

**Cancer is notoriously challenging to diagnose and treat. Discuss whether we will ever cure cancer. You can refer to a maximum of two forms of the disease in your essay.**

Cure is derived from the Latin word *curare* - to take care of. In medical terms, it refers to restoring health or to heal. Whether or not cancer is a disease that can be cured is a question that around 24.5 billion dollars has been spent on in the last few years alone (McIntosh et al., 2023) - but we are yet to see a definite conclusion. However, several significant breakthroughs have contributed to our comprehension of the disease in the last few decades and if the challenging condition could be treated, it could completely revolutionise modern medicine as we know it. Nonetheless, to understand if a cure is even within the realms of human capability, we must first be conscious of the peculiar nature of cancer.

The origin of the term 'cancer' is said to be the work of Hippocrates, using terms such as 'carcinus' and 'carcinoma' to describe tumours - in the Greek language, these words relate to the crab and the physician may have used this vocabulary to describe cancer because the projections of a tumour could be visually similar to the appendages of the crustacean (American Cancer Society, 2018). But the first human records of cancer don't come from Ancient Greece - the Babylonians charged fees for the surgical removal of tumours, the Egyptians blamed the disease on the gods and the Indian tale of the Ramayana suggested using arsenic paste to inhibit the growth of tumours. However, the 'Father of Medicine', Hippocrates, was the first to establish the difference between malignant and benign tumours, a discovery which helped to narrow down what cancer truly was. Benign tumours are different to malignant tumours because they are not cancerous - the former cannot spread to other parts of the body whereas the latter can. They are typically quite harmless, unless the tumour is applying pressure on important structures like organs or nerves, which tends to be the only scenario in which they pose a threat. However, malignant tumours are not as simple to treat and, unlike their benign counterparts, are classified as 'cancerous'.

Cancer can start to grow in one organ and gradually it will start to spread to other parts of the body. This process is called metastasis and this process involves cancerous cells breaking off from the tumour and travelling through the circulatory or lymphatic system. According to the National Institutes of Health, the new tumours that form in different parts of the body 'are made of the same cancer cells as the original tumour' - for example, testicular cancer cells that metastasize to the brain still look like testicular cells (News In Health, 2017). Speaking to Dr Sanjay Dixit, a consultant clinical oncologist at Castle Hill Hospital and Scunthorpe General Hospital, I learned that in his opinion, 'the mechanism of cancer cells spreading is complex and multifactorial', with research still being done today to further improve the understanding of such mechanisms. Some types of cancers are more likely to metastasize than others, at sites such as the lungs, liver, bones and brain. This

ability that the disease has presents a significant hurdle in the path to cure cancer, because there is no completely effective treatment that will destroy the original tumour and the other disseminated cells. The result of having tumours in different locations means surgeons have to consider multiple microenvironments, which may respond individually to different therapies - additionally, the genetic characteristics of metastatic tumours are said to 'make them highly resistant to standard treatments' (National Cancer Institute Staff, 2017).

The genetic complexity inherent to the disease contributes significantly to the challenges researchers face in their attempts to find a cure. After all, the cause of the illness itself arises from a combination of genetic mutations that results in uncontrolled cellular growth, and as these cells continue to divide, more mutations accumulate which leads to the formation of a diverse landscape of cancer cells, even within a single tumour that hasn't metastasized. This means that not all the cancerous cells in a tumour would necessarily respond similarly to treatment, which makes the already difficult task of trying to target aberrant cells while sparing healthy tissue much more onerous. The genetic instability of cancer, that comes as a result of its rapid growth, can also lead to the emergence of drug resistance, which renders initially effective treatments useless over time. Therefore, the endeavour to cure cancer becomes a race against time, with genetic intricacy emphasising a requirement for personalised treatment plans, so that the unique genetic makeup of a patient is taken into consideration, and precise medication that can be used when conventional therapies become obsolete.

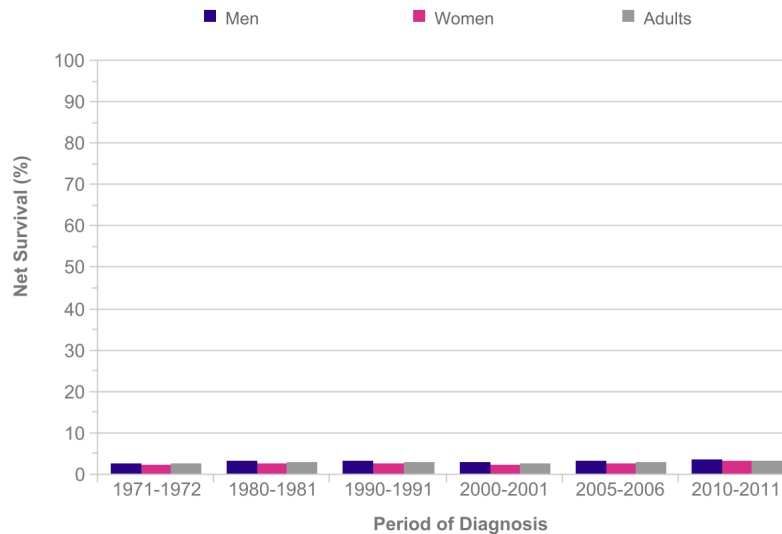
The economic aspect also plays a huge role in the development of cancer research, with funding challenges hindering the resource-intensive endeavour of cancer studies. Following the COVID-19 pandemic, Cancer Research UK has had to cut its research funding by £45 million, on top of the £44 million cut made to grants at the beginning of the pandemic (Cancer Research UK, 2020). This undoubtedly would have long-term effects on the procuring of a cancer cure, leaving hundreds of world-class scientists without the investment to continue their research, or the patients to conduct their clinical trials due to the employment of social distancing. Not only does the scope and pace of research reduce, but the translation of promising discoveries to applied practice is hindered which denies patients access to innovative treatments, if they weren't already facing financial barriers. However, surprisingly enough, the coronavirus situation also provided the opportunity for some developments in cancer treatment, especially post-pandemic. Electronic consultations were being used by healthcare services - the process of adopting e-consultations into general practice was greatly accelerated by the NHS as they committed to offering them by April 2020 (Murphy et al., 2021), which would undoubtedly decrease the waiting time for the diagnostic process, as well as allowing cancer patients who live in remote locations or those who don't have the ability to attend appointments to take advantage of telemedicine. Additionally, the medical world came to a significant realisation regarding the cooperation between academia

and industry as experts across the world and across disciplines collaborated to expedite the development, validation and deployment of COVID-19 medications. This subsequently proved that it was possible to establish more optimised approval processes for life threatening diseases such as cancer, allowing researchers and practitioners to synergistically help save the lives of many across the globe. Therefore, it should be noted that the pandemic didn't just impede the progress of cancer research, but encouraged collaboration in the scientific world at such a rate that the once arduous 12-15 year process of developing drugs could be reduced to less than a year (University of Basel, 2022I).

However, some forms of cancer remain incredibly difficult to treat, especially when they have reached a higher level of cancer staging. Pancreatic cancer is one of the most formidable challenges in the realm of oncology, with one of the reasons for this being the subtle early symptoms which often means it is diagnosed at later stages. Being one of the more aggressive forms of cancer, chemotherapy is a standard approach to target cells spread beyond the pancreas and immunotherapy is currently being investigated in clinical trials to take advantage of a person's own immune system to help kill cancer cells (O'Hara, no date). The problem of pancreatic cancer is described as being multifactorial in nature, with one particularly aggressive strain metastasizing microscopically in the early stages, which makes treatments such as surgery and radiation less effective (Oberstein et al., 2013). A study done by London School of Hygiene and Tropical Medicine shows that 'Overall, only 1% of people diagnosed with pancreatic cancer today are predicted to survive their illness for the next ten years', which is a deeply disturbing statistic (Cancer Research UK, 2014).

**Pancreatic Cancer (C25): 1971-2011**  
**Age-Standardised Five-Year Net Survival, England and Wales**

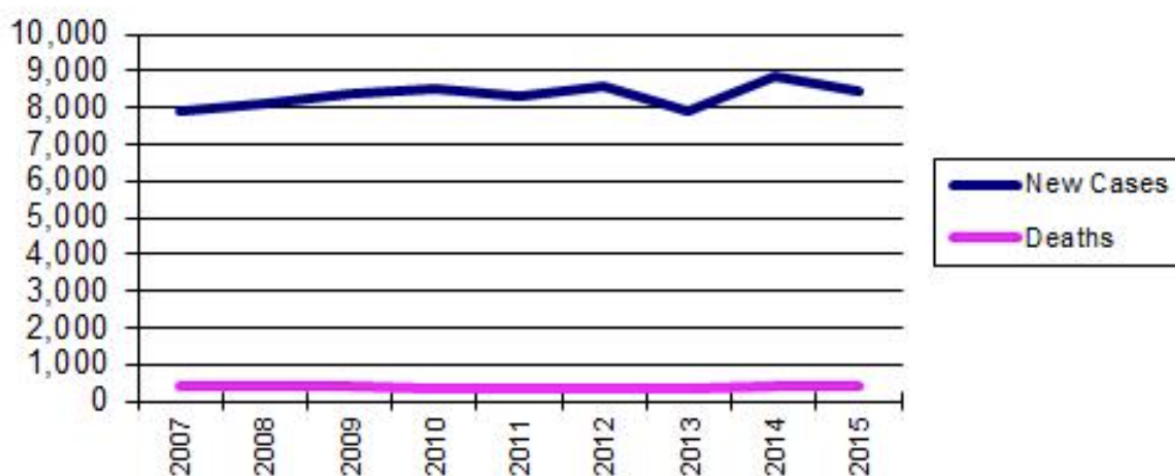
Period of Diagnosis	Net Survival (%)		
	Men	Women	Adults
1971-1972	2.5	2.3	2.4
1980-1981	3.3	2.5	2.9
1990-1991	3.3	2.5	2.9
2000-2001	3.0	2.4	2.7
2005-2006	3.2	2.7	3.0
2010-2011	3.5	3.1	3.3



The figure above (Cancer Research UK, 2014) shows that the survival trend has not significantly increased between 1971 and 2011, unlike the majority of cancers. Despite the generally poor prognosis, an earlier diagnosis will lead to an improved quality of life and a greater life expectancy for those diagnosed with pancreatic cancer (Kenner et al., 2017)

Despite the challenges posed by the complexity of the disease, many advancements have been made in understanding cancer, dealing with its underlying mechanisms and creating contemporary therapies. Before chemotherapy became a medically mainstream method of cancer treatment, testicular cancer was mostly fatal in cases of patients with advanced stages of the disease. Now, 'the advances in the treatment of testicular cancer are among the great achievements in medicine' with researchers now having all the fundamental answers regarding the treatment of patients with the disease (Hanna et al., 2014). According to the NHS, in England and Wales, 99% of men survive for a year or more after being diagnosed, which is an incredibly positive statistic that comes as a result of the discovery that testicular malignancy has a high sensitivity to chemotherapy.

## Estimated New Testicular Cancer Cases and Deaths 2007-2015



This data from the American Cancer Society displays the estimates for new cases of testicular cancer between 2007 and 2015 alongside the deaths caused by the disease, and the results are evidently positive - the number of deaths has stayed consistently low over the years thanks to the combination of early detection, a range of successful treatment modalities, and the cancer's overall responsiveness to therapies. It clearly contributes to the perception of testicular cancer as a condition with a favourable prognosis and relatively straightforward treatment path.

Meanwhile, many news organisations continue to publish sensational stories regarding cures to cancer that suggest historical medical breakthroughs, such as the 'cancer-killing pill' which Sky News wrote a story about in August 2023 (Sky News, 2023). The eye-catching title does appear to suggest that cancer could be eliminated as a whole, but after discussing the topic with Dr Milan Anjanappa, a consultant clinical oncologist at Mount Vernon Cancer Centre, the glorification in the article became more apparent. When asked about the reliability of such stories, Dr Anjanappa made me aware that according to a 2011 study, the overall success rate of a drug passing through from Phase 1 of clinical trials to being FDA approved is 9% (Biotechnology Industry Organisation, 2011). Unfortunately, cancer is frequently given poor quality media coverage. By naively presenting 'wonder cures', this kind of reporting can feed the misconception that cancer is a death sentence as well as foster stigma and dread. Sensationalised coverage can also overshadow the progress that has been made in cancer research and treatment, giving a skewed perspective that does not accurately reflect the advances and improvements in cancer care. In essence, media sensationalism about cancer not only misinforms and alarms the public but also detracts from the balanced and accurate understanding needed to address this complex and sensitive health issue.

A factor that plays a crucial role in determining prognosis and treatment options is the staging of cancers, with each stage representing the extent at which the cancer has spread into the body. In Stages 0 and I, the cancer is limited to the tissue of origin and metastasis has not occurred, with treatment success rates being generally high. Stage II sees the cancer grow beyond the initial site to nearby tissues or structures and a combination of surgery, chemotherapy and radiation should be considered at this point. Once the cancer has spread even more extensively, it is classified as Stage III and the treatment used tends to be more aggressive. The most advanced stage cancer can be classified as is Stage IV, at which point the cancer has metastasized to distant organs, tissues and lymph nodes away from the original site. When asked about differences between early and late stage cancer research, Dr Anjanappa described how the former requires therapies that 'reduce the toxicity' of treatment and its effects on the patients, while the latter is incurable, with treatments focusing on managing symptoms, improving quality of life and extending their survival.

The fact is that humanity will never live in a cancer-free world. This is because the disease cannot simply be eradicated through vaccinations, like many viruses can, or treated with antibiotics, like many bacteria can. Cancer - an umbrella term for several uniquely different diseases that can affect any part of the human body - is currently not always curable. However, the concept of 'curing' cancer could evolve into a more nuanced approach. The focus may shift towards converting cancer into a manageable chronic condition, similar to how HIV/AIDS has transitioned from a fatal disease to a manageable one with antiretroviral therapy. Moreover, a greater emphasis on prevention, early detection, and personalised treatment strategies could substantially reduce cancer-related morbidity and mortality. Decades ago, it would have been unthinkable for late stage testicular cancers to be fully treated, but in this modern day and age, it has become one of the most curable forms of the disease. Through extensive research and explorations of cancer's multifaceted nature and the differing microenvironments of each type, it might even be plausible for treatments to be developed for more aggressive cancers such as Stage IV pancreatic cancer. Although the disease will continue to pose a threat to humanity in the future, the unyielding spirit of scientific inquiry and the unwavering determination to alleviate human suffering inspire confidence that, step by step, we will advance closer to a future where the threat of cancer is diminished, and lives are saved and improved.

## Reference List:

American Cancer Society (2018) *Understanding What Cancer Is: Ancient Times To Present*. Available at:

<https://www.cancer.org/cancer/understanding-cancer/history-of-cancer/what-is-cancer.html> (Accessed: 30 August 2023)

Anjanappa, M. (2023) Private interview as part of TechFest's STEM Next Essay Competition. Interview by Divit Kelmani, August 23rd 2023.

Biotechnology Industry Organization, (2011) *New Study Shows the Rate of Drug Approvals Lower than Previously Reported*. Available at:

<https://archive.bio.org/media/press-release/new-study-shows-rate-drug-approvals-lower-previously-reported#:~:text=Overall%20success%20rates%20from%20Phase.rate%20of%20one%20in%2030> (Accessed: 30 August 2023)

Cancer Research Institute (no date) *How is Immunotherapy for Pancreatic Cancer Changing the Outlook for Patients?*. Available at:

<https://www.cancerresearch.org/cancer-types/pancreatic-cancer> (Accessed: 30 August 2023)

Cancer Research UK, (2014) *Pancreatic cancer survival statistics*. Available at:

<https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/pancreatic-cancer/survival#heading-Zero> (Accessed: 30 August 2023)

Cancer Research UK (2020) *Cancer Research UK forced to cut research funding due to COVID-19*. Available at:

<https://news.cancerresearchuk.org/2020/12/08/cancer-research-uk-forced-to-cut-research-funding-due-to-covid-19/#:~:text=Due%20to%20the%20effects%20of,scientists%20have%20been%20left%20unfunded> (Accessed: 30 August 2023)

Damilakis, E. (2022). Potential Positive Effects of COVID-19 on Cancer Care: A Window of Opportunity. *National Library of Medicine*, DOI:10.3389/ijph.2022.1604394.

Dixit, S. (2023) Private interview as part of TechFest's STEM Next Essay Competition. Interview by Divit Kelmani, August 23rd 2023.

Hanna, N., Einhorn, LH (2014). Testicular Cancer: A Reflection on 50 Years of Discovery, *Journal Of Clinical Oncology*, 32(28), DOI: 10.1200/JCO.2014.56.0896

Kenner, BJ., Go, VLW., Chari, ST., Goldberg, AE., Rothschild, LJ (2017). Early Detection of Pancreatic Cancer: The Role of Industry in the Development of Biomarkers, *National Library of Medicine*, 46(10), DOI: 10.1097/MPA.0000000000000939

McIntosh, S., Alam, F., Adams, L., Boon, I., Callaghan, J., Conti, I., Copson, E., Carson, V., Davidson, M., Fitzgerald, H., Gautam, A., Jones, C., Kargbo, S., Lakshmiathy, G., Maguire, H., McFerran, K., Mirandari, A., Moore, N., Moore, R., Murray, A., Newman, L., Robinson, S., Segaran, A., Soong, C., Walker, A., Wijayaweera, K., Atun, R., Cutress, R., Head, M (2023). Global funding for cancer research between 2016 and 2020: a content analysis of public and philanthropic investments. *The Lancet*, 24 (6), DOI:10.1016/S1470-2045(23)00182-1

Murphy, M., Scott, LJ., Salisbury, C., Turner, A., Scott, A., Denholm, R., Lewis, R., Iyer, G., Macleod, J., Horwood, J (2021). Implementation of remote consulting in UK primary care following the COVID-19 pandemic: a mixed-methods longitudinal study. *National Library of Medicine*, 71(704), DOI: 10.3399/BJGP.2020.0948

National Cancer Institute (2017) *Overcoming the Challenges of Metastatic Cancer: An Interview with Dr. Rosandra Kaplan*. Available at: <https://www.cancer.gov/news-events/cancer-currents-blog/2017/metastatic-cancer-kaplan#:~:text=For%20example%2C%20the%20genetic%20characteristics.growing%20in%20a%20different%20organ> (Accessed: 30 August 2023)

News In Health (2017) *How Cancer Cells Spread in the Body*. Available at: <https://newsinhealth.nih.gov/2017/04/how-cancer-cells-spread-body#:~:text=When%20cancer%20spreads%2C%20it%27s%20called,bones%2C%20liver%2C%20or%20lungs> (Accessed: 30 August 2023)

Oberstein PE., Olive KP (2013). Pancreatic cancer: why is it so hard to treat?, *National Library of Medicine*, 6(4), DOI: 10.1177/1756283X13478680

Sky News, (2023) 'Cancer-killing pill' that appears to 'annihilate' solid tumours is now being tested on humans'. Available at:



<https://news.sky.com/story/cancer-killing-pill-that-appears-to-annihilate-solid-tumours-is-now-being-tested-on-humans-12932133> (Accessed: 30 August 2023)

