Understanding Cancer

1.7 million diagnosed with cancer each year

What is Cancer?

Cancer is a group of diseases in which cells divide and invade other parts of the body.[1] Every cancer results from a multifaceted process that involves a unique combination of genetics, environmental exposure, and lifestyle behaviors. Overall, cancers are very common. In the United States, 1 in 2 men and 1 in 3 women will be diagnosed with cancer in their lifetime.[2]

COLORECTAL CANCER SCREENING CAN SAVE YOUR LIFE. SEEN IN MEN & WOMEN.	BREAST CANCER SCREENING IS NOT A ONE SIZE FITS ALL. AFFECTS MEN & WOMEN.	EXPOSURE TO ULTRAVIOLET RAYS IS THE MOST COMMON CAUSE OF SKIN CANCER.	SMOKING CAN CAUSE CANCER ANYWHERE IN YOUR BODY.
WWW.CDC.GOV	WWW.CDC.GOV/CANCER/BREAST	WWW.CDC.GOV/CANCER/SKIN	WWW.CDC.GOV/CANCER/TOBACCO

According to the CDC, cancer is a major public health problem worldwide and the second leading cause of death in the United States. There are over **200** types of cancer. The latest year for which cancer incidence data are available is 2020. In the United States in 2020, 1,603,844 new cancer cases were reported and 602,347 people died of cancer. For every 100,000 people, 403 new cancer cases were reported and 144 people died of cancer.

Sometimes an unusual number of cancers are diagnosed among people in a particular location. These cases may be by chance or may result from:

- Differences in cancer screening
- Access to health care
- Genetic susceptibility
- Behavioral risks
- Exposures, both environmental and occupational[3]

Prepared by Navy and Marine Corps Force Health Protection Command 2023

Understanding the Cancer Process

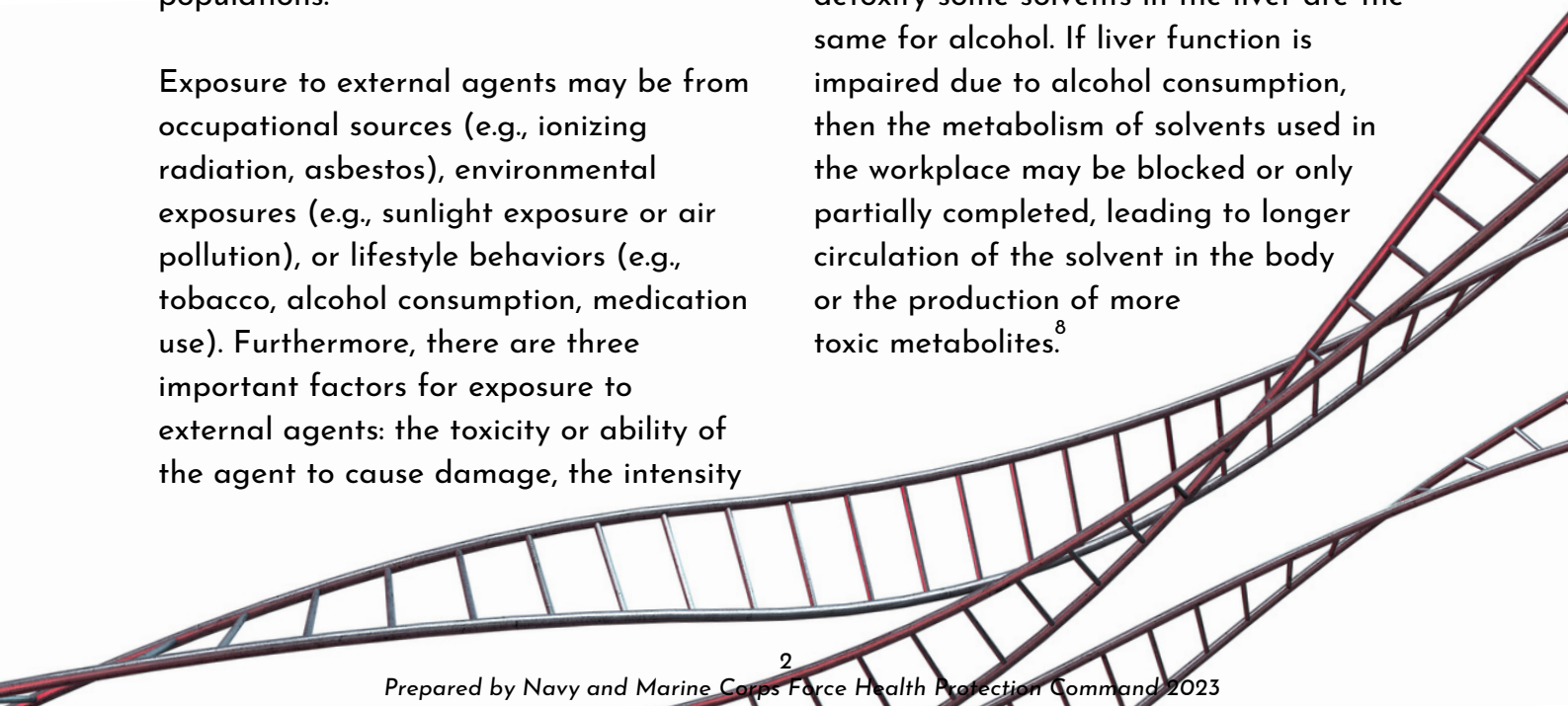
The four factors considered in conducting cancer investigations include a person's genetic makeup, age at diagnosis, exposure to external agents, and lifestyle behaviors.

All cancers involve changes in how a gene is expressed. Gene expression is the process by which the information encoded in the gene is turned into a function. These changes can be inherited, caused by an external factor (e.g., ionizing radiation or chemicals), or from an uncorrected error during cell division. A person with a family history of cancer is at an increased risk of developing cancer.[4]

The first step in cancer development is initiation, in which a change in a cell's genetic material (a mutation) primes the cell to become cancerous. Most cancers take an extended period to develop from the initiating factor. A person's age is such a powerful determinant of cancer that observed rates must be adjusted to account for age in order for the rates to be comparable within and between populations.[5]

Exposure to external agents may be from occupational sources (e.g., ionizing radiation, asbestos), environmental exposures (e.g., sunlight exposure or air pollution), or lifestyle behaviors (e.g., tobacco, alcohol consumption, medication use). Furthermore, there are three important factors for exposure to external agents: the toxicity or ability of the agent to cause damage, the intensity of the exposure, and the total exposure dose. Using sunlight as an example, some ultraviolet (UV) radiation components in sunlight are known risk factors for skin cancer. UV radiation can directly damage DNA or indirectly impact the expression of genes that prevent tumors (toxicity). The risk for skin cancer increases with the number and severity of sunburns (intensity) and the amount of time a person had unprotected exposure to the sun (dose).[6]

Finally, lifestyle behaviors such as smoking, alcohol consumption, and sedentary lifestyle may increase the risk of cancer.[7] These behaviors can change the body's ability to manage biochemical conditions that may be related to cancer. Most chemicals that enter the body from external sources are metabolized in the liver. The metabolic pathways that detoxify some solvents in the liver are the same for alcohol. If liver function is impaired due to alcohol consumption, then the metabolism of solvents used in the workplace may be blocked or only partially completed, leading to longer circulation of the solvent in the body or the production of more toxic metabolites.[8]



Latency

Cancer development is a series of steps over time, starting with the initiation of the cancer process, leading to subclinical markers (not detectable by the usual clinical tests), and culminating in a clinical diagnosis. These steps are divided into two phases. The first phase called the induction period, is defined as the interval from the first exposure to an agent to the initiation of the cancer process. The next phase, the latent period, is defined as the time from cancer initiation to clinical detection.[9] Better cancer screening may shorten the time between the induction and latent periods, according to some research, albeit the precise moment when one phase transitions to the other is usually unknown and depends upon the type and level of exposure.

Although cancer screening may result in earlier detection and may shorten the latency period, it does not necessarily increase life expectancy. Moreover, some cancers detected in screening resolve themselves or grow so slowly (e.g. prostate), that early treatment may not be beneficial. Unfortunately, it is not well understood which cancers are going to progress or resolve, and why.

Previous studies defined the latent period for many diseases based on known occupational exposures or industrial accidents where a large group of people were exposed to chemicals or other agents at the same time (e.g., Chernobyl nuclear accident). If an estimated toxicity, intensity, and duration of exposure are known, then an estimated latency period might be calculable based on collected data. However, the latency from exposures to environmental pollutants is typically unknown due to the relatively low levels of exposure (compared to occupational levels), different metabolic pathways, and different routes of exposure.

Understanding Cancer (continued)

Cancer Promoters

Cancer does not progress in the same way for every individual. The development and progression of cancer are multifactorial (i.e., genetic, behavioral, and environmental). A cancer promoter is an agent that can shorten the latency period, but it is not part of the cancer process.[10] For example, drinking alcohol may be a cancer promoter for breast cancer. While there has not been a definitive link between alcohol consumption as a cause of breast cancer, a significantly increased risk of breast cancer was associated with recent drinking (within five years of diagnosis) in several studies. In this case, alcohol consumption was not implicated as being the etiology (cause) of cancer, but rather it may have played a role in promoting the cancerous growth.

Hypersensitivity and Immunity

Latency periods and exposure risk levels for cancer are calculated based on a population of people and not the individual. The population includes people who are hypersensitive and some who are immune to the exposures that initiate cancer.[11] For example, some people can smoke three or four packs of cigarettes per day for 40 years and not get lung cancer, while some people can be exposed to extremely low levels of passive smoke, and cancer will be initiated.[12] Knowing an individual's genetic makeup and family history allows for a better understanding of the cancer risk, but much is still unknown about individual susceptibility to carcinogens.

Understanding Cancer (continued)

Cancer Clusters

A cancer cluster is defined as 'as a greater than expected number of the same or etiologically related cancer cases that occurs within a group of people in a geographic area over a defined period of time.[13]

- **A greater than expected number:** When compared with a similar group of people (age, sex, ethnicity).
- **Of the same or etiologically related cancer cases:** Cancers should be the same type, in the same family, or all have a known or suggested connection to a specific exposure. If the exposure has been linked to multiple types of cancer (i.e., radiation), multiple cancer types may be considered.
- **Within a group of people:** Demographic factors (age, sex, ethnicity, occupation, etc.) define the population.
- **In a geographical area:** This may be defined by existing geopolitical boundaries, or the area impacted by a potential exposure. Geographic boundaries allow for comparisons with the general population. These boundaries need to be carefully considered, as they could inadvertently hide or create a cluster.
- **Over a period of time:** The beginning and end dates for analysis. Years, even decades, can pass between exposure and the development and diagnosis of cancer.

Although the causes of many cancers are unknown, there are known causal relationships between some cancers and environmental contaminants (i.e., exposure to asbestos and the development of mesothelioma).[3] Specific environmental contaminants that are the cause of cancer clusters are very rare. A review of 576 cancer cluster investigations over 20 years found that only 72 of the apparent clusters had an increase in cancer rates that could be confirmed. Of the 72 clusters, only 3 could be linked to a possible exposure, and a clear cause could be identified in only one case.[3] Generally, the first step in a cancer cluster investigation is to gather information about the pattern of cancer among a specific group of people.[13] This information includes the expected cancer rate, cancer type(s), number of cases, and the age, sex, race, address, occupation, and age at diagnosis of the people with cancer.

Cancer Clusters (Continued)

Cancer cluster investigations rely heavily on biostatistics. The strength of biostatistics depends on quality of data, especially the number of cases and the accuracy of the information available about those cases. If there are fewer than five cases of the same type of cancer, epidemiology will be of little help; the cases will have to be considered individually, and, except for acute effects from known exposures, not much more can be said.[14] With five or more cases, a case series analysis may be performed; some statements can be made, but quantifying the risks is not possible. With 15 or more cases, a crude incidence rate can be calculated, which may help compare the rates to what is seen in other populations (i.e., to the "expected" rate).[15] Cancer is not a single disease as each type of cancer may have distinct triggers, promoters, and latency period. Thus, 15 different cancers do not represent a cluster, but simply one case each of 15 different diseases.

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