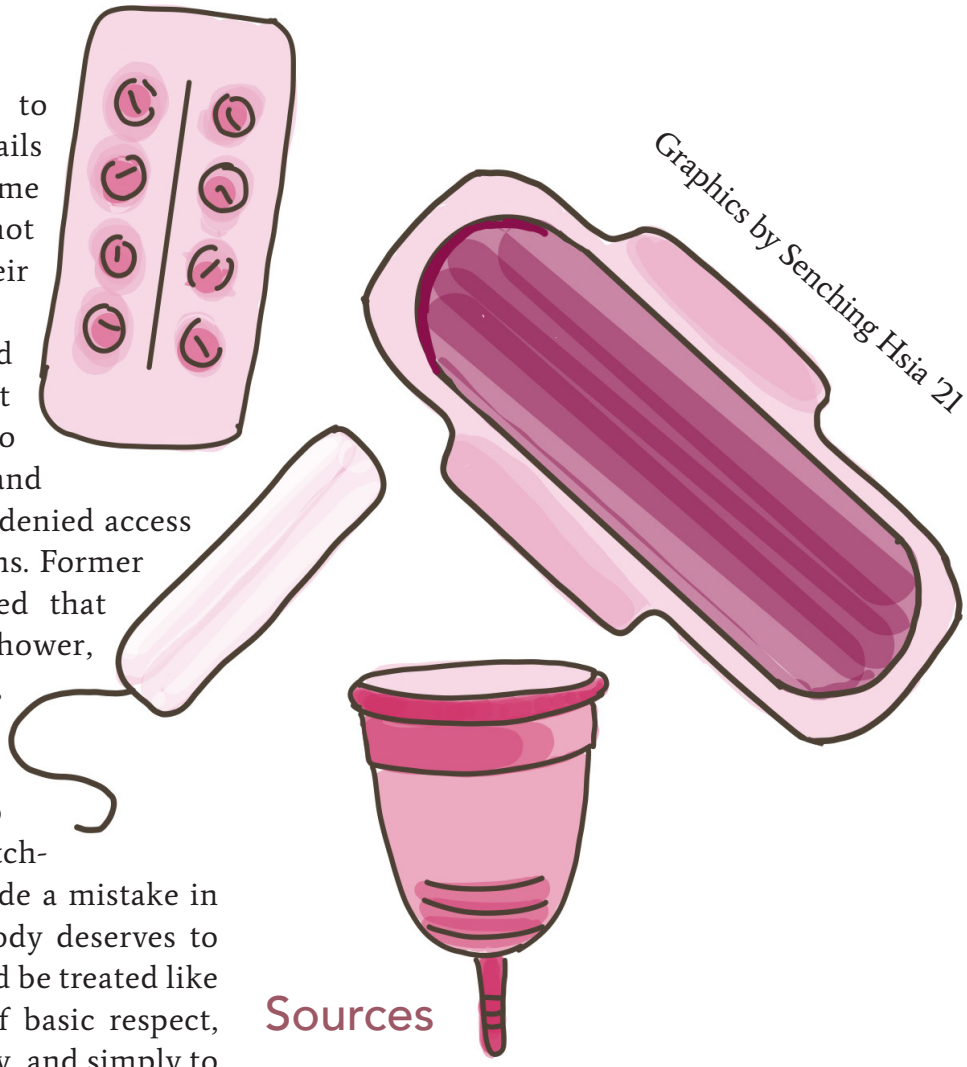
The current prison system in the United States labels these deplorable conditions as the norm, marking even the minimum standards for feminine hygiene as a luxury. However, numerous activists have demanded the implementation of new policies to change this unjust status quo. Jill Miller, who is the chapter director for Days for Girls International, an organization which

provides feminine hygiene kits to those in need, said, "Women in jails and prisons should be afforded some basic human dignity and should not be put into a position in which their health is jeopardized."[6]

In 2014, female prisoners sued Muskegon County, alleging that male guards were permitted to watch female inmates change and shower and that they were being denied access to clean clothes and sanitary items. Former inmate Londora Kitchens alleged that male guards would watch her shower, and when she was on her period, instead of providing her with the basic sanitary products, the guards would warn her not to "bleed on the floor." Londora Kitchens said, "I understand that I made a mistake in breaking the law. However, nobody deserves to be forced to live like an animal and be treated like one. We are women deserving of basic respect, sanitary conditions, bodily privacy, and simply to be treated like the women we are."[7] The incarceration status of women should not undermine the basic right of access to menstrual products that every woman deserves.

The right for incarcerated women to sanitary products has been reinforced as a constitutional right to basic cleanliness as a part of the Eighth Amendment in 1989's Carver v. Knox County, Tennessee, 1997's Carty v. Farrelly, and 2005's Atkins v. County of Orange. However, both state and private correctional facilities need to be held accountable to protect and fulfill the rights of imprisoned women. David Fathi, Director of the American Civil Liberties Union, argues there needs to be a mechanism in place to reprimand all violations of a prisoners' civil rights.[6]

Although there are many organizations, politicians, and activists fighting for the rights of incarcerated women, there is still much to do to ensure the humane treatment of incarcerated women in their journey towards rehabilitation.



Graphics by Senching Hsia '21

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CONNECTING CLIMATE CHANGE AND INFECTIOUS DISEASE

By Ellie Pyper '22

Climate change is a major concern for its large economic and social ramifications, but one important aspect of its effects, the intensification of infectious disease spread, is often disregarded.

Climate change can escalate the expansion of pre-existing diseases as well as introduce new pathogens to the world. In particular, rising temperatures contribute to the melting of ice caps, which may harbor frozen bacteria and viruses. On a trip to Tibet in 2015, researchers from China and the United States found 28 previously undiscovered viruses hidden within a melted glacier. As the climate continues warming, released pathogens can get carried along rivers, lakes, and streams, allowing for these unknown diseases to spread around the world.[1]

Glacial melt poses potential extensive impacts for human disease as well as animal disease. For example, the melting of ice caps has been connected to the spread of Phocine Distemper Virus (PDV) among the sea lion population in the Arctic. In August of 2002, researchers discovered a massive outbreak in PDV among sea lions following a record amount of glacial melt at the time. During this outbreak, scientists found that almost 30% of sea lions in the region tested positive for PDV.[2] As ice caps continue to melt, PDV holds the possibility of affecting larger percentages of the animal population beyond the Arctic region.

With that said, melting ice caps are not the only consequence of climate change that affects the transfer of disease — scientists have also found a link between rising temperatures and both waterborne and vector-borne illnesses. Vector-borne illnesses refer to diseases that are transferred to humans and animals by blood-feeding insects. Some well known transmitters include mosquitoes, ticks, and fleas; a bite from any of these insects may cause diseases ranging from Malaria to Lyme Disease.[3] Waterborne illnesses, on the other hand, are transferred through many different microorganisms, biotoxins, and contaminants found in water, causing diseases such as cholera or schistosomiasis.[4]

In the past, many wealthier countries in the Northern hemisphere had fewer cases of vector-borne diseases due to colder temperatures.[5] As temperatures have begun to rise in these regions, mosquitoes and other insect vectors sensitive

to the cold can become more active — resulting in an increase of cases of diseases such as Malaria and West Nile virus. For instance, Lyme disease in the United States is typically concentrated within 13 states in the Midwest and Northeast, with around 20,000 cases per year since 2005. This number rose to 30,000 in 2009, which scientists feared was a result of the rise in humidity and temperature around those regions. Additionally, warmer conditions allow ticks to spread into various regions they would not have previously inhabited before and accelerate the tick's developmental cycle.[6]

Climate change causes similar impacts on waterborne illnesses. In the wake of global warming, many populations have experienced a spike in waterborne disease due to drought. Drought causes widespread water scarcity, and there often is poor sanitation among the remaining water sources, some of which are already contaminated. Increased consumption of contaminated water facilitates the spread of waterborne illnesses, which is further exacerbated by little rainfall to provide fresh drinking water. Climate change can also cause an excess amount of rain and result in some water sources being contaminated due to overwhelmed sewage lines or runoff waste from livestock. The World Health Organization reports that "by 2030 there will be 10% more diarrheal disease than there would have been with no climate change."[7] If climate change is not addressed, diseases will continue to spread more rapidly, creating a multitude of health issues in countries with weaker healthcare systems.

Ultimately, human action against climate change is long overdue. The climate crisis is a major threat to the environment as well as global public health. It is necessary that collective measures be taken to alleviate climate change and its effects, as well as support the most vulnerable populations facing them.

Graphic by Elton Zheng '22

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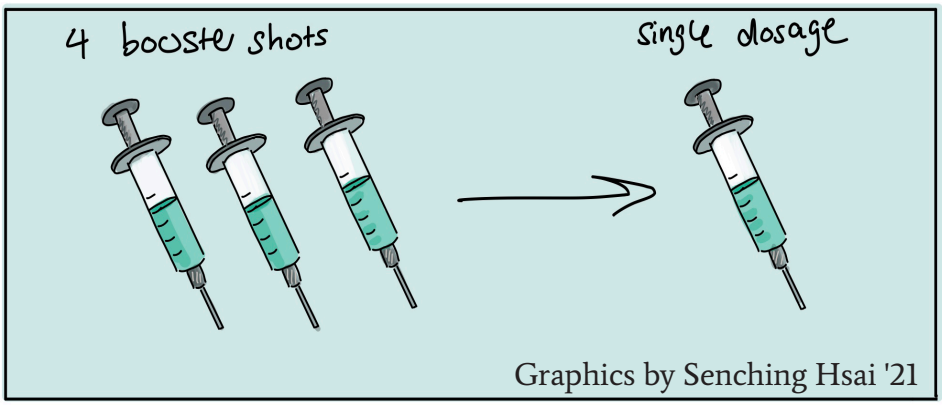
NEEDLE-LESS VACCI

By Sofia Mu



Graphics by Senching Hsai '21

The global need for vaccines, particularly in developing regions, has called for new methods to stabilize, maintain, and store vaccines. Vaccines can be tricky to store because their components are susceptible to damage at temperatures above two to eight degrees celsius (35-46°), preventing them from being widely accessible.[1] Now, after years of researchers experimenting with different stabilization techniques, such as shelf-stable films and sugar, it appears that a promising solution has been developed.

In 2007, Maria Croyle, Professor of Pharmaceutics at the University of Texas, was asked by the National Institutes of Health (NIH) to develop needle-free, shelf-stable vaccines. Her research group discovered a way to stabilize live viruses and biological medicines within a dissolving film that did not require refrigeration and could be given orally.[2] When the research first began, the scientists found an unusual source of inspiration in hard candies. They started by mixing natural ingredients, such as sugars and salts, and observing which formulations could form the shape of hard candy. After 450 attempts, they found a "mold" that could suspend the viruses and bacteria encased in peelable film.[2] The first layer is a peel-off strip that protects the viruses and bacteria inside. The middle is the mixed formula that contains the vaccine, or the antigen. Lastly, there is a base layer that dissolves once the vaccine is used.

The viability of film as a vaccine storage method was proven using old films with Ebola viruses still attached from a project three years prior. Whenresearchers tested the film to see if the vaccine could induce an immune response, 95% of the virus was still active. This demonstrated that the films could guarantee vaccines to last up to three years.[2]

A shelf-stable film could impact vaccine campaigns worldwide by making them more affordable, temperature-resistant, and accessible. According to Professor Croyle, the team is involved in startups to bring it to market in the next two years.

Researchers at McMaster University have also found a cost-effective method of administering vaccines. This potential technique is a combination of freeze-drying and adding stabilizing agents. Freeze-drying, which involves freezing then drying the antigen, has long been a method for preserving vaccines.[3] The stabilizing agents, approved by the Food and Drug Administration (FDA), consist of sugar molecules, pullulan, and trehalose.[1]

The researchers tested the McMaster method on Herpes Simplex Virus 2 (HSV-2), and Influenza A Virus (IAV) with vaccines composed of killed or weakened versions of the virus. In the experiment, they used the sugar-drying method on one group of five mice and did not use the method on the other group of mice. The mice from the first group recovered or did not show any symptoms, while the second group of mice died or showed signs of infection. This success suggests that the sugar-drying method could be a possible solution for the issue of vaccine stabilization, especially since it was tested on two viruses that are notoriously hard to stabilize.[1] But there are some drawbacks: the amount of material present in the initial vaccine is slightly depleted by the process, and there could be other unforeseen effects.

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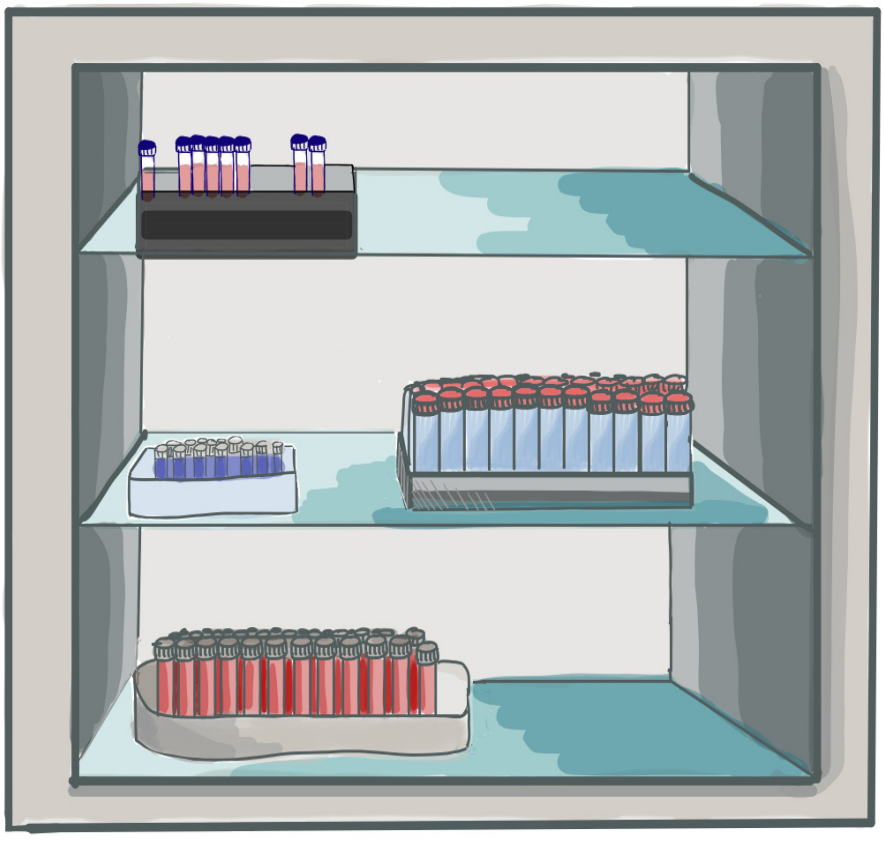
Therefore, the researchers are continuing development.

In another case, Professor Robert Garcea from BioFrontiers Institute, and Professor Theodore Randolph from the University of Colorado at Boulder earned a $1.2 million grant in funding from the Bill and Melinda Gates Foundation to develop a stabilizing vaccine that does not require refrigeration.[4] The groundwork for their project was laid by Professor Al Weimer (Melvin E. and Virginia M. Clark), who created a technology that uses a vapor phase technique for thin films put on an underlying substance.[5] Garcea and Randolph combined the technique with thermostabilization techniques already generated by Randolph and Garcea's vaccine antigens.[6] They created small particles that were thermally stabilized and then coated them with nanoscopic layers of metal salts to enhance the body's immune response. They tested their method against the Human Papillomavirus Virus (HPV) over temperatures greater than 50°, and it remained stable for months. This was particularly innovative because vaccines are typically given in series, or "booster" shots, after the initial shot to ensure it remains effective.[4] By implementing Garcea and Randoph's method for vaccine stabilization, even in old vaccines, such as polio, would only require a single dose to be effective. The two researchers are using the grant to begin human trials late next year.

Ultimately, these cutting-edge technologies could change the future of vaccines by making them more accessible and therefore, protecting more people.



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