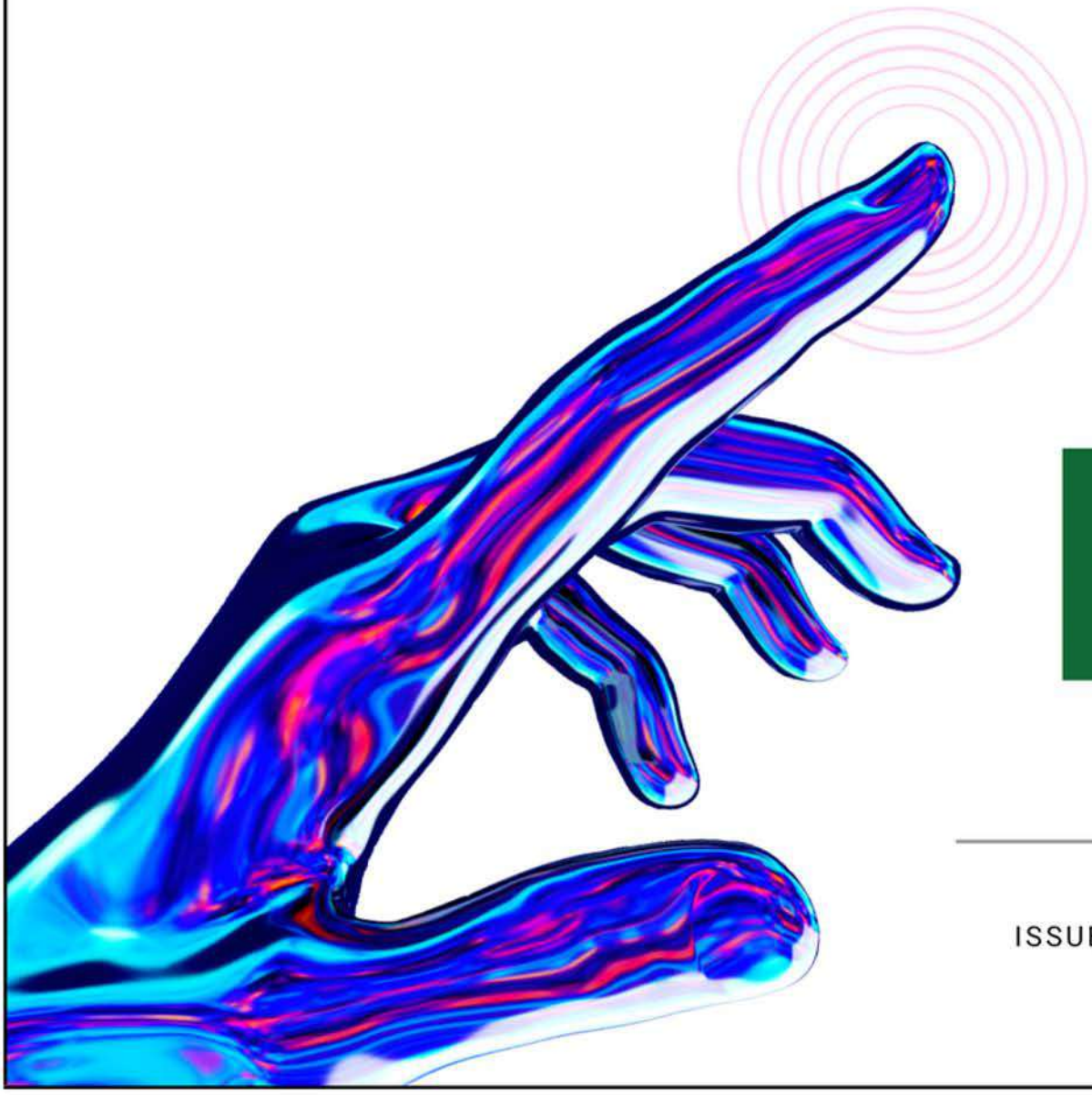
UNDER THE SCOPE

MEDICAL NEWS



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The Use of AI in Surgeries

The Rise of Robotic Surgery

Meher

In the ever-evolving landscape of modern-day medicine, the field of surgery has witnessed a revolutionary change with the emergence and development of robotic technology. Robotic surgery is a form of minimally invasive surgery, also known as a laparoscopic or keyhole procedure, which involves smaller incisions (surgical cuts) and is lower risk than open surgery. Moreover, the robotic systems aid surgeons in enhancing precision and control when performing surgical procedures, ultimately leading to prospective improvements to the standard of patient care.

The concept of robotics being used in surgery dates back to the mid-20th century, but it was in 1985, when the first surgical robot, PUMA 560 was used to insert a needle into the brain for a biopsy, which is the extraction of sample tissue for examination, this was a practice that was prone to errors due to instability of the hands. During the 1990s, there was a surge in laparoscopic surgeries, where surgeons use small incisions and a camera in the abdominal and pelvic regions. Thus, surgeons looked to other robotic systems to be utilised in minimally invasive surgeries. There was the da Vinci surgical system, the AESOP system and the Zeus Robotic Surgical system, which was used in specific laparoscopies such as reconnecting cut fallopian tubes but was eventually discontinued. Therefore, the da Vinci surgical system is now the most prominent robotic surgical system worldwide.[1]

The Da Vinci Surgical System was developed by Intuitive Surgical to perform complex, minimally invasive surgical procedures and consists of three major components:

- Surgeon console - a surgeon will sit at the console and control instruments that mimic human hand movements but have far greater precision and range of motion.
- Patient cart - holds the high-definition 3D camera and instruments that the surgeon controls from the console and is positioned next to the bed.
- Vision cart - connects all the components of the system, facilitating communication between the surgeon console and patient cart.

Robotic surgery offers many advantages over other surgical techniques such as:

• Providing surgeons with enhanced visualisation of a surgical site due to the high-definition 3D cameras attached to the robotic arms of the system, which allows for improved depth perception and spatial awareness, making the navigation of more delicate tissues and intricate procedures easier.

• An increased range of motion for the surgeon so complex manoeuvres in procedures such as hysterectomies and cardiac surgeries can be performed with greater confidence and precision, leading to an improved outcome for the patient. For example, a study funded by the Urology Foundation, found using robotic surgery in bladder cancer removal reduced the chance of readmission by half and reduced the prevalence of blood clots by 77%, when compared to those who had undergone open surgery. [2]

• Benefits for surgeons as there is a reduction in physiological tremors with the use of robotic systems and it can be argued that robotic surgery provides relatively superior ergonomics, as it seemingly reduces physical fatigue during long procedures.

Despite having a multitude of advantages, robotic surgery also poses some limitations: high costs, limited availability in hospitals currently, concerns regarding technological malfunctions, the requirement of specialised training and though robotic surgery provides relatively better ergonomics, 56.1% of regularly practising robotic surgeons still experience discomfort during long procedures.[3]

Open surgery remains to be the 'Gold Standard' recommendation for complex surgical procedures for the National Institute of Clinical Excellence (NICE), however, researchers are currently urging NICE to make robotic surgery available as an option for all major abdominal surgeries with the motivation that the use of robotic systems will not replace surgeons but rather help them to improve their efficiency and care for their patients.

On balance, robotic surgery continues to evolve and will become more widespread as technology develops further. Already, it represents a significant advancement in modern medicine, due to its ability to improve the standard of care that surgeons give and patients receive, as well as continuing to push the boundaries of what is possible in the operating room.

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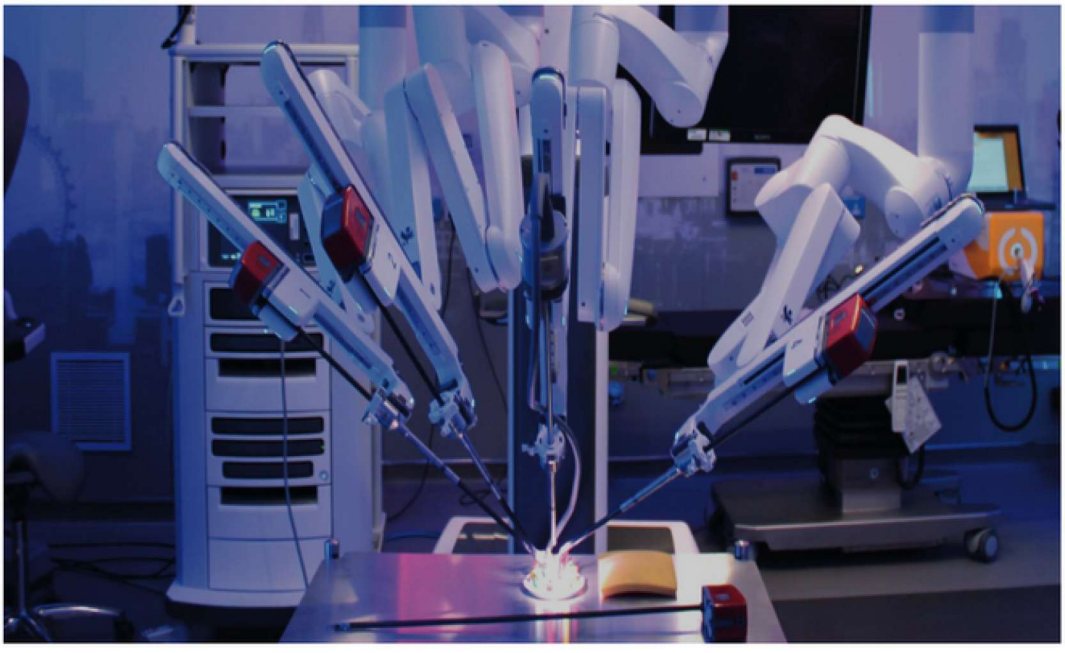
Future of Healthcare and Medical Research

AI is rapidly growing in the world today as recently the first ever brain chip (Neuralink) was installed within a human; but is this necessarily a good thing and will AI continue to be used in surgeries? There are already many applications of AI in surgery for example; pre-operative planning, intraoperative guidance, surgical robotics and transplants.
Pre-operative planning is where surgeons plan the surgical procedure based on existing medical records. AI can be useful in these scenarios when decision-making,

surgeons make decisions based on their knowledge and experience; so, their judgement can be biassed at times. AI can objectively analyse patient data and could identify correlations that humans may not have picked up.

Intraoperative guidance allows a surgeon to see the location of their instruments during surgery as well as tumours and other important structures. This allows the surgery to be planned and executed efficiently and to guide the neurosurgeon during surgery. AI-based intra-operative improve the efficacy, safety and efficiency of the surgical procedures, however there are concerns about validation, trust and how much control should be given to AI.

Currently, robotic surgery is carried out using the 'da Vinci' system. This is a unique set of technology as it includes specialised 'arms' to hold tools for example cameras, consoles, screens. The surgeon is guided by a console through the surgery. The aim of robotic surgery is to increase the precision, flexibility and control during a procedure. However, not only is there room for human error but also error for machinery malfunction.

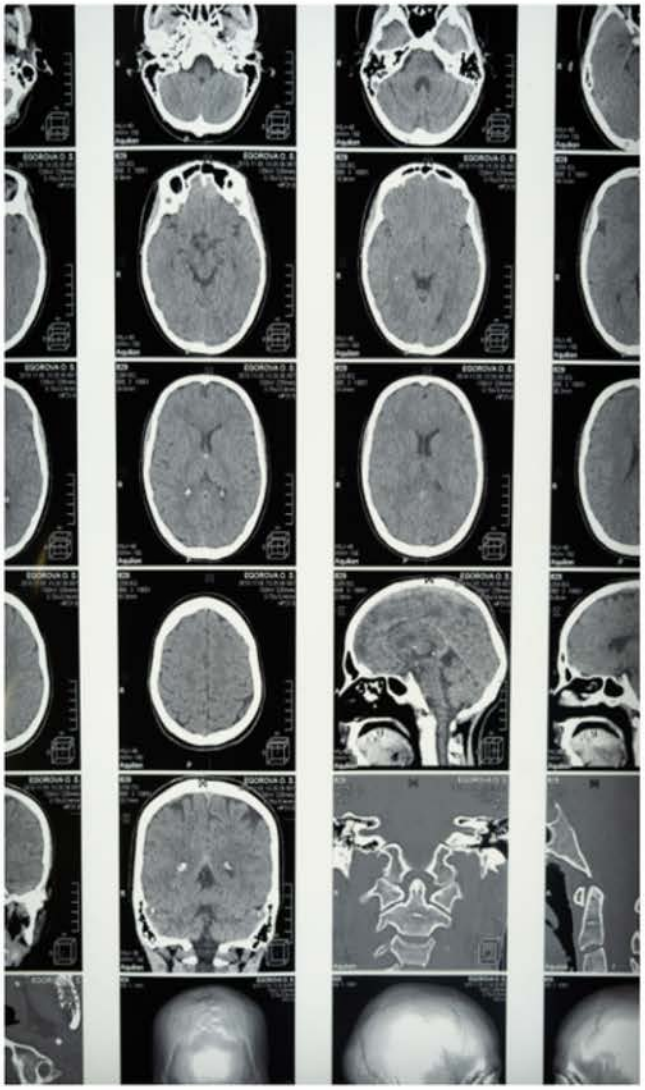


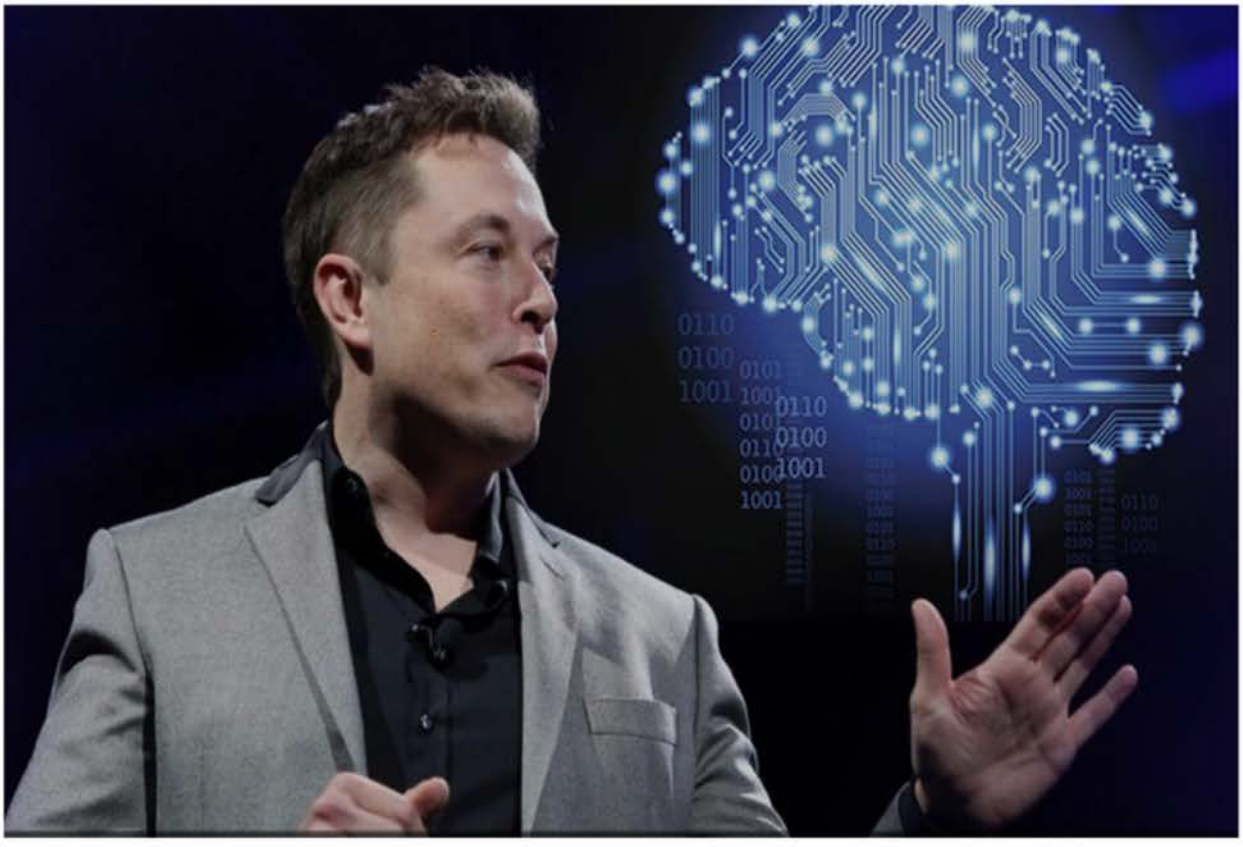
The first ever brain chip demonstrates how advanced AI is becoming. The aim of the Neuralink is to help those suffering with paralysis, blindness and neurological conditions such as Alzheimer's. People who have paralysis could control prosthetic limbs with just a thought using the AI chip. However; the technology raises ethical and privacy issues. These chips could hack into people's thoughts and manipulate their emotions. Since this is a recent discovery, the chip could malfunction which could risk the safety of the person.

In the future, it is predicted that AI could help the NHS with 300 more transplant operations every year. Some AI can be used to 'cherry-pick' organs for transplant, improving the efficiency and time taken to find a suitable donor as they won't be rejected. AI can detect organ failure earlier thus preventing the need for a transplant in the first place, saving lots of money and time.

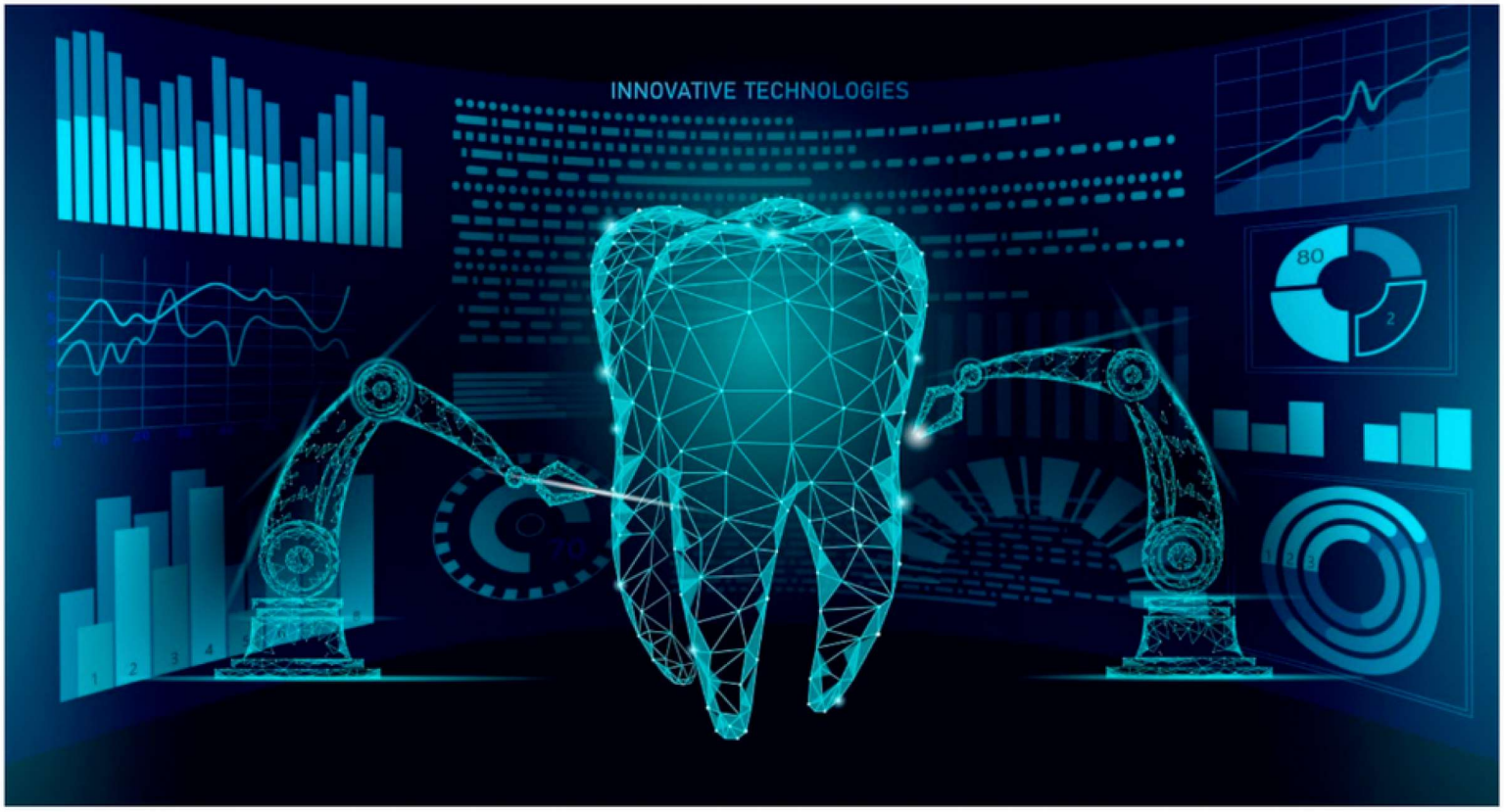
Some people are concerned that the use of AI in surgery could breach the patient's data privacy and security. This is why people see AI as ethically wrong as it opens more opportunities for the data to be hacked into for uses that are not related to medical records.
Despite the increasing use of AI; it seems unlikely that robots will replace surgeons in the future; they will only be of assistance to the surgeons to ensure a smoother procedure. They enhance decision-making as they have high processing speeds, therefore they can quickly identify patterns and make predictions better than humans can.

Mahshami

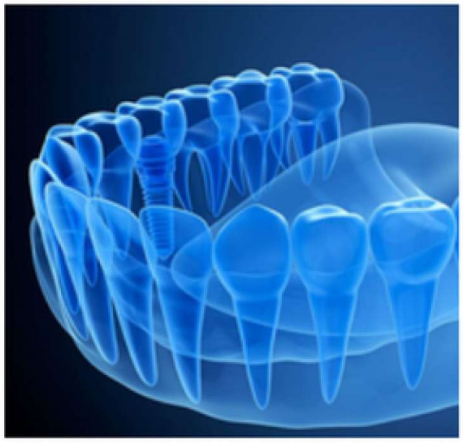




The Future of Dentistry



After years of traditional oral healthcare, dentistry is on the verge of transformation. As we look further into the future, it is certain that, by incorporating more innovative ideas such as enhanced technology and improving oral hygiene, the overall patient care in the country will improve.



Technology in dentistry

One of the most significant aspects of the future of dentistry is the introduction of improved technology. Traditionally, the processes that were used in dental practices were slow and created large amounts of wastage. For example, 3D visuals of teeth consisted of dental impressions, which were carried out by biting onto alginate (a rubber-like substance) to create a negative mould. This would then be filled by a plaster-like substance to form a positive model of the teeth. Problems that occurred when using this process include errors that could arise in the mould, which would mean that the process must be repeated, and the long time taken in the formation of the impression.

The use of 3D printing has now eased the hardships of both dentists and their patients by reducing the time, money and effort required for treatments. Another major benefit is the ability to digitally store the patient's scanned teeth. Not only does this allow orthodontists to recall data more easily, but the 3D scan of various patients' teeth can also allow different orthodontists to understand more uncommon complications by examining the differences and similarities. These attributes have created an overall improvement in dental experiences. By further developing the technology used, dentistry will only change for the better in the future.

Improving national oral hygiene

Although the development of dental technology has immensely helped treatment, there is still a major issue: there are not enough dentists working for the NHS. Since COVID-19, it has been difficult for many people to obtain dental treatment from the NHS as most dentists have closed their doors to more patients. This creates a vital injustice to those who are unable to secure a private dentist and ultimately produces an inequality throughout the country.

To reduce the severity of this problem, the UK government has implemented plans for the future. For example, to help increase access to dental care for children living in under-served areas, dental teams will be deployed to schools to provide fluoride varnish treatments and education. This will allow children to develop dental habits so that it becomes part of their daily routine. By executing this project, the NHS will potentially have less of a strain for supplying dental care to the population which will ultimately lead to better services in dentistry.

Another way in which the inequality of dental treatment could be minimised is through the fluoridation of water. In England, only around 6 million people have access to fluoridated water, especially in the West Midlands and the Northeast1. Fluoride is known for protecting teeth from cavities and decay, which is why it is incorporated into toothpaste and water supplies. This means that, by increasing the accessibility of fluoridated water, tooth decay rates should be reduced.

Therefore, by using preventative oral health measures throughout the country, people who are unable to access non-NHS dentistry are more likely to be accepted by dental practices. This will potentially decrease the disparities in dentist availability as lower demand for dental treatment will free space for the patients that require NHS care.

Overall, dentistry has become a service that has made remarkable advancements in innovation and technology. This has created a simpler and more comfortable experience for patients. However, due to the high demand and limited supply of NHS dentistry, it is crucial for the country to implement schemes to address these challenges to better the future.

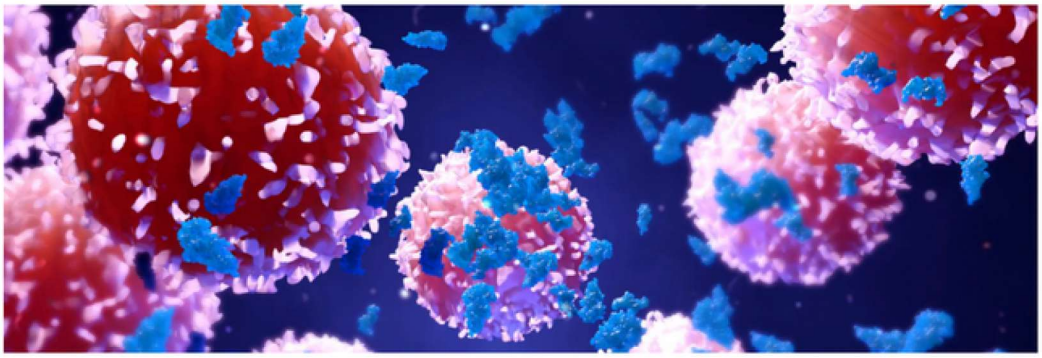
Mahsa

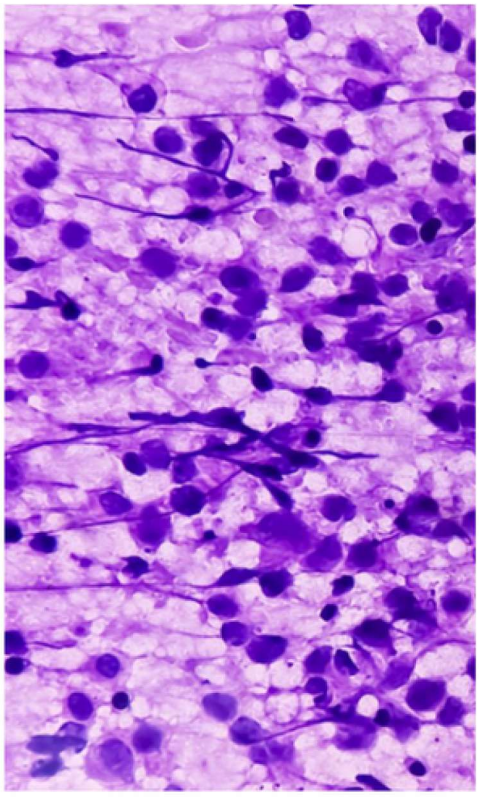
[1] Health and Care Bill: water fluoridation. GOV.UK. Published 10 March 2022. Accessed 7 February 2024. https://www.gov.uk/government/publications/health-and-care-bill-factsheets/health-and-care-bill-water-fluoridation

Cancer Treatment with mRNA

Where does the future of cancer treatment lie?

Cancer is a group of over 200 diseases caused by damage to the proto-oncogenes and tumour suppressor genes that regulate mitosis and the cell cycle. This leads to the rapid and uncontrolled growth of cells which consequently forms a group of affected cells called a tumour. If this tumour develops into a cancerous tumour (known as a malignant tumour) then this can have detrimental effects on a person's health (National Cancer Institute, 2021). On top of this, it is estimated that around one in two people will get cancer in their lifetime (NHS, 2017). If cancer is so common yet so damaging, how can this be successfully treated? Recently, there have been many ongoing studies suggesting that mRNA can be used as an effective treatment for cancer as it is non-infectious, fast, inexpensive, and generally does not involve serious adverse effects (Lorentzen et al., 2022).





How does mRNA in cancer treatment work?

Compared to other viruses, mRNA vaccines for cancer work very differently. For example, the vaccine designed to protect people against COVID-19 is prophylactic (i.e. it prevents disease), whereas an mRNA vaccine for cancer is a treatment that tries to activate our immune system to target and fight the cancer cells (Graff, 2021). One way of treating cancer with mRNA is by targeting neoantigens on a tumour cell to attack it. Neoantigens are new proteins that form on tumour cells after a mutation in the DNA has occurred. Firstly, formulated mRNA vaccines are injected into our body intramuscularly. The mRNA vaccine then enters the cell via endocytosis and is taken up by the cell's ribosomes where transcription and translation occur to produce a polypeptide, and in turn a protein. After further modifications in the Golgi apparatus, the protein is expressed on the cell's surface as a neoantigen. This activates CD8+ T-cells and CD4+ T-cells (T-lymphocytes, which are a type of white blood cell) to recognise cells expressing the neoantigens (Lorentzen et al., 2022) and stimulate a cell-mediated immune response.

Cell-mediated immunity refers to how mature T-cells, macrophages and cytotoxic T-cells destroy abnormal and infected cells:

· Phagocytes engulf the tumour cell and present the neoantigens from the tumour cells on its own cell membrane. This allows receptors on helper T-cells to attach to these antigens which activates the T-cells to undergo rapid mitosis and form genetically identical clones. These clones can develop into memory T-cells, stimulate phagocytosis, activate cytotoxic T-cells and even initiate a humoral immune response, which is explained later.

· Macrophages conduct phagocytosis, which is a process where the target cell pathogen is engulfed and destroyed.

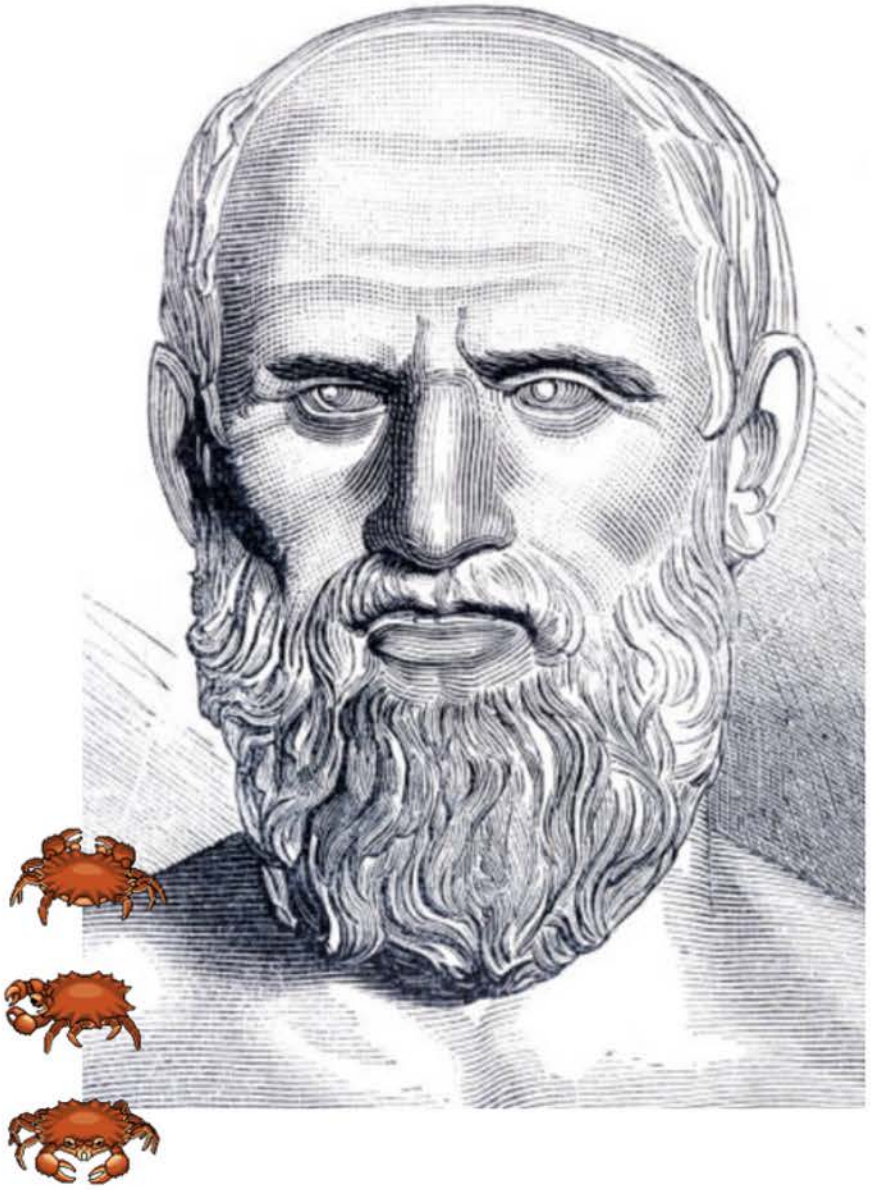
· Cytotoxic T-cells produce a protein called perforin that makes holes in the cell membrane of the tumour cell making it highly permeable. This allows the contents of the tumour cell to leak out as well as water moving into the cell by osmosis and causing cell swelling, resulting in cell death (Janeway et al., 2013).

On the other hand, CD4+ T-cells can stimulate B-cells to produce a humoral immune response. This response refers to B-cells producing antibodies complementary to the shape of the tumour antigen and attaching to them. The tumour antigen then enters the B-cell via endocytosis and is expressed on the surface of the B-cell, allowing helper T-cells to stimulate division of B-cells by mitosis and forming clones of B-cells, which can all produce the same complementary antibody to the tumour antigen (Medicine LibreTexts, 2018). The tumour antigen acts as a marker to allow the T-cells to directly destroy the cancer cells which have the tumour antigen.

Unfortunately, one of the biggest problems for treating cancer this way is developing the mRNA vaccines. The neoantigens which the tumour cells express are very specific, so developing several mRNA vaccines that target these neoantigens has been proven to be challenging (Stallard, 2023).

Little fun fact about the etymology of the word 'cancer.' Hippocrates, a Greek physician who is highly regarded in the medical field, used the word 'cancer' which means 'crab' in Greek as he likened the swollen veins seen in a breast tumour to the legs of a crab (NPR, 2010).

Roha



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Creutzfeldt-Jakob disease

Creutzfeldt-Jakob disease, or CJD for short, is a rare and fatal neurodegenerative disorder that can lead to dementia or even death. It is known to develop from the accumulation of abnormal proteins called prions in the brain which can be made formidable when discovered to cause protein misfolding and death of brain cells. CJD is therefore classified as a prion disease which has possibility to affect both humans and animals.

The reason for CJD being a rare disorder is due to the complexity and perplexity of the disorder itself. CJD's diverse nature and spectrum of neurological symptoms, some like Alzheimer's disorder, is especially why a proper treatment has not been yet derived. However, there are still some methods of treatment and ways of prevention to prohibit CJD from getting worse. Patients with CJD experience symptoms such as impaired coordination. They may also experience problems such as cognitive decline, memory loss, personality changes and visual disturbances – leading to profound functional impairment. As the disorder progresses, patients may even experience severe and life-threatening symptoms such as myoclonus (quick, involuntary jerks like hiccups), seizures and akinetic mutism- which is a mental state where patients lack the ability to move and speak! When developed even further, a patient may even culminate in a state of profound disability and eventually death within months to a few years of detection.

However, there are certain methods, prevention strategies and treatments- either being used or in progress- to address this disorder. While sporadic CJD – a variant of CJD which arises spontaneously without identifiable external causes- includes most cases, other forms such as variant CJD and iatrogenic CJD highlight the importance of targeted prevention strategies. Variant CJD is mostly linked to the consumption of contaminated meat products from cattle that are affected by bovine spongiform encephalopathy (BSE). This helps to highlight and signify the critical role of food safety measures, including vaccinations for cattle, maintaining personal hygiene, avoiding cross-contamination surfaces with raw food and following food regulations, to minimise chances of CJD from developing.

Additionally, rigorous control measures to prevent the transmission of prion diseases via blood transfusions, organ transplants, and surgical procedures are essential in mitigating the risk of iatrogenic CJD. There are numerous public health education campaigns aimed at raising awareness of the risks associated with specific dietary habits, medical procedures, and potential sources of prion contamination which are paramount in empowering individuals and healthcare professionals to make informed decisions. Furthermore, ongoing research into the pathogenesis of CJD, the development of sensitive diagnostic tools, and the exploration of novel therapeutic interventions are crucial components being implicated as comprehensive prevention strategies aimed at reducing the burden of this devastating neurodegenerative disease.

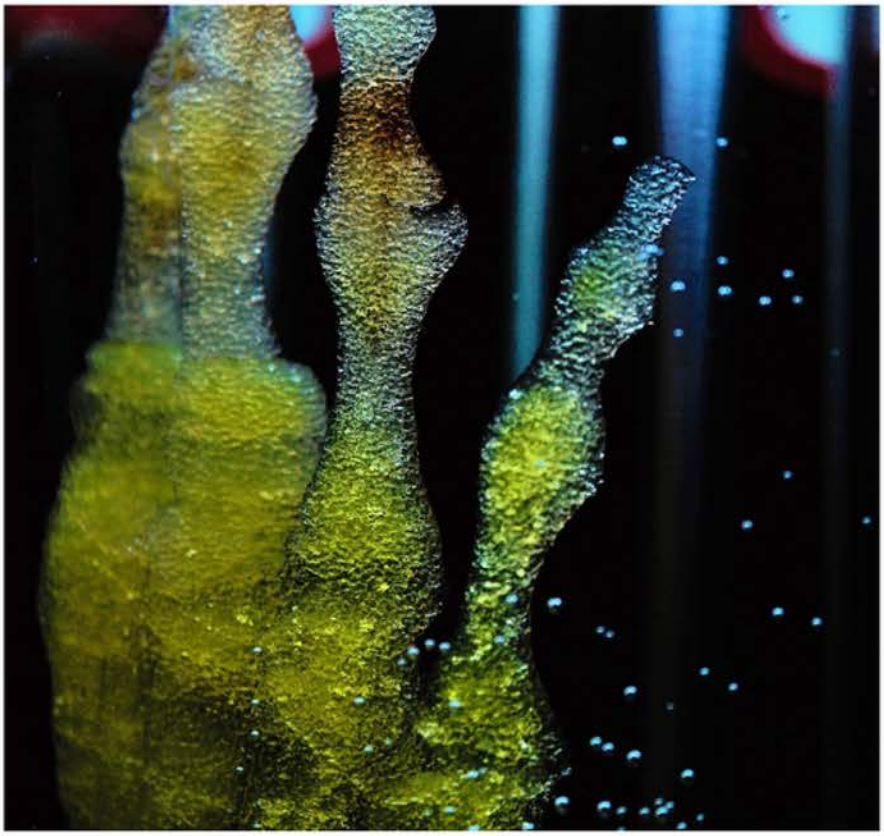
Treatment options for Creutzfeldt-Jakob disease (CJD) remain limited, with management primarily focused on supportive care to alleviate symptoms and improve quality of life. Symptomatic treatments such as anticonvulsants, sedatives, and analgesics are employed to address seizures, agitation, and pain, respectively. Additionally, supportive measures such as physical therapy and nutritional support aim to optimise patient well-being and functional capacity. Experimental approaches targeting the underlying pathology of CJD are being investigated, including immunotherapy aimed at clearing abnormal prion proteins from the brain using monoclonal antibodies or vaccines. However, these experimental treatments are still in early stages of development and require further evaluation to determine their safety and efficiency in clinical settings. Stem cell therapy, which involves the transplantation of neural stem cells to replace damaged neurons in the brain, holds promise for restoring neurological function in CJD patients, but significant challenges such as optimal cell delivery methods and immunological considerations need to be addressed. Despite ongoing research efforts, effective treatments for CJD remain elusive, highlighting the urgent need for continued exploration of novel therapeutic strategies.

In summary, understanding Creutzfeldt-Jakob disease (CJD) involves knowing how to prevent it through food safety and infection control measures, as well as raising awareness through public education. While current treatments focus on symptom management and supportive care, ongoing research into innovative therapies like immunotherapy and stem cell therapy offers hope for future advancements. By continuing to collaborate and advance scientific knowledge, we can strive to improve outcomes for individuals affected by CJD and their loved ones.

Amrita

The Future of Bioprinting

Hajrah



Firstly, what is 3D bioprinting?

Of course, it's in the name – the whole idea behind it is to make a complete replica of any object – but of course the range of objects used was once limited. Of course, Bioprinting would simply be the printing of various 3D tissues as well as bone grafts (using new transplanted bone to repair diseased or damaged bones), But recently huge advancements have been made with this tech and in 1999, a bladder was successfully printed and transplanted! Now, more complex organs like lungs and hearts are being created on a much smaller scale than they should be to function in a human body, but it's predicted that soon life size, working organs will develop!

How did Bioprinting originate?

It all started with Robert J Klebe in 1988 when he constructed a rudimentary (but groundbreaking) 2D cell. He used a commercial inkjet printer to deposit cells by using cytoscribing tech – a way to micro position cells and construct manmade cells – as if you're writing a cell on paper. Ever since then, this idea has been developed by providing cohesion between individual cells and forming small tissues in 1999, and after much development of the bioprinter, a sample of bone cartilage was made as well as the first artificial liver! And, in the most recent milestone, in 2019, the bioprinting of a small-scale human heart made of collagen (a type of protein).

Most importantly, how does it work?

This is the part you've probably been waiting for!

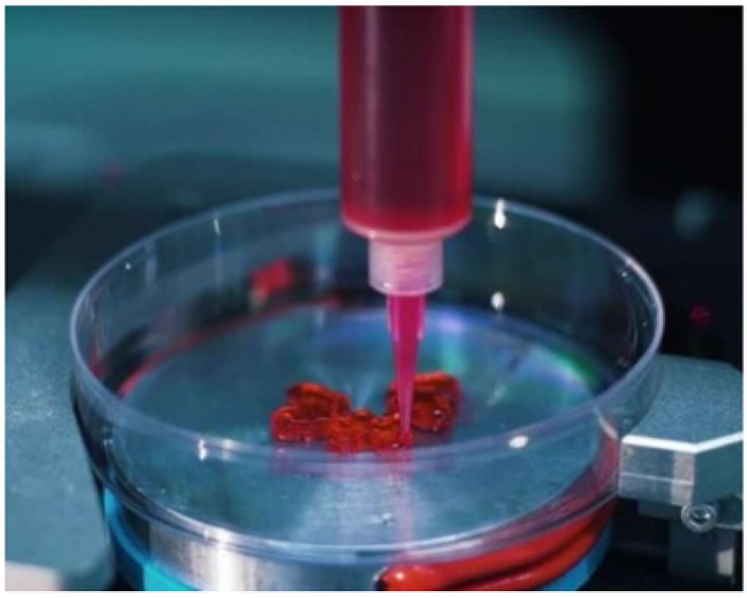
Bioinks are any kind of polymer which is specially selected to support living cells with growth and help stem cells differentiate (making a blank cell specialised to carry out a certain task) as well as cell adhesion to create tissues, to create organs.
Biomaterials are any kind of substance (although man made material is optimal) which can be introduced into bodily tissue as part of an implanted medical device (such as a cochlear implant, planted in the ear when the original cochlea has burst) or to replace organs.

These two essential ingredients, carefully mixed with cells are 3D printed.
Step 1
This involves creating a digital file of a 3D model, for specialised printers to read. The model can be built from scratch or a scan, although some labs, such as the Cellink DNA studio, gives scientists the ability to design simple models directly on the printer.
You also prepare all the aforementioned materials in this stage. In Cellular printing (when cells are required in this case) cells are embedded into the chosen bioink (like giving water and soil to ensure a plant lives and grows) However, some cellular applications only need the scientist to apply the cells to the printed result in the final step. Some applications have no need for cells; they simply use biomaterials if necessary.

Step 2
The actual Bioprinting! A general method would be to load the bioink-cell mixture into small cartridges, so they end up on one or more printing surfaces.
Parameters (a factor and/or rule that sets conditions as well as creating the scope of the process) are set and the print starts, according to the 3D digital files given to the printer/s, acting as a blueprint for the 3D printer/s to build on, layer by layer. The bioink used during this process will be forcefully squeezed by the printer into the desired shape of the product.
For another form of Bioprinting, which is light based (and much more gentle on the bioink) , a photosensitive bioink is used and put in a vat. The structure built by projecting a patterned light onto the bioink, morphing it into whatever shape needed to avoid the light. The light is attached to a moving print arm. Developing different 3D tissue requires different cells and bioinks, as well as equipment.
A small-scale intestine (the small intestine) bio printed.

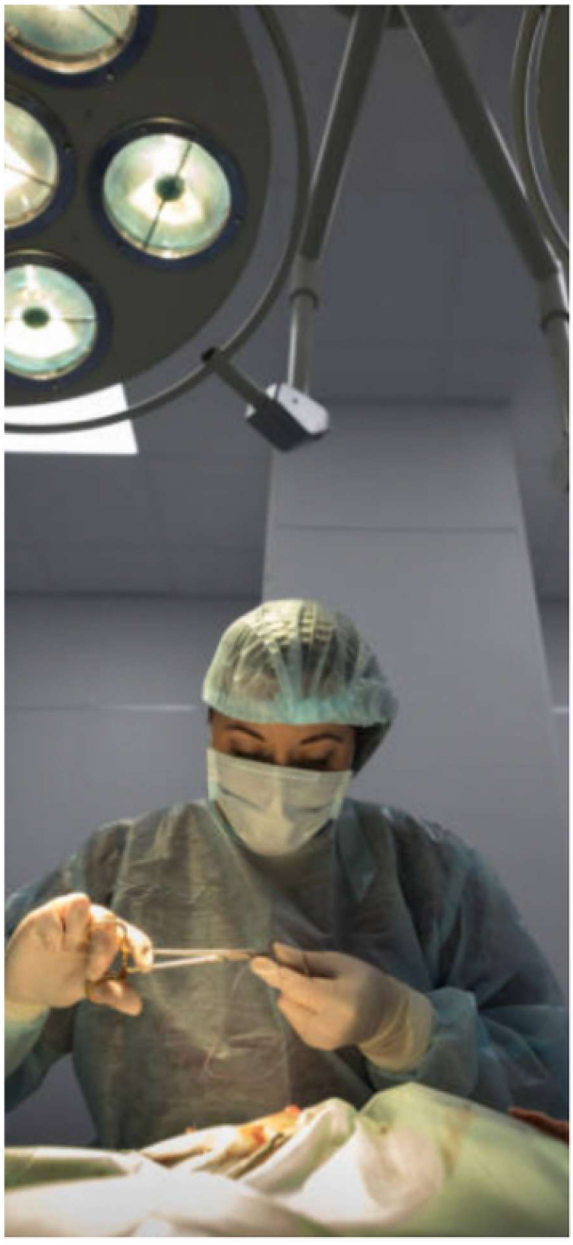
Step 3
The final step: The printed structure needs to be stabilised (No explanation needed there!).
This can be done by Crosslinking – treating the product with a certain ionic solution or a UV light to neutralise any hazards; the composition and structure of the product determines which method is best.
The product is now placed into an incubator with certain conditions for safe growth.

It's being used for ethical drug development and testing, wound healing like bone grafts and severe tissue damage as well as evaluating toxicity in organs – but there is so much more groundbreaking potential that could come to fruition in future generations – which is the commercial printing of full size, working organs. This could prevent almost every single disease -and will be incredibly useful in cancer research - plaguing mankind, simply replacing an old, diseased organ with a fresh, young and working one would change and restart countless peoples' lives for the better. With Bioprinting, thensky's truly the absolute limit, because if you start with printing cells, once every detail is covered, the number of things you can cure are limitless. I believe that 3D Bioprinting will truly become the most fascinating and on-demand medical area in the future, and someday, everyone across the world, especially those who need it most, will get this amazing, intriguing treatment.



The Future of Veterinary Medicine

Veterinary medicine is an ever changing and relatively new branch of medicine in Britain as seen by how the first meeting of a Veterinary Medicine Association occurred nearly 200 years ago in 1836. Much of the modernisation that has befallen medicine happened to veterinary medicine as well in parallel.



Now as human medicine looks towards the emergence of AI and technology to alter the administration of drugs and medication and hopefully improve the efficiency, veterinary scientists are looking for similar ways to improve animal healthcare.

- Surgical robots are one example where robotic arms are to carry out the surgery in efforts for the procedure to be less invasive and more precise so the recovery period is less painful. Though some veterinary practices may be investing in this bit of technology, robotic surgery has had major pitfalls when dealing with the human body let alone the delicate makeup of your grandma's calico cat. For example in 2014, Intuitive were under 93 lawsuits as NBC news reports that many of the victims of the da Vinci Surgical System "allege that they or a family member underwent surgical procedures that utilised the da Vinci Surgical System and sustained a variety of personal injuries and, in some cases, death as a result of such surgery." Another example of robotic care is robotic rehabilitation where robots analyse how the pet moves after sustaining fractures or other injuries which can tailor physical therapy to fit your pets' needs. These improve efficiency and may even speed up the recovery process for the pet however this type of instrument is yet to be implemented in mainstream veterinary healthcare.

Prosthetics with the aid of 3D printing are also becoming more widely researched. So much so that in 2016, it was published by the University of Colorado that a canine artificial exoskeleton was giving paralysed dogs a chance to walk again. This is done for other animals as well, including those with limbs amputated off. Money is being put to better the quality and long-lasting properties of these prosthetics.

Though smart collars are already prevalent, the accuracy of them are hoped to increase as more on different animals' biology is learnt and these are hoped to be linked to IoT apps which sends the owner and the vet immediate information of your pet's health and any important changes to their bodily functions. Telemedicine is also slowly becoming more prevalent in treatment of pets due to the pandemic when virtual consultations with a vet were encouraged and now more technology is being developed to make the process simpler. AI-powered decision support systems are clever tools that give vets case-specific counsel, recent research, and evidence-based advice. With this knowledge, veterinarians can create customised preventative care regimens to keep pets healthy. This is slowly becoming developed.

- Finally, nanoparticles are also hoped to be used more widely in veterinary medication for Targeted Drug Delivery which only attacks the diseases without damaging healthy cells thus preventing awful side-effects. This is also how they wish to treat cancers (by targeted chemotherapy) and rabies in your pets. The small nature of these particles allow them to be more precise. Overall, what you should take from this article is that if scientists are treating emerging veterinary science with higher esteem, then treat your pets with greater value and remember to take them to regular vet appointments.

Jitya

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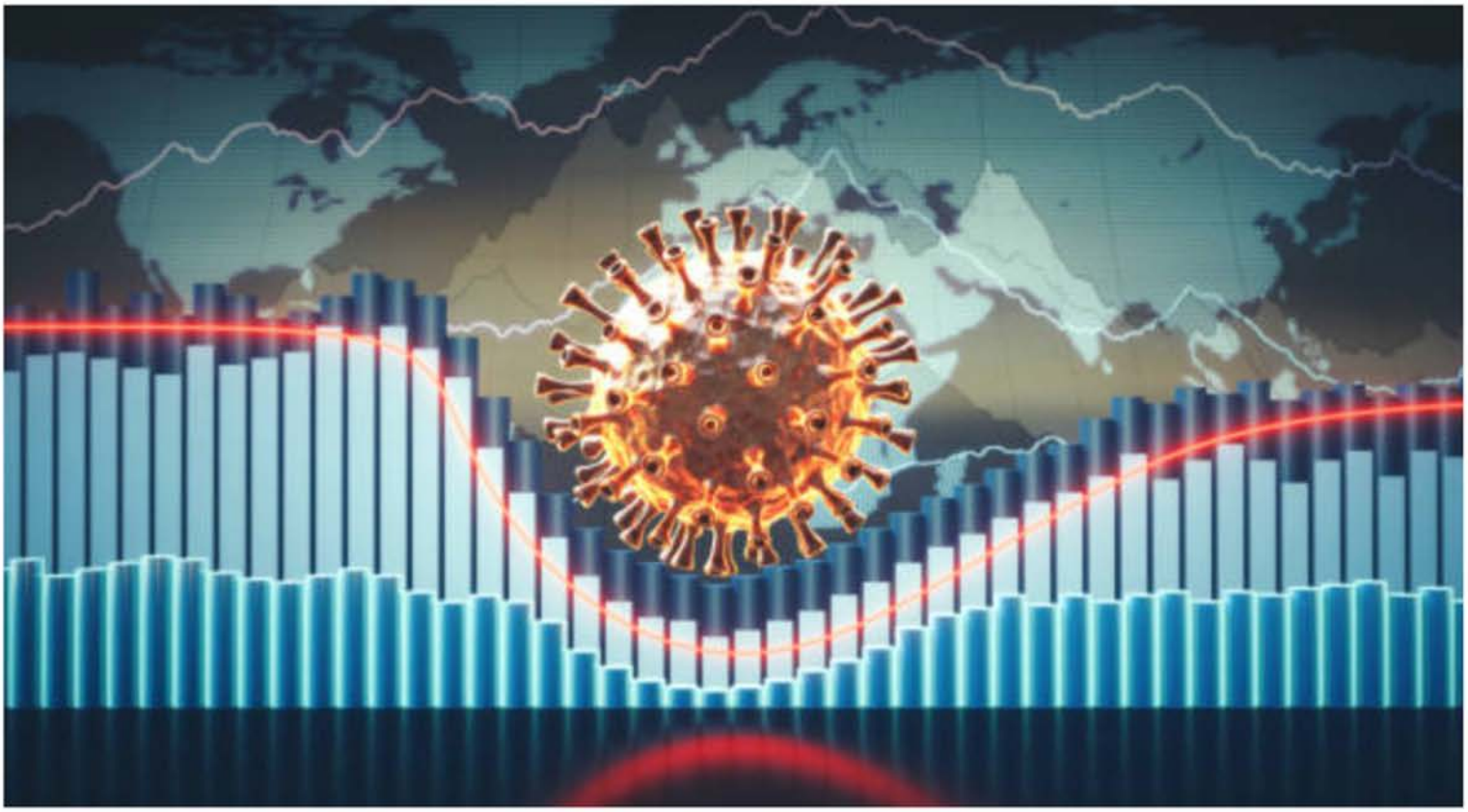
The Future of Pandemics



What will future pandemics look like?

Iqra

Despite the significant technological advances helping medical responses, the potential for disease spread is increasing, and so is the risk of outbreaks becoming epidemics (regional) or pandemics (internationally spread). There are several key factors leading to a potential increase in pandemics. With technological advancements, travel has become easier and easier across the past century. More people can quickly and cheaply travel abroad, potentially spreading diseases they carry to and from the country they are travelling.

As urbanisation is happening at a much faster pace, particularly in Africa and Asia, the cities are unable to cope with the substantial amounts of people moving into them, leading to overcrowded and unhygienic conditions, which can lead to a fast-paced spread of disease before appropriate housing and healthcare facilities are developed. As well as this, due to increased inflation and the cost-of-living crisis, it has become harder for people to afford necessities such as a clean-living space, heating, and nutritious food. This increases susceptibility to infection. As well as this, people's wages can be so low they cannot afford to take time off work in a future pandemic.

Globally, we have found there is an ageing population. This is a particularly vulnerable sector of the population, who are more susceptible to the disease. As these increase the spread of disease, it has also become harder to slow or stop this spread. An ageing population also causes existing pressure on health services, only increased by their further vulnerability to infection. They are also the most likely demographic to refuse to wear masks (according to PubMed Central), despite the protection they provide. Vaccine uptake rates were also lower in participants aged 80+, due to hesitancy caused by 'Not feeling in good health' or 'vaccine side effects causing complications. In future, more widespread, simpler communication, and limiting misinformation on social media will help to prevent this reluctance to take vaccines.

There is a shortage of healthcare workers, as those studying medicine often travel from LICs (low-income countries), making regions where pandemics are most likely to originate more vulnerable.

Those who are asymptomatic also pose a threat, as they are unlikely to seek medical advice, and unknowingly infect those around them.

However, after COVID, we have learned that the faster the introduction of policies improving food protection, lockdown, and test development the better. In future, lockdown procedures and implementation should be stricter, preventing the spread of a pandemic more than necessary. It may be that in future pandemics, the development of testing kits and vaccines may be faster, due to previous experience. It is clear that the 'herd immunity' concept may not be the best decision going forward, as during the COVID-19 pandemic it was called one of the 'country's worst ever public health failures', causing the deaths of thousands of elderly people.

In the UK, we will likely be better prepared for future pandemic, training more qualified personnel, providing enough ICU (intensive care unit) beds, ventilators, masks as well as psychological support – as this has also been a significant impact on people during COVID-19, as lockdown and social distancing took a mental toll. We should also further look into financial support for people who lose their jobs in the pandemic or improving technology to improve the remote work capabilities or increase safety procedures in essential jobs (e.g. NHS staff).

Cognitive-Enhancing Drugs

Are they helping or harming

Amilah

Cognitive-enhancing drugs, also known as novel psychoactive substances (NPS) have been popular within different industries of society such as military enhancement, and more commonly in treating conditions such as attention deficit hyperactivity disorder (ADHD). However, more recently, CE drugs have been the source of controversy due to their increasing traction among healthy students and young adults. The effects of NPS supposedly increase alertness, concentration, and memory. NPS can be prescription medicine such as modafinil and methylphenidate, as well as non-prescription substances such as caffeine and cobalamin. Marketed for both educational and recreational purposes, NPS is easily obtained. Due to its availability and popularity, it is essential to raise awareness on the risks of cognitive-enhancing drugs, and the consequences it can have on our youth.

The definition of cognitive enhancement is: 'the amplification of the core capacity of the mind by improving internal and external processing systems'. Drugs like methylphenidate are said to inhibit dopamine transporters, therefore increasing levels of dopamine and noradrenaline within the brain. By increasing hormone levels, distractibility levels decrease, allowing a higher level of concentration. Similarly, modafinil is known as a wakefulness promoting agent that treats conditions such as narcolepsy and obstructive sleep apnoea. Alertness is induced via the alpha-adrenergic receptor which regulates blood pressure. Modafinil's popularity can be attributed to its euphoric effects that accompany its treatment. Such effects mimic the effects of traditional psychostimulants such as cocaine.

Moreover, methylphenidate mostly produces positive effects, albeit there is some debate in its usefulness amidst earlier research. (Robbins et al 1979) found that although methylphenidate enhanced low baseline performances, high level performances were in fact not changed. (Campo et al in 2013) found that sustained attention improved following methylphenidate usage, irrespective of whether participants were diagnosed with ADHD or not. Conversely, this usage often leads to baseline dependency- methylphenidate consumption has been at an all-time high since 2018. Modafinil induces similar effects, although to a much lesser extent. In more complex situations, modafinil exerted beneficial effects regarding attention for higher executive functions. For sleep deprived individuals, a repeated dosage of modafinil did not enhance attention, and had no other effect on concentration or memory. Non-prescription drugs such as caffeine are under less scrutiny yet can be just as harmful as that of prescription substances. A high dosage of caffeine can massively boost energy but can also lead to harmful side effects such as anxiety, muscle tremors, and withdrawal.

NPS are said to imitate the effects of more mainstream drugs such as cannabis, cocaine, and LSD; however, due to their synthetic manufacturing, they are often able to evade international drug legislation. In the UK, since May 2016, the Psychoactive Substances Act states that the supply of NPS is illegal. Interestingly, the possession of such drugs is not illegal; this is to avoid the criminalisation of young people due to its popularity. Until 2017, CE drugs were sold openly in 'head shops', which sell drug-related paraphernalia. Examples of the widespread use of cognitive-enhancing drugs are in the sports industry, where 'doping' is done by athletes to gain advantage over others in competitions. Doping is considered illegal and is heavily monitored by the World Anti-Doping Agency. Among healthy individuals, usage of NPS spikes during periods of high pressure among youth, such as during exam season; the term 'academic doping' was coined by the BMC Med Ethic to refer to this

So, why is NPS so popular? And what can we do to prevent unregulated usage of CE drugs? Motivations for substance use differ in terms of gender: females take NPS to increase concentration and memory, whereas males aim to increase study time, and experiment for recreational purposes.

CE drugs may moderately enhance performance in healthy individuals, but the subsequent mood elation hinders the student more so than helping, in that the euphoria often distracts the student from exam preparation. Additionally, one should consider the ethical circumstances that lead to consumption, such as increased academic pressure. One should not substitute a healthy work environment for a temporary boost. In fact, there is growing evidence of an association between cognitive function and sleep, due to it benefiting neuronal plasticity. Similarly, a healthy diet and physical interaction with the environment has a massive impact on focus. Overall, consensus for NPS is split, as there is little evidence to support actual benefits, and not just anecdotal information from peers and online. Unfortunately, CE consumption is increasing every year, with little to no thoughts of the consequences; however, if awareness about how little NPS helps spreads, hopefully we can improve both the physical and mental health of students.

Genomic Research

How will it help to prevent disease?

Eman

There is no proven cure for most uncommon diseases- eight out of ten have genetic origin and are frequently chronic and potentially fatal. They often take more than four years to accurately diagnose. If the sickness could be prevented, we wouldn't have to wait for it to progress to a more serious stage before diagnosis. Genomic research is a field of biology that studies the structure, evolution, function, mapping, and editing of genomes- useful in treating diseases such as cancer and schizophrenia due to their links to genes as hereditary diseases. However, it can be argued that this cannot become real due to the expansive limitations holding it back.

Thomas Hunt demonstrated in 1915 that the fundamental building blocks of inheritance are genes. Gregor Mendel presented his theories of inheritance in 1866, drawing on hybridization studies with garden peas; when he crossed a purple flower with a white flower, the result was purple offspring instead of a hybrid of the two. In the early 1900s, Sir Archibald Garrod described several diseases, calling them "inborn errors of metabolism" indicating a genetic basis because they displayed an inheritance. Garrod explained autosomal recessive inheritance, which requires two copies of an abnormal genetic variant to express the disease. Using Mendelian principles, two parents who are heterozygous for the disease allele have a one-in-four chance of giving birth to a child who carries both disease alleles: the disorder.

Genomic research should be explored further; helping prove which diseases are hereditary and who is at risk. With technology, it is possible for organisations to investigate those most at risk and need attention for their chronic diseases before it's too late as we can now identify the variants which carry a higher risk of diseases and trace it to the individual. Less than 20% of people diagnosed with difficult cancer types to diagnose/treat survive their cancer for ten years or more, if this was prevented, there would be less death. However, diseases aren't cured; lifespans are elongated; so the future of medicine must look into fully preventing chronic conditions from appearing to improve the healthcare system- it's vital that these people don't have to worry about chronic diseases which could've been prevented, and now developed, don't have a cure.

Diagnosis, prognosis, and monitoring of disease are employing genomic biomarkers, which is utilised to determine cancer subtypes. Genetic signals are used in the clinical management of cancer to predict prognosis and responsiveness to therapy, beyond simple classification and diagnosis. This helps identify patients at the earliest subclinical stages of the illness, when treatments are more effective and preventive measures can be used, or after a diagnosis has been made but further subtype differentiation is required for intervention and medication treatment plans- sparing the patient from pain and improves their quality of life quicker.

Preventing chronic diseases sounds enticing, but there are limitations. Not all chronic diseases are hereditary and can be prevented; heart disease is prevented through lifestyle habits. Genomic research is expensive, with costs ranging from £10,000,000 to £100,000,000- large-scale studies are time intensive, requiring continuity of expertise. Gathering and analysing personal data presents privacy and confidentiality issues. Moreover, participants must understand the nature of the study and any possible risks and benefits.

Whilst there are limitations to genomic research like costs, ethical issues and unreliability in preventing all diseases, its potential to revolutionise healthcare is too great to ignore, the revelation of preventing diseases instead of curing them opens to a more efficient healthcare system which prioritises the patient's quality of life. It is a magnificent opportunity for medicine and research to combine to change how we deal with patients for the better, as now they avoid all the pain quicker. Preventing disease is the future of medicine and through genomic research, it may become a reality.

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