

Future Doc

Student Journal



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Welcome

The Future Doc Student Journal: By Students for Students.

Our journal offers publishing opportunities to students of all ages and expertise.

Within healthcare, we offer a wide range of topics and article types to give our authors as much flexibility as possible. The journal is published quarterly and is posted on our website, where you can also view past issues.

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Section 01 - By Ben Wood

Cancer: Sugar's Best Friend

A Discussion About the Impact of Sugar

Abbreviations:

- PAM: PI3K Akt mTOR
- EU: European Union
- HIF: Hypoxia inducible factor
- TME: Tumour microenvironment
- GPR81: G-protein coupled receptor 81
- VEGF: vascular endothelial growth factor
- PTEN: phosphatase and tensin homolog

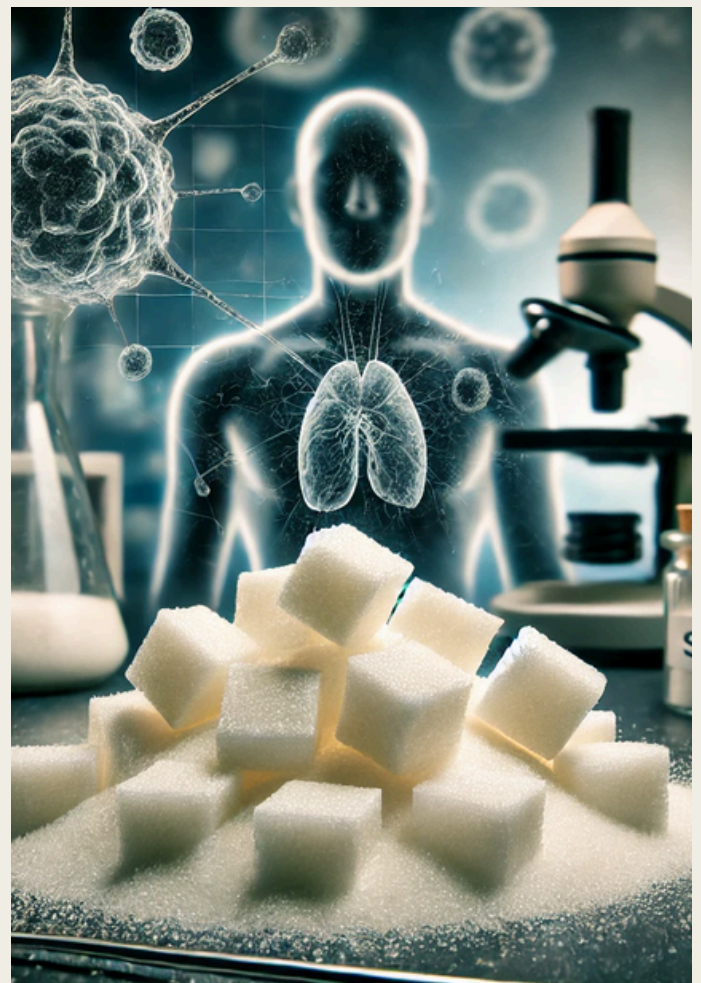
The global health burden of cancer remains significant. In 2020, estimates of over 4 million new cases of cancer had emerged in Europe. Specifically, over 710,000 cancer deaths in males and 560,000 in females had taken place in the EU (1). Moreover, dietary composition has changed over the past decades to reflect the development of poorer health outcomes (2). Dietary global sugar intake has increased, which has seen increases in disease burden, such as type 2 diabetes and obesity (3). Interestingly, diets that primarily consist of fat, like keto diets, have shown evidence of disease regression (4). However, more research is needed to prove that remission is conclusive, however. Therefore, with the knowledge of how modern diets have changed, understanding sugar consumption's link to cancer development is paramount. This article aims to explore the link between sugar intake and carcinogenesis, with the primary and secondary effects of sugar consumption at the centrepiece.

Otto Warburg was a German physiologist and medical doctor who observed significantly higher glucose uptake from tumour cells than normal cells (5). He found that tumour cells almost exclusively prioritised glycolysis over more efficient forms of energy production, like oxidative phosphorylation. What's more interesting, however, is that the presence of oxygen made no difference to the tendency towards anaerobic processes. This stubborn refusal to use more efficient methods of energy production seems highly counterintuitive, primarily when more glucose is being used. However, when the effects of lactic acid, a by-product of glycolysis, and HIF, a hormone produced in anaerobic conditions, are considered, it seems to be a highly advantageous choice for cancer (5).



Lactic acid is present in the environment of cancer cells and is produced from the soaking up of dietary glucose. This can be observed from the abnormally high concentration of lactate in the TME (7). The decrease in pH from lactate in the TME can be beneficial to the progression of cancer by aiding development in three areas: metastasis (7), immune system modulation (8), and angiogenesis (9). Metastasis, the translocation of cancer cells, is achieved through the degradation of the extracellular matrix, enabling the cancer to immobilise and invade other tissues through their basement membrane. The immunosuppressive effect of lactate needs further mechanistic elucidation, however, it is evidently important via the observation of uncontrolled proliferation of cancer (10). As cancer grows, it will naturally move away from its source of nutrients via the blood, so will receive less glucose and oxygen. Lactate aids angiogenesis, the creation of new blood vessels, via . of GPR81 on cancer cells. Thus, lactate has solved cancer's problem of movement, immune surveillance, and malnutrition. HIF, an enzyme activated when low oxygen levels are present, has effects similar to lactate. HIF, via VEGF, will promote angiogenesis (11) and, additionally, will encourage metastasis (12). More importantly, HIF will switch a cell's metabolism to glycolysis, effectively keeping the tumour cancerous after it has grown far enough away from its source of energy (13).

Cancer's unusual sweet tooth is the product of being selectively advantageous. It consumes more sugar because that aids its chaotic proliferation, which is one of the hallmarks of cancer (14). Cancer's objective to survive leads its host to be withered and skeletal, cachexic, which is symptomatic of the disease's late stage (15). The Warburg effect has disastrous consequences for the human body, but it perfectly illustrates cancer's desperate desire for sugar(16). Moreover, sugar can also influence a hormone that regulates an individual's growth, and energy metabolism; qualities which cancer, a disease characterised by hyperproliferation, is especially interested in (17). This hormone's name is insulin.



In 1964, breast cancer cells were noted for a high dependency of the hormone, insulin, and without it those cells died (16). Interestingly, however, normal breast cells only require a minimal amount of insulin. This is to be expected, as one of insulin's roles is to increase glucose trafficking into the cell. In essence, due to the Warburg effect, the cancer cells require more glucose because of the metabolic change to a more inefficient mode of energy production (5). However, as mentioned earlier, insulin has a remarkable influence on a tissue's growth (18).

To understand insulin's effect on growth, the signalling pathways behind it need to be understood. Growth is a complex interplay between signalling pathways, however, what is heavily implicated in uncontrolled proliferation that defines cancer is disruption of the PAM pathway and is often implicated in anticancer therapies (19). Below is figure 1, which illustrates the causal relationship between insulin and growth using this pathway.

When a person is in a state of chronic glucose consumption, they are, therefore, in a state of hyperinsulinemia. Hyperinsulinemia translates to elevated insulin in the blood. This state can offer increased proliferation, which gives rise to more chance mutations that can benefit cancer.

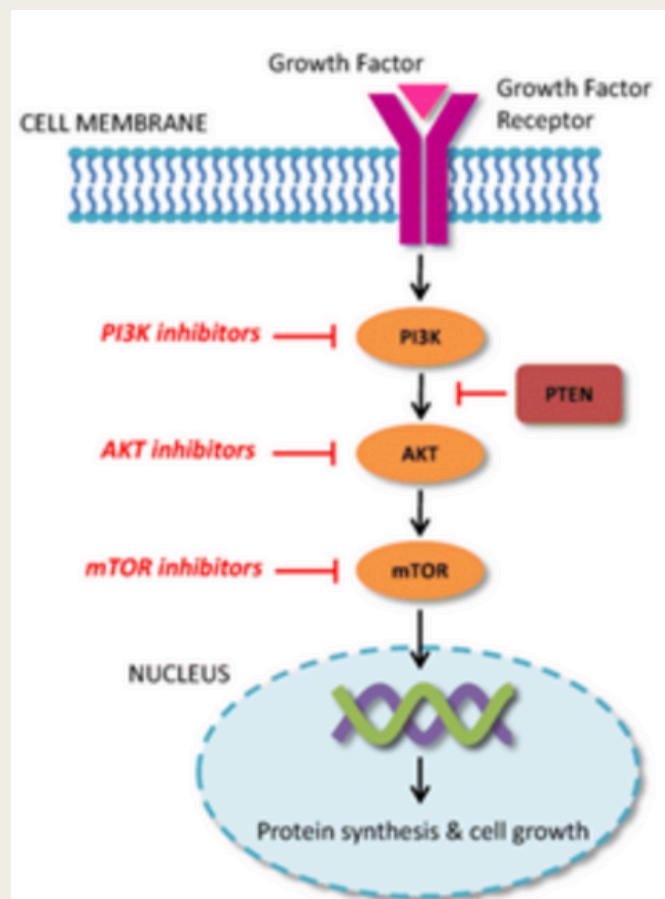


Figure 1. Simplified PAM pathway. Above shows signal transduction whereby insulin works as a growth factor acting through PI3K, AKT, and mTOR. (6)

By consulting figure 1 this is evident. If PTEN, an inhibitor of the PAM pathway was mutated to be non-functional then growth would be encouraged and harder to stop. Hyperinsulinemia is also implicated in the rise of obesity, which is a significant risk factor in carcinogenesis (20)

One of the hallmarks of cancer is uncontrolled growth (14). A response to sugar, is a growth factor, named insulin (18). Therefore, elevated states of insulin will lead to the rise of unchecked proliferation. These cancerous states thrive on insulin, as was seen with the breast cancer example (16). Cancer's sugar addiction has never been stronger. What's worse, however, is that global sugar addiction is just as bad. Sugar sweetened beverages intake is consistently above the recommended daily limits for free sugar in many high-income countries and is on the rise in low and middle-income countries (21).

The progression of cancer through the lens of sugar intake can be seen as this. Excessive sugar consumption leads to hyperinsulinemia. Sustained hyperinsulinemia leads to excessive growth (18). This increase in growth leads to an increase in the likelihood of the dysfunction of the PAM pathway, via cumulative mutations, which can lead to cancer (19). As these cells move further away from their blood supply, they will start to be deprived of oxygen and nutrients, which will result in the release of HIF. HIF will switch the cells' metabolism to glycolysis (13).

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It can be harrowing to conclude that the primary energy source for your body can be used to fuel rogue entities which can invade and disrupt the functioning of your body. But, with most things, the key is moderation, as cancer is a disease of excess, not deprivation. It is also important to know that this pathology is characterised by excessive sugar intake over long periods. A Fanta every so often isn't going to kill you. Vigilance is important, however, because it is far too easy to overindulge, especially how accessible sugar has become. Always remember, that no matter how much you may love sugar, cancer loves it more.



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Section 02 - By Aisha Hafeez

Mpox: Public Health Emergency

A News Update on Mpox

Mpox, previously known as monkey pox is a viral illness caused by the monkeypox virus. The threat posed by Mpox persists today, and an increase in cases in the Democratic Republic of Congo and other countries has raised concern. Common symptoms of Mpox include skin rash, fever, headache, muscle aches and back pain. Vaccines provide a level of protection against Mpox. However, preventative measures are also necessary. Mpox can be transmitted through close contact with an infected person, contaminated materials or infected animals. The risk of catching it in the UK is low.

The virus causing Mpox was identified in 1958 following two outbreaks of a disease resembling smallpox in research monkey colonies (1). Despite initially being called "monkeypox," the exact origin of the disease remains uncertain. It is believed that the virus could be harboured by African rodents and non-human primates (such as monkeys) and transmitted to humans (1).

The first human case of Mpox was documented in 1970 in what is now the Democratic Republic of the Congo. By 2022, Mpox had become a global health concern. Prior to this, occurrences of Mpox in other countries were rare and were usually linked to travel or the transportation of animals from endemic areas (1). In 2022, the World Health Organisation changed the disease's name to comply with updated naming guidelines.

According to these criteria, disease names should be culturally sensitive and avoid negative impacts on trade, travel, tourism, and animal welfare. Nonetheless, the virus responsible for the disease retains its original name (1)



The incubation period for Mpox is typically 5 to 21 days. Initial symptoms include (2):

- Fever
- Headache
- Muscle aches
- Backache
- Swollen glands
- Chills
- Exhaustion
- Joint pain

A rash usually appears 1 to 5 days later, and it can occur anywhere on the body, including the hands, feet, mouth, genitals, and anus. Additionally, anal pain or bleeding may occur. The rash can be mistaken for chickenpox and starts as raised spots, which develop into sores or small blisters filled with fluid. These blisters eventually form scabs and fall off. Symptoms generally clear up within a few weeks, during which time the infection can be transmitted to others (2).

The Mpox virus primarily infects rodents and primates in central Africa. Early human infections are usually linked to contact with infected animals, including exposure to body fluids, mucous membranes, or undercooked meat consumption. Transmission can also occur through scratches or bites from infected animals (3). Human-to-human transmission is believed to occur through direct contact with respiratory droplets from infected individuals (4). Additionally, Mpox virus can be vertically transmitted from infected mothers to their newborns (5). Unlike previous outbreaks, the recent epidemic of Mpox infection is not primarily associated with contact with infected animals or travel, but rather with sexual contact between individuals (6). Over the past two years, the majority of reported cases of Mpox outbreaks have involved homosexual or bisexual males. A study reported that 98% of cases were among homosexual or bisexual males, with 41% of them co-infected with HIV. Furthermore, 73% of the observed lesions occurred in the anal and genital regions (7). The incubation period of Mpox is approximately 7-14 days, with symptoms lasting for 14-21 days. This prolonged incubation period presents challenges for accurate diagnosis and may lead to delayed medical attention, disease progression, and further transmission of the virus (8,9)

To prevent the spread of Mpox, individuals with the condition should isolate at home or in a hospital, following guidance from their healthcare provider until the infectious period has passed. It's important to cover lesions, wear a well-fitting mask, and use condoms during sex to reduce the risk of transmission. Taking a break from sexual activity with new partners during periods of increased transmission can also help lower the risk of getting Mpox. Health workers should strictly adhere to infection prevention and control measures when caring for patients with Mpox (10).

The primary objective in treating Mpox is to manage the rash, alleviate pain, and mitigate potential complications. It is crucial to provide early and supportive care to effectively address symptoms and prevent further issues (10)

Receiving a Mpox vaccine is essential in preventing infection, especially for individuals at high risk, particularly during an outbreak. The vaccine can also be administered post-exposure, ideally within 4 days of contact with an infected person, and up to 14 days if symptoms have not yet developed (10)



While certain antivirals have gained emergency use authorisation in some countries and are under clinical evaluation, there is currently no proven effective antiviral treatment for Mpox. Therefore, it remains critical to continue evaluating therapeutic options through robust clinical trials and emphasise the optimisation of supportive care (10).

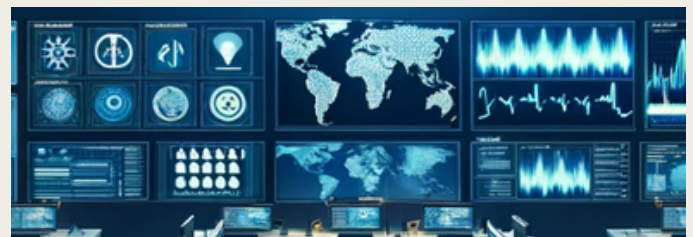
For individuals with HIV and Mpox, it is important to continue their antiretroviral therapy (ART), ideally initiating treatment within 7 days of an HIV diagnosis (10).

An unexpected and rapid outbreak of Mpox occurred in May 2022, spreading throughout Europe, The Americas, and eventually all six WHO regions. The worldwide pandemic has predominantly (but not only) impacted gay, bisexual, and other men who are in relationships with other men. It is transmitted from person to person via sexual networks (10).

Mpox outbreaks caused by Clade I occurred in the Republic of Sudan refugee camps in 2022. In the Democratic Republic of Congo, there has also been a rise in Mpox cases and fatalities since 2022. Clade Ib is a newest variant of clade I that has been spreading person to person in various parts of the nation. The clade has also been documented in other nations as of mid-2024 (10).

Between January 2022 and August 2024, more than 120 countries reported cases of Mpox, with over 100,000 laboratory-confirmed cases and over 220 confirmed cases that resulted in deaths (10).

Since 2022, there have been a few instances of Mpox in the UK. All of these cases have involved a milder type of Mpox known as Clade 2 Mpox. There have been no reported cases of the more severe Clade 1 Mpox in the UK. This strain of Mpox has primarily been detected in countries across west, central, and east Africa. The likelihood of contracting Mpox in the UK is minimal (2).



Despite being declared a public health emergency and a major health concern around the globe, Mpox can be prevented and managed with the appropriate measures. Global health authorities are better equipped to contain future outbreaks thanks to the lessons learned from the 2022 outbreak and the continued use of vaccines. Nonetheless, vaccination and public awareness campaigns will continue to be essential for controlling the infection. As research progresses, it is hoped that like smallpox, Mpox can eventually be controlled and cease to be a serious threat to world health.

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Section 03 - By Anshul Sament

Should You Freeze Your Eggs?

Abbreviations:

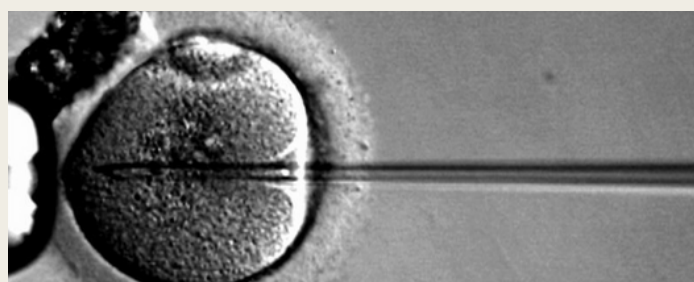
- OC: Oocyte Cryopreservation

As the pursuit of higher education, professional career endeavours, and financial stability take greater priority, more and more young women are delaying having children.[3] Consequently, the rates of fertility amongst young women in their 20s and 30s are declining.[4] However, this also illustrates the rise in the empowerment of women by ensuring the cultivation of their lifestyle and values before they settle down. [5] Unfortunately, more women are struggling to become mothers by the time they feel confident to take on this role, as a result of the natural decrease in female fertility with age.[4] Do they have to choose between their professional endeavours and motherhood, or is there a way we can use medical technology to combat this issue? This article aims to discuss the advantages and disadvantages of oocyte cryopreservation in combating this issue and to help them decide whether this is the right choice for them.

Studies and surveys have shown that more women are receiving tertiary education and taking on professional careers than ever before.[1,2] “The average age of first-time mothers in America is now up from 21 to 26,” [3] whilst the most common age has now struck 30! [4]

The development in these philosophical beliefs and advancements in social norms can be depicted by the phrase, “Waiting to have kids is a kind of empowerment for some women, ensuring they can finish their education, find a fulfilling job, become financially stable, choose the right partner, and grow and mature as a person before settling down to have a family.”[5] The majority of women are delaying having children in their lives as a way of managing the pressure of having a career and a family simultaneously, and to prevent giving up one opportunity for the other [3].

Having a limited supply of egg cells from birth, as well as ovulation, results in an irreversible decrease in egg quantity with age. This reduces the likelihood of getting pregnant at an older age [6]. Additionally, the increase in chromosomal abnormality and the decrease in effectiveness of meiosis in egg cells with age [7] results in chromosomally abnormal eggs (poor egg quality). Therefore, even after successful fertilisation, the egg would be highly unlikely to implant and grow. These abnormalities increase rapidly after the age of 28-29. All of these biological factors show that the chances of pregnancy in women decrease with increasing age [6].

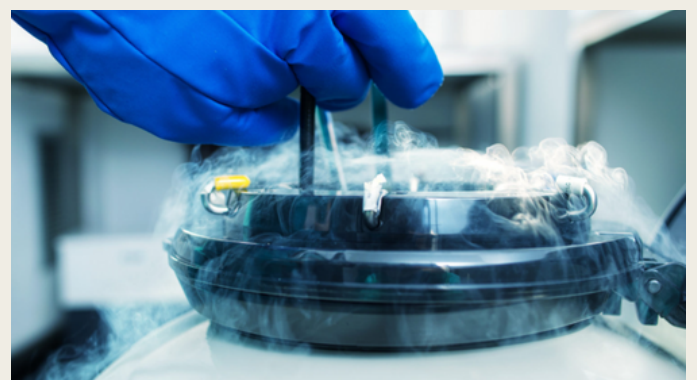


The aim of oocyte cryopreservation is to provide these women the opportunity to have their eggs surgically extracted and utilised at a later time in their lives when they feel ready for motherhood. This allows women to pursue their creative and professional endeavours with more freedom, living their lives intentionally, rather than being restricted by their biological clocks. Some studies even show that children born to parents who are older, often with tertiary education and wealthy circumstances, grow up to be healthier, better educated, and better behaved!^[8] Furthermore, studies show that women who have children later in life reported more happiness and satisfaction around and after their birth, compared to the younger mothers.

The woman will consult with her fertility doctor (reproductive endocrinologist) to see if she is a fit candidate for egg freezing. Women above 40 years of age are usually discouraged from the treatment due to the low probability of success, and an unrealistic number of eggs needed. If they are fit, they will inject medications for approximately 10 - 12 days to increase their egg count and prevent the ovaries from releasing them (so they can be extracted later). The drugs typically include follicle-stimulating hormone and luteinising hormone, although they can vary from person to person

Then, the doctor will order the patient to take the “Trigger shot” to determine when they will mature and release so they can be retrieved during surgery exactly 35 hours later. Egg cells are then taken into the lab, where they are either mixed with sperm cells to be fertilised to create the embryo and dipped in a tank of liquid nitrogen or dipped in directly to be vitrified instantly.^[11] This is done using a rigid embryo straw. They can then be stored in liquid nitrogen containers to be removed for thawing, fertilisation, and implantation in the distant future when the patient wants to become pregnant.

Oocyte cryopreservation doesn't guarantee pregnancy, and it isn't an insurance policy as most people assume ^[9]. The overall chance of success from OC is only 39%, and this is highly dependent on various factors, including the age at extraction, and the number of eggs retrieved and stored. The younger the woman is when the eggs are surgically extracted, the higher the chance of success due to better egg quality and higher quantity. The larger the number of eggs extracted, the higher the chance of pregnancy due to the loss of eggs at different stages of OC.



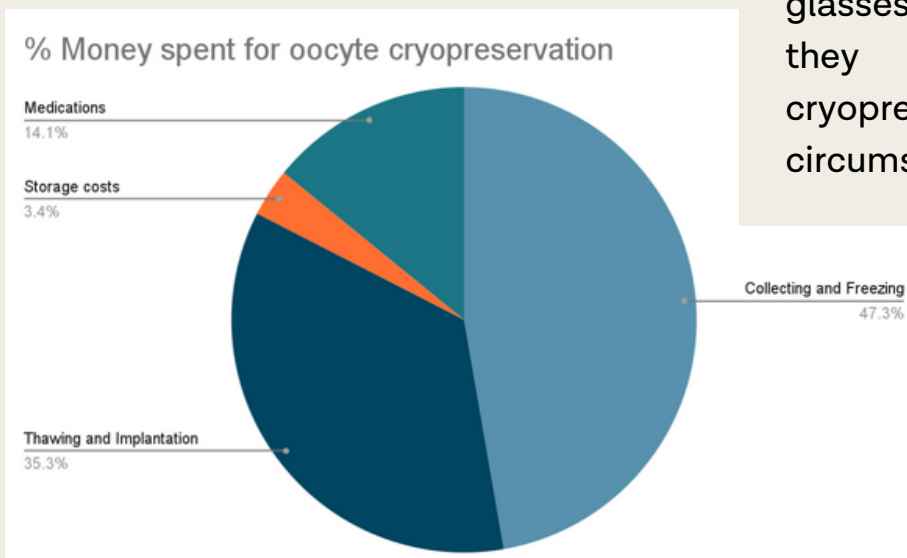
Age of women (years)	Amount of mature eggs frozen	Chance of at least one birth (%)
<35	15	80
35 - 37	20	80
38 - 40	30	75
40 - 42	30	50

The job of a CRP provides the unique experience of being an important cog in the chain of healthcare whilst seeing its workings as an outsider. Though I witness the beauty of medicine and research symbiosis, I also see the ways in which their relationship must form better cohesions in order to maximise healthcare. With increased communication fluidity and an in-depth understanding from both parties, research and medicine can further how patients are treated beyond our wildest dreams.

There are also expenses to consider, and the potential financial burden. The cost of OC in the UK can be very expensive (see chart above).

Another disadvantage could be the lack of use of these eggs, resulting in a significant loss of money and time. “Most women end up never using their frozen eggs after paying for egg retrieval and storage, often because they got pregnant on their own.” [10]

This is purely a matter of personal preference and would be unique to the circumstances of an individual. For example, it may not be a very effective option for women older than 40, who have a low probability of success, or women who cannot afford the financial and or physical burden of the treatment. However, if they can afford the treatment, are under the ages 35 - 40, and are planning to delay having children, it is clearly a very viable option to increase their chances of pregnancy later on. In my strong opinion, In the same way that people use prescription glasses to see, and hearing aids to hear, they should use oocyte cryopreservation, under the correct circumstances, to begin motherhood!



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Section 04 - By Anonymous

Capturing Health

The Impact of Intergrating Camera Technology in
Healthcare

Since the initial creation of the photographic camera in the 1800s, the process of taking a photograph has been shortened significantly. The first ever photo from a photographic camera took over “8 hours of exposure on pewter coated in bitumen (1),” which seems simply inconceivable in the modern era. Nowadays, the average person can simply pull out their phone, open an app and take a photo. Being capable of adding any additional filters or cropping out certain objects with a tap or few clicks of a mouse. Yet, where does the Healthcare scene come into play with the leap in technology?

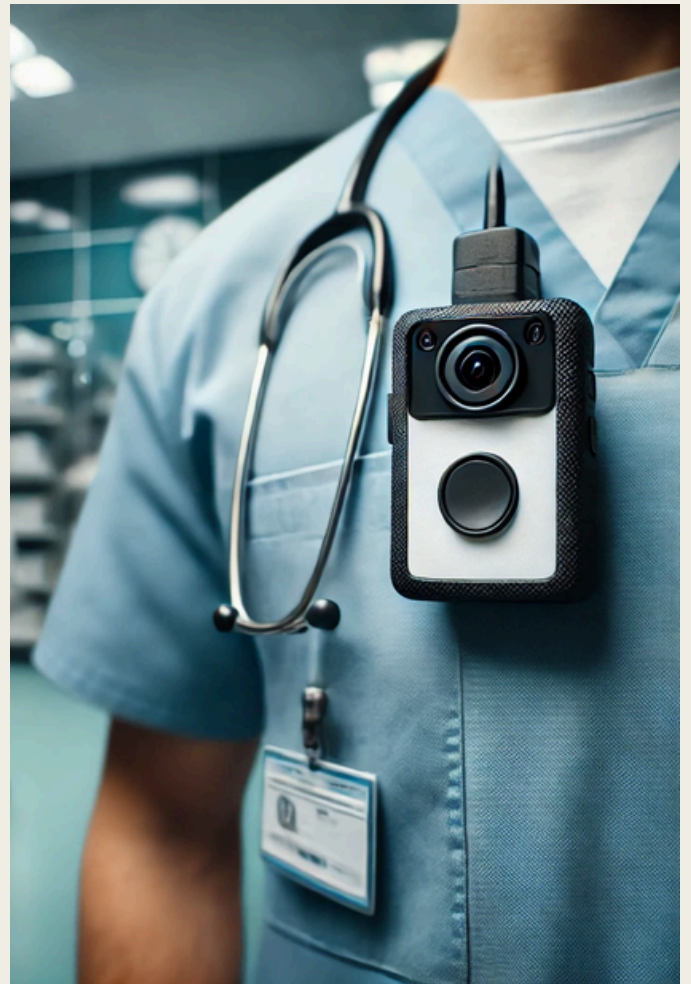
In 1839, the first photograph specifically done for medicine was taken by French physician and cytologist Alfred François Donné. He later showcased more photographs (with the assistance of Jean Bernard Léon Foucault) of platelets, leukaemia and *Trichomonas vaginalis*-cells (a highly prevalent STI) (2). Soon after, several different medical specialities took an interest in photography.

Yet, medical photography doesn't necessarily have to come from small, portable, cheap cameras. Advances in both the scientific and technological fields have resulted in large X-ray machines capable of taking high-speed photos of bone structures for medical diagnoses or (in the case of CT scanners) taking images of the internal human body, which both have significantly aided in speeding up the diagnosis of a patient.

However, photographs are simply one part of the larger scope of camera technology in healthcare. What if rather than taking still pictures of specific bones, organs and structures, we could insert a small camera into the body so that we can see the live action of the organs. May I introduce the endoscope! A small thin tube with a small camera attached at one end and the other end attached to either a TV screen or eyepiece lens for which doctors or (more specifically) surgeons may view (3). There are different cases where endoscopes can be used, but the three main cases are for investigating unusual symptoms, supporting the diagnosis of a patient, or key-hole surgery (4) Key-hole surgeries are usually performed so that your consultant doesn't need to make a large incision into your body, which can help speed up the healing process after surgery.



Yet, one can't mention cameras without mentioning security cameras. The integration of security cameras within healthcare practices has been of vital importance for the safety of both patients and staff within hospitals, GP practices, and pharmacies, to name a few. According to an OSHA article, healthcare providers are at least 4-5 times more likely to suffer injuries that result in days off work and aid, compared to other industries (5). Another article investigated using body cameras for security personnel across several different hospitals and found that (compared to a control group) the number of incidents involving disorderly conduct and violence was reduced considerably. Statistics also show that the security personnel and care staff at the hospitals would feel much safer and protected with a 95.8% "Yes" response (6). It has been 200 years since the first introduction of cameras into the healthcare scene, but despite its late introduction, it has already proved that they are indispensable piece of the healthcare world. Its usage for safety, patient care and treatment have no doubt further solidified its position as a critical part of the healthcare world.



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