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Strategies for Minimizing Cancer Risk from Viruses

"An estimated 15 percent of all human cancers worldwide may be attributed to viruses, representing a significant portion of the global burden" (Liao 115). In 2020, there were 18.1 million new cases of cancer and 10 million deaths from cancer ("Cancer Today."). And of those 18.1 million, roughly 15 percent or 2.7 million, may die in the future from cancer-causing viruses that are preventable or treatable. In 2020, roughly 1.5 million people died from cancer-causing viruses (Liao 115). And shockingly, these cancer death statistics are actually much higher because developing countries do not use cancer registries. They also consider HIV a cause of death. For example, Uganda, which has good cancer reporting practices, reports 50% of all cancers are caused by viruses which is a more likely scenario (Chang et al. 1). Furthermore, there are likely millions of people with current virus-related infections that will eventually lead to cancer, unreported in all cancer statistics. Thus making it clear that the global problem of cancer-causing viruses is much more significant than is reported and must be understood before solutions can be proposed.

Background

Cancer-causing viruses have been around for centuries. The first human virus causing cancer was discovered in 1964 by Anthony Epstein, Bert Achomng, and Yvonne Barr (Moore 1). It is called the Epstein-Barr virus, and since then, another six viral infections have been linked to cancer. They are Kaposi's sarcoma-associated herpesvirus, high-risk papillomaviruses, th Merkel cell polyomavirus, Hepatitis B virus, Hepatitis C virus, and Human T-Cell Lymphotropic virus type 1

(Morales 4048-4049). Each of these viruses is transmitted differently and causes different cancers (see table 1).

The chronic infections from the viruses lead to inflammation that allows cancer to develop. Sometimes, the lag time between infections and cancer may be several decades (Martel, 187). During this time, individuals are unknowingly ill while living everyday lives without receiving treatment. To understand this concept, suppose an individual has an infection from a cancer-causing virus for a prolonged period. In that case, this individual's body eventually weakens, leaving cancerous cells the opportunity to divide and multiply. The individual has no way of knowing this is occurring. Considering approximately 1.5 million people worldwide will die this year from preventable or treatable cancers they may have had for decades, there needs to be more screening, more vaccine development, and more antiviral and antiretroviral medications used to save lives.

Refutation

There is speculation whether it is cost-effective to introduce preventative measures in lower-income countries because of the high cost of vaccines and antiviral medications. However, the cost of chemotherapy and radiation, which attacks both healthy and unhealthy cells, is exorbitant and frequently has poor outcomes (Laos 120). But most importantly, countries cannot place a dollar value on human life.

Cancer Prevention Strategies

Screening

"Early detection relies on the diagnosis of disease at a more treatable stage, before the onset of symptoms that would bring the patient to medical attention" (Willit 90). There are simple blood tests to diagnose the seven viruses; Hepatitis B, Hepatitis C, Epstein Barr, Kaposi's

sarcoma-associated herpesvirus, and Human T-Cell Lymphotropic Virus Type 1 (WHO). For example, the screening tool to prevent HPV is through an annual pap smear, and for Merkel cells is a full-body skin exam. Proactively screening saves lives because there are ways to treat these viruses before they become cancerous.

Vaccines

Two vaccines can prevent cancer-causing viruses—the Hepatitis B and human papillomavirus vaccine. "The introduction of vaccines against Hepatitis B virus in the early 1980s marked a major milestone with what might be considered the first cancer prevention vaccine… " (Liao 160). A decade later, a second vaccine for human papillomavirus dramatically reduced deaths from cervical cancer (Liao 119). There are no vaccines for the other five viruses. For decades, researchers have tried to find a vaccine for HIV, but they have been unsuccessful due to the variations of the virus. The recent Covid-19 vaccine has brought promise that there will soon be a vaccine for HIV (Khalid 11). Hepatitis C mutates too quickly and Merkel cell polyomavirus and Human T-Cell Lymphotropic virus death rates are too low to have a vaccine demand (Welch 1). Fortunately, these cancer-causing viruses respond to other antiviral and antiretroviral medications (Shiller et al. 3).

Antiviral and Antiretroviral Medications

Liao finds, "Close study of viruses and human cancer has led to optimism for the development of new strategies for the prevention of the preceding infection that can lead to carcinogenesis" (115). One new strategy is antiviral medications which can reduce the inflammation caused by viral infections making it more difficult for viruses to cause cancer (CTCA Blog). Antiviral medications minimize chronic infections and prevent cancer in all seven of the cancer-causing viruses. For example, in unvaccinated individuals who contract Hepatitis B or Hepatitis C, taking

antiviral medications reduces viral replication, minimizing cancer risk (Martel 187). Antiretroviral medications have profoundly impacted patients living with the Kaposi sarcoma herpes virus, which eventually leads to AIDS. They reduce the viral load and thereby extend people's lives (Basavaraj 75).

Conclusion

Knowing 7 cancer-causing viruses exist and are either preventable or treatable indicates that extensive efforts to save lives must occur. One way to do that is to gain knowledge of the cancer-causing risk factors related to these seven viruses. Furthermore, there needs to be more worldwide screening, more vaccines and vaccine development, and more targeted therapies regarding prevention and treatments for these seven viruses. The statistics of getting cancer during a person's lifetime are alarmingly high. Until technology improves, the best strategies for minimizing the risk of virus-causing cancer and saving lives must include a proactive worldwide healthcare approach. Cancer-causing viruses are equally opportunistic and do not discriminate between the rich and the poor. Therefore every country, as well as every individual in a country, must take a proactive approach towards the prevention and treatment of cancer-causing viruses.

Appendix

Table 1

Virus Types and Transmissions

Virus	Cancers	Transmission
Epstein-Barr virus (EBV)	Basal Cell, gastric, nasopharyngeal, and Hodgkin and Burkitt Lymphomas	Any contact
Hepatitis B Virus (HBV)	Cirrhosis and Hepatocellular Liver cancer, Non-Hodgkin's Lymphoma	Mother to child, infected body fluids, sexual, needle drug use, body tattoos, and piercings
Hepatitis C Virus (HCV)	Lymph Node damage (inflammation), Liver cancer, Non-Hodgkin's Lymphoma	Intravenous drug use
Kaposi's sarcoma-associated herpesvirus (KSHV)	Kaposi's sarcoma, cancer linked to AIDS, HIV squamous cell	Mother to child, infected body fluids, sexual, needle use
human papillomaviruses (HPV)	Cervical cancers	Infected body fluids, sexual
Merkel cell polyomavirus (MCPyV)	Skin cancer known as Merkel Cell Carcinoma	Respiratory route
Human T-Cell Lymphotropic virus type 1 (HTLV-1)	Adult T-cell Leukemia/Lymphoma Cancer (ATL)	Infected body fluids

Sources: Morales-Sánchez, Abigail, and Ezequiel M Fuentes-Pananá. "Human viruses and cancer." *Viruses* vol. 6,10 4047-79. 23 Oct. 2014, doi:10.3390/v6104047

Murthy, N. S., and Aleyamma Mathew. "Cancer Epidemiology, Prevention and Control." *Current Science*, vol. 86, no. 4, Temporary Publisher, 2004, pp. 518–27, http://www.jstor.org/stable/24107904.

Works Cited

Basavaraj, K H et al. “Quality of life in HIV/AIDS.” *Indian journal of sexually transmitted diseases and AIDS* vol. 31,2 (2010): 75-80. doi:10.4103/0253-7184.74971

“Cancer Today.” *Global Cancer Observatory*, https://gco.iarc.fr/today/fact-sheets-cancers.

Chang, Yuan et al. “Human oncogenic viruses: nature and discovery.” *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* vol. 372,1732 (2017): 20160264. doi:10.1098/rstb.2016.0264

Connie, Welch March 26, 2021. “Why Isn't There a Vaccine for Hepatitis C?” *HepatitisC.net*, https://Hepatitisc.net/living/vaccine-why.

de Martel, Catherine et al. “Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis.” *The Lancet. Global health* vol. 8,2 (2020): e180-e190. doi:10.1016/S2214-109X(19)30488-7

“HIV/AIDS.” *World Health Organization*, World Health Organization, https://www.who.int/news-room/fact-sheets/detail/hiv-aids.

“How Can a Virus Cause Cancer?” *Cancer Treatment Centers of America*, 11 June 2021, https://www.cancercenter.com/community/blog/2017/08/how-can-a-virus-cause-cancer.

Khalid, Khizer et al. “HIV and Messenger RNA (mRNA) Vaccine.” *Cureus* vol. 13,7 e16197. 5 Jul. 2021, doi:10.7759/cureus.16197

Lao, Thuan Duc et al. ``Molecular Screening for Epstein-Barr virus (Epstein-Barr virus): Detection of Genomic EBNA-1, EBNA-2, LMP-1, LMP-2 Among Vietnamese Patients with Nasopharyngeal Brush Samples.” *Asian Pacific journal of cancer prevention: APJCP* vol. 18,6 1675-1679. 25 June. 2017, doi:10.22034/APJCP.2017.18.6.1675

Liao, John B. “Viruses and human cancer.” *The Yale journal of biology and medicine* vol. 79,3-4 (2006): 115-22.

Martel, Catherine de, et al. “Global Burden of Cancer Attributable to Infections in 2018: a Worldwide Incidence Analysis.” *The Lancet Global Health*, Elsevier, 17 Dec. 2019, https://www.sciencedirect.com/science/article/pii/S2214109X19304887#bib32.

Moore, Patrick S, and Yuan Chang. “Why do viruses cause cancer? Highlights of the first century of human tumour virology.” *Nature reviews. Cancer* vol. 10,12 (2010): 878-89. doi:10.1038/nrc2961

Morales-Sánchez, Abigail, and Ezequiel M Fuentes-Pananá. “Human viruses and cancer.” *Viruses* vol. 6,10 4047-79. 23 Oct. 2014, doi:10.3390/v6104047

Murthy, N. S., and Aleyamma Mathew. “Cancer Epidemiology, Prevention and Control.” *Current Science*, vol. 86, no. 4, Temporary Publisher, 2004, pp. 518–27, http://www.jstor.org/stable/24107904.

Rosenthal, E.S., Graham, C.S. Price and affordability of direct-acting antiviral regimens for Hepatitis C virus in the United States. *Infect Agents Cancer* 11, 24 (2016). https://doi.org/10.1186/s13027-016-0071-z

Schiller, John T, and Douglas R Lowy. “An Introduction to Virus Infections and Human Cancer.” *Recent results in cancer research. Fortschritte der Krebsforschung. Progres dans les recherches sur le cancer* vol. 217 (2021): 1-11. doi:10.1007/978-3-030-57362-1_1

“Testing Recommendations for Hepatitis C Virus Infection.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 29 July 2020, https://www.cdc.gov/Hepatitis/hcv/guidelinesc.htm.

Willett, W. C., et al. “Strategies for Minimizing Cancer Risk.” *Research Profiles at Washington University School of Medicine*, https://profiles.wustl.edu/en/publications/strategies-for-minimizing-cancer-risk.