

What should our national cancer goals be?

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What are reasonable goals regarding cancer in the United States?

First, let's discuss what is not reasonable. Conquering cancer does not mean attaining "a world without cancer" (**American Cancer Society Mission Statement**, accessed 12May21). Cancer will always be part of our world. New cancer cases will continue to arise because (a) cancer is part of the tradeoff inherent in the design of multicellular organisms (**Jacqueline 2016**); (b) new cancers will continue to develop due to random chronic stress or bad luck (**Curing Cancer Blog – Part 7 – Random chronic stress / bad luck as a major cause of cancer, 2021**) and (c) we cannot completely eliminate personal behavior which promotes cancer, such as tobacco use or excess weight.

Second, cancer deaths cannot be reduced to zero. There are hundreds of types of cancer, considering that the same type of cancer at different body sites may be a different disease. Developing optimal treatment for all these diseases will take decades. Even if optimal treatment for a specific cancer is developed, some patients will still die of cancer because of treatment refusal, compliance issues, medical conditions which interfere with treatment, treatment error, treatment failure for unknown reasons and development of additional cancers.

Third, conquering cancer is not equivalent to splitting the atom or landing a man on the moon, as articulated in President Nixon's announcement of the War on Cancer in 1971:

I will also ask for an appropriation of an extra \$100 million to launch an intensive campaign to find a cure for cancer, and I will ask later for whatever additional funds can effectively be used. The time has come in America when the same kind of concentrated effort that split the atom and took man to the moon should be turned toward conquering this dreaded disease. Let us make a total national commitment to achieve this goal. **President Nixon's 1971 State of the Union at 15:03**

Splitting the atom and landing on the moon were achieved by a concentrated effort among a select group of people. However, to markedly reduce cancer deaths will require changes in individual behavior by hundreds of millions of people, new government policies and a myriad of research breakthroughs.

Fourth, we must stop relying on an outdated view of biology that presumes that we can find a "silver bullet" to cure cancer. Scientific theory is often based on reductionism, a belief that the behavior of the whole is equal to the behavior of the sum of the parts. The reductionist goal

for cancer was to find and fix the broken parts. In reliance on this theory, we focused on “the cause” and “the cure”. However, this way of thinking is incorrect.

Life and much of the physical world is actually based on complexity science: the behavior of the whole is greater than the sum of the behavior of the parts. These extra properties are due to interactions between the parts, which are often unpredictable and surprising. Each type of cancer is caused by behavioral risk factors or random events that cause small network changes beginning in a few cells that slowly percolate across adjoining networks and eventually may produce bursts of major changes leading to premalignant conditions. Additional bursts may cause overt cancer. Due to the complicated nature of these network changes, occurring over large areas of an organ or body site, no simple therapy can eradicate the existing cancer and premalignant conditions and restore order.

What can we do?

We can prevent many cases of cancer, we can detect them earlier and we can develop more effective treatment. We can, I believe, reduce annual US cancer deaths from the current 600,000 to 100,000, as discussed in our **strategic plan**. We cannot “cure” most cancers in the sense of ridding them completely from our lives, but we can “conquer cancer” or “end cancer as we know it” or make cancer just another chronic disease that we have to monitor and manage.

It is instructive to think about the types of cancer we have successfully treated, including childhood leukemia, testicular cancer and Hodgkin lymphoma. These cancers of children and young adults are easier to treat than adult cancers because they are typically caused by inherited or constitutional cancer predisposition or developmental mutations (**Kentsis 2020**), are not due to risk factors and show no “field effects” (large areas affected by premalignant or malignant change) (**Curing Cancer, Part 2 – Adult versus childhood cancer, 2020**). Even so, effective treatment is complicated. It involves detailed study of the cancers to classify them correctly, combinations of treatments that require sophisticated administration (**Mukherjee: The Emperor of All Maladies 2010**), careful attention to preventing and managing treatment side effects and enrolling as many patients as possible in clinical trials to learn from each patient’s experience (**NCI: Childhood Acute Lymphoblastic Leukemia Treatment (PDQ®)–Health Professional Version**, accessed 12May21).

Treating adult cancers is more difficult than treating childhood cancers. Adult cancers are caused by risk factors acting over decades, including tobacco use and exposure to other carcinogens, alcohol use, excess weight, Western diet (high fat, few vegetables), microorganisms and parasites, constant hormonal exposure and immune system dysfunction (**Pernick 2017**). Instead of combinations of treatments required for cancers in the young, combinations of combinations of treatments will be necessary to destroy a sufficient number of links on the weblike biologic pathways that nurture the cancer (**Curing Cancer – Part 8 – Strategic plan for curing cancer, Feb 2021**). No magic pill will eliminate these diseases.

Success in the war on cancer will require us to continually assess what we know and what we don't know and to improve our strategic plan accordingly. For adult cancers, we must focus on the biologic networks of the primary cancer (for solid cancers) and its microenvironment, as well as systemic networks affecting the cancer (e.g. inflammation, some germline variations, immune system dysfunction, hormonal effects, risk factor related networks). We need a marked increase in clinical trials to test new therapies. We need national, state and local commitments for prevention to reduce risk factors causing cancer and to identify cancers earlier. Finally, we also need more individuals and institutions to be honest and admit that they don't know everything and to acknowledge when they make mistakes so that we can continually improve on these difficult goals.